Beyond Einstein: non-local physics, 5th ed.

(popular format)

Abstract

Edition History: *Beyond Einstein: non-local physics* (2nd ed.) offered simple explanations for the nature and behavior of gravity, the stability of galaxies and globular clusters, Dark Matter, the EPR paradox, the Twin Paradox, the constancy of the speed of light, the concept of non-directional motion, the negative result of the Michelson–Morley experiment, the wave-particle duality, observational effects of accelerated reference systems, etc.—all on the general theme of non-local physics. The 3rd edition includes the 2nd edition and adds much new material, including the properties of the Ether, globular cluster, star, and planet formation, comments on galactic time limits from the Bible. The 4th edition includes the topics of exploding galaxies, non-local astronomy, reference system inversion effects, GRBs, induced radioactivity, supernova, important quantization effects, quasars, and redshifts. The 5th edition adds a section on perpendicular reaction forces, rotational effects on inertia, electroaerodynamics, neutrinos and "cold electricity", some UFO links, derivation of space/time dimensions, a primer on Quantum Mechanics, insights on the geometry of space, time, and motion, and various additions/corrections. This document is NOT a formal article intended for a formal journal. It is intended as a physics educational, "pot stirring" outreach and offers credible alternatives to the conventional "received truth" of institutional physics and astronomy. A Table of Contents was added to help the reader navigate the document.

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Summary:

"Beyond Einstein: non-local physics" is about how temporal motion manifests itself in a spatial reference system. This type of physics is not taught in the schools and is not addressed in the journals. It has been neglected for 100 years. But it gives satisfying insights for numerous strange and seemingly inexplicable behaviors in the world of physics—from Quantum Mechanics to Quasars. Some hints for practical applications are also apparent. (Consult the Abstract and Table of Contents for details)

Currently, this is the only known book-length, comprehensive treatment of non-local physics outside of the extensive literature on Quantum Mechanics. It is not what most readers will expect, but it is NOT “alternative physics”. This is *real physics* that has been neglected and kept out of public view.

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Table of Contents

Intended audience and purpose

This article is a follow-up to *Beyond Einstein: non-local physics* (4th ed.) It may be freely distributed for non-commercial purposes, provided the copyright notice is included and the author's rights to maintain the document are respected.

Like that article, this one is NOT a formal article intended for a formal journal. It is intended as a physics educational, "pot stirring" outreach and offers credible *alternatives* to the conventional "received truths" of institutional physics and astronomy.

Introduction

Einstein's Special and General Relativity theories, have proven to be very useful in the several decades since the theories were introduced, starting in 1905 and 1907–1915. It is noteworthy, however, that these are "local" theories by design and intent. They simply do not address the "non-local" behaviors discovered by physicists in the decades since SR and GR were introduced.

You have no doubt heard people say things like "according to Einstein, nothing can travel faster than light". But the existence of aberration free forces which appear to have instantaneous effects ("faster than light") even over large distances, was simply not recognized in 1905 when Special Relativity was introduced. Einstein himself noticed some problems in this regard in a 1935 paper which is now referred to as the EPR paradox. In the following decades more and more experiments revealed more and more problems. But these "faster than light" problems are simply outside the scope of SR and GR; a "local" theory cannot treat truly non-local phenomena in a satisfactory manner.

The following analysis gives powerful and fascinating insights about the deep properties of space, time, and motion. It uses one of Einstein's own equations to develop satisfying, intuitive explanations for many of these mysteries and paradoxes raised by Relativity. It is intended for a general science audience—people who "like science". It has been compiled from previously published obscure sources in scattered locations on different themes over the years.

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The Universe has two behaviors: local and non-local

The Universe has two types of physical behaviors. Physicists call them "local" and "non-local".

Local physics is characterized by cause-and-effect being linked by spatial contact or spatial proximity. It limits all speeds to less than that of light or light speed itself. It conceptualizes "space" as a connecting medium (rather than something that separates). It is the everyday physics that is very familiar to us and is widely taught in the schools and has immediate practical applications. It includes Newtonian mechanics, statistical mechanics, chemistry, biology, etc. To the human mind, it "makes sense" and is intuitively understood even by people who are not scientists or engineers.

Non-local physics, in contrast, is virtually unknown to the general public. It is not taught in the schools, except in the form of quantum mechanics (which has a limited but very important scope). It is characterized by cause-and-effect NOT being linked in space ("action at a distance"). Speeds of

interaction are instantaneous or at least superluminal, and are not limited by spatial separation, even if the interacting objects are separated by light years. In its full scope, non-local physics is weird, baffling and non-intuitive. It has practical applications that are strange, bizarre, and astonishing.

The usual illustration to help the layman understand the difference between these two types of physics uses a doll. If someone sticks a pin in the head of the doll, the effect is that the doll acquires a pinhole in its head. The cause is direct spatial contact with the pin. Cause and effect are linked in space, and are easily and intuitively understood. This is "local physics" or "physics of locality".

Now suppose the doll is a voodoo doll. If someone sticks a pin in the head of the doll, the victim immediately gets a headache. The action occurs instantly and at a distance, even if the victim is on another planet, or light years away. There is no propagation in space or traversal of space (as with an arrow or a bullet). Spatial shielding is not possible and the cause is not apparent to the victim. The only apparent connection between cause and effect is one of *time*. The science is baffling and paradoxical; it is sometimes even called "voodoo physics."

Physicists have identified several non-local behaviors. The most obvious ones are gravity and electric and magnetic fields. These display the characteristic "action-at-a-distance" behaviors, and (as we will see later) exert forces that seem to be superluminal.

Another one well-known in physics circles, is the EPR paradox. It was a "thought experiment" in quantum mechanics proposed by Einstein, Podolsky, and Rosen in 1935. Its essence was that under certain circumstances, measurement of one particle's properties could instantaneously affect another particle's properties, irrespective of spatial separation. This was a violation of "causality", and was contrary to common sense and to the "local" views of physicists (including, of course, Einstein) of that time. Something, was apparently wrong with the predictions of quantum mechanics. Hence, it became a "paradox". Later, Bell's theorem of 1964 allowed this proposition to be tested experimentally. The conclusion was that measurement of one particle does indeed instantaneously affect the other. The effect became known as "quantum entanglement". It could not be adequately treated within the "local" framework of Einstein's Special or General Relativity.

Various other experiments pointed to the conclusion that the Universe really does have non-local behaviors:

- Aharonov–Bohm effect 1949-1959)
- Aharonov-Casher effect (1991)
- Chalmers W. Sherwin and Robert D. Rawcliffe experiment (1960)
- Clauser-Horne-Shimony-Holt inequality (1969)
- Stuart Freedman (1972) and Alain Aspect (1981)
- Colella-Overhauser-Werner effect (COW)

These showed, variously, the unexpected influences of "potentials", instant action-at-a–distance for electric or magnetic fields, and that the effects could not be explained by as yet undiscovered "hidden variables" that had a "local" nature. These experiments, along with the non-local behaviors inherent in Quantum Mechanics, led to the conclusion that "local realism" had to be abandoned.

Einstein would not have liked these conclusions. His Special and General Relativity theories were intentionally and purposefully "local" theories and had, and still have, many uses and successes. SR and GR are actually intuitively understandable (if you can keep your head on straight); the mathematics of SR can even be understood by high school students who have a background in algebra and trigonometry. The theories work fine for reference system effects, but are not adequate to deal

with non-local phenomena—not even Einstein's own EPR paradox. Additionally, SR and GR still have not been reconciled with quantum gravity.

There is a startling resolution to these problems, however. It is buried in one of Einstein's own equations: $\mathbf{E = mc^2}$.

What E = mc2 reveals about gravitation, space, time, and motion

Einstein is especially well known for his equation that expresses the relationship of energy and mass. Written in its usual "local" form it is

$$\mathbf{E = mc^2}$$

For our purposes, we need to express it in its "non-local" form:

$$\frac{E}{\left(\frac{1}{c}\right)^1} = \frac{m}{\left(\frac{1}{c}\right)^3}$$

The first form is the one most of us are familiar with. It is simple, computationally friendly, and is the one that students would use on timed tests. The second one still works out to $E= mc^2$, but gives us some additional insights. It is saying that mass is a three-dimensional form of energy. And it is suggesting that the 1/*c* term has some sort of special significance that is not normally recognized. Most important to us is that the dimensions of mass can be worked out in pure space/time units. In conventional physics and engineering, space, time, mass, and charge are regarded as the fundamental dimensions. But here we have an opportunity to see what the dimensions of mass would be in terms of pure space and time. The table below shows the dimensions of all terms in pure space/time dimensions.

Item	Name	Space/time dimensions
c	speed of light	s/t
1/*c*	energy	t/s
m	mass	t^3/s^3
E	energy	t/s

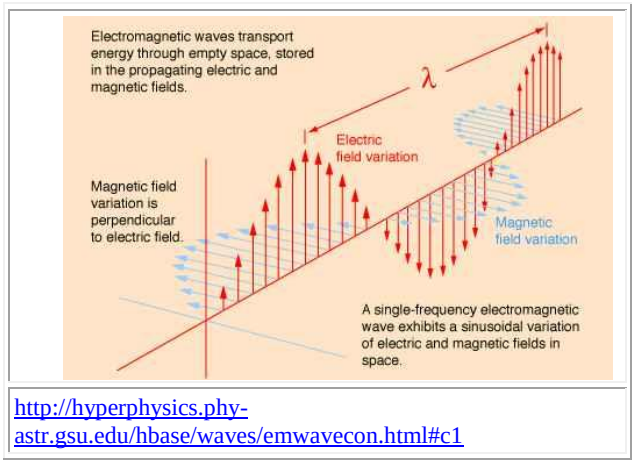
The 1/*c* in the denominators of *both* sides in a *fundamental* equation like this one, suggests that 1/*c* is some sort of "unit quantity". It is like "unit pricing" in the grocery store. You can get so many ounces of nuts for <u>*one*</u> dollar, or a cost of so many cents per <u>*one*</u> ounce. Hence, 1/c is <u>*one*</u> unit of *energy* and $(1/c)^3$ is <u>*one*</u> unit of *mass*. For quantities, we get 1=1 in the numerators and $1^1 = 1^3$ in the denominators.

The same reasoning applies to *c* itself. It is in the denominator of 1/*c*, and so it too must be a fundamental <u>*unit quantity*</u>. In this case it would be one unit of <u>*speed*</u>.

Hence, we now have a unit quantity of speed, a unit quantity of energy, and a unit quantity of mass. Also, implied is that there are unit quantities of space and of time. In other words, all these items are "quantized". That is, they exist in discrete, rather than continuous, units, at least at a fundamental level.

The same argument applies to electromagnetic quantities. The relation of an electric field to a magnetic field is E = cB, a well-known formula. But like the equation above, this can be rewritten as $E/(1/c)^1 = B/(1/c)^2$, implying the existence of unit quantities. This means that the B field is a two-dimensional version of the E field. This implies that an E field, when given an added motion, will produce a B field effect (as with an electron in motion).

The formula also shows that the E and B fields are *in phase*. Consider the following illustration for an electromagnetic wave (light, microwaves, etc.):



http://hyperphysics.phy-astr.gsu.edu/hbase/waves/emwavecon.html#c1

Here we see that the E and B field increase (or decrease) *simultaneously*. They do *not* toss their energy back and forth between the E form and the B form while propagating. In fact both fields *simultaneously* have a value of *zero* twice in a cycle. (Of course, we must note that the representation here is linear instead of rotational)

And so we discover that the Universe not only has built in mathematics (enough of a mystery), it also has built in unit quantities. And if mass and energy can be expressed in terms of pure space/time dimensions, then apparently everything else can too, if we insist on dimensional consistency (rewrite the textbooks!).

A corollary to this realization here is that if mass can really be represented as a ratio of time/space, then mass is NOT an irreducible fundamental substance as it is defined to be in the MKS or CGS systems. Mass is not made out of unanalyzable "fundamental particles" such as protons, neutrons, electrons, quarks, and so-ons, *ad infinitum* . Those supposed "parts" of the atom are actually "disintegration products"; they show how the atom breaks up, not how it is put together. Particle theory and string theory are dead ends. The unanalyzable fundamental "substance" must be a relationship between space and time (*i.e., motion*).

Non-directional motion

The dimensions of energy (t/s) and the dimensions of mass (t^3/s^3) are puzzling. Do they have a physical meaning or are they just mathematical artifacts?

Space/time is just ordinary speed or velocity in space with respect to time. So time/space must analogously be a speed in time relative to space. That implies that both space and time must be three-dimensional, and that space must progress like time, and that there must be locations in time just as there are locations in space. So in addition to the concept of spatial motion and position we have the concept of temporal motion and temporal position. But what would a temporal motion look like in a spatial reference system? How could we identify a "when" motion in a "where" type of reference system?

Two things are immediately apparent. First, temporal motion is **not** a *spatial* motion and therefore has no *spatial* trajectory. From our ordinary viewpoint it is some sort of "motionless motion".

Second, a temporal motion (or temporal momentum) cannot have a preferred direction in a spatial reference system. It must be non-directional (like time) and have only a magnitude.

Hence, we are looking for a "motionless motion"◊, that despite being motionless, must also be non-directional! (As I have asserted on previous occasions, the Universe is simple, but it is also perversely clever.)

This non-directional trait means it is "scalar" as the mathematicians would say, having only a magnitude. In contrast, a ***spatial*** motion has both a direction and a magnitude, and is mathematically described as a "vector".

Hence, energy, expressed as t/s, must be a magnitude-only, "scalar" quantity. And mass, expressed as t^3/s^3 must likewise be scalar (having only magnitude but no direction). It turns out that both of these are indeed treated as scalar quantities in ordinary physics.

There is one more quirk that we can wring out of this. The speed of light is *c*, and it is a unit quantity and can therefore be expressed as 1/1 or as 1/1. No, that is not a typo. It means that ***at the speed of light***, spatial and temporal speeds are equal. That is, s/t = t/s because they are both 1/1 (one unit of time divided by one unit of space, or vice versa). This is telling us that a temporal motion can appear to us as some kind of energy, especially at speeds near that of light.

So let's look at electrons being accelerated in a large particle accelerator. We are interested in finding a good measure of the "amount of motion" these electrons possess. An electron with a speed of 0.995 that of light, has an energy of about 15 MeV. At a speed of 0.99999995 that of light, it has an energy of 5 GeV. Note that the *speed* has increased by a factor of only 1.0005 but the *energy* has increased by a factor of 300. How can there be such a huge increase in energy with only a tiny (5 parts in ten thousand) speed increase? Physicists say that the mass of the particle increases. The mathematics of this claim are consistent with the behavior, and so this is one possible interpretation.

But in light of the above, an alternative presents itself. The real speed of the electron is a combination of spatial speed and temporal speed. Spatial speed is space/time. Temporal speed is time/space. The former has a direction, is mathematically "vectorial", and is very familiar to us. The latter is non-directional, is mathematically "scalar" and is not at all familiar to physicists or engineers. In fact, it does not seem to make any sense at all. It is not a *speed in space*, but is a *speed in time*.

How these two different speeds combine can be seen in the Lorentz-Einstein correction factor commonly known as “gamma”. In local form it is:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The non-local form is:

$$c^2 = (c/\gamma)^2 + v^2$$

The second form of the equation is saying that everything moves at the speed of light, and that the total speed is composed of a non-local speed and a local speed, or, in other words, a temporal speed and a spatial speed. The magnitude of the temporal speed cannot be directly summed with a spatial speed unless the γ correction factor is applied.

It follows that there must be two kinds of speed measurements, one for spatial speeds, and another for temporal speeds. Spatial speeds have the dimensions of *c* (s/t) but temporal speeds have the dimensions of 1/*c*, that is, energy (t/s). Spatial speeds are always less than that of light, and temporal speeds are always above the speed of light. Both are equally common and ordinary, as we shall see later. And there is no “speed of light barrier”; the speed spectrum is continuous, all the way from zero speed in space to infinite speed in space (i.e., non-local “speeds”, which are actually temporal). Only the *representation* of the speed changes at the speed of light.

In the particle accelerator, the measure of motion starts out as a change of position in space with respect to time (velocity). But at higher speeds, the measure of motion includes an increasingly larger temporal component, and its proper measure is ***energy***. From the standpoint of non-local physics, the mass remains constant.

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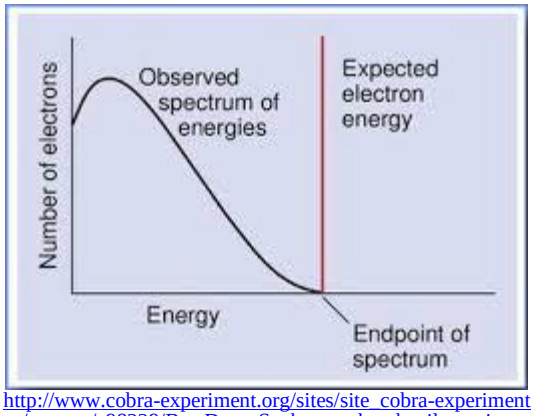
Actually that “increase in mass” stuff is only taught to freshman; to a physicist the issue is momentum/energy increase, not mass increase. I wish I had known about this when I learned about beta decay. Massless particles have momentum, even though they do not have mass.

In beta decay there are supposed to be two end products: an atom and either a positron or an electron which is ejected in the decay process. The energies involved should be discrete and sum to a certain expected value, in accord with the principle of Conservation of Energy. But the observed energy spectrum of the electron (or positron) was continuous, not discrete. Wolfgang Pauli had to invent the neutrino to account for the missing energy. But I could not figure out how that solved the problem.



http://www.cobra-experiment.org/sites/site_cobra-experiment/content/e98229/BetaDecaySpektrum_thumbnail_eng.jpg

The neutrino was massless and moved at the speed of light. How could it vary in energy with a fixed speed and no mass? What I did not know was that physicists in this case are looking only at energy/momentum increase—something more fundamental than mass. The mass can remain at zero and the energy can still change, but the maximum speed that can be portrayed as a ***change of position in space with respect to time***, is *c*, the speed of light. Anything beyond that is non-local and will appear as energy (1/*c*). Problem solved.

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Most people are initially uncomfortable with the concept of non-directional motion, and so-called "dimensions of ***motion***", in contrast to dimensions of space or dimensions of time. But we do in fact experience instances of non-directional motion. You see it every time you watch TV. As the camera zooms in on a scene, all the picture elements move outward and away from each other. This is really just ***one motion*** but it requires two dimensions of space to describe it.

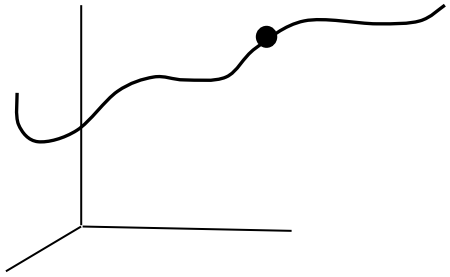
You see it again when using your computer. If you want to expand a Microsoft window, there are two ways of doing it. You can drag one edge, say rightward, and then drag another edge, say downward. We could say that ***TWO***, ***one-dimensional motions*** have enlarged the picture in two spatial dimensions.

You could also drag a corner and accomplish the same thing. In this case you are applying ***ONE***, ***two-dimensional motion*** to enlarge the picture in two dimensions. (Read that carefully.)

Astronomers use these concepts in explaining the expanding Universe. They use the surface of an expanding balloon to illustrate spatial inflation. As the balloon expands, all points on the balloon's surface move away from each other. All have equivalent motion, and no one point is more special than any other point. It is a centerless expansion and there is no "zero" point, or point of origin for the motion (as there would be in an explosion). It is a two-dimensional example of the expansion of space (s^2/t) in a three-dimensional Universe.

A distortion is introduced, however, when one point on the balloon is designated as "stationary" and the motions of the other points are referred back to the stationary point. The motion that would have been attributed to the stationary point is now attributed to the other points. One point loses a motion that it inherently has, and the other points now acquire an additional motion that they do not in fact possess, just due to the choice of a reference system. This will skew an astronomer's interpretation of a redshift; part of that redshift is attached to us, and the other part is inherent in the object being observed.

If you survived all that, you are now ready for the heavy-duty, industrial strength stuff. Picture a bead on a wire as in the illustration below.

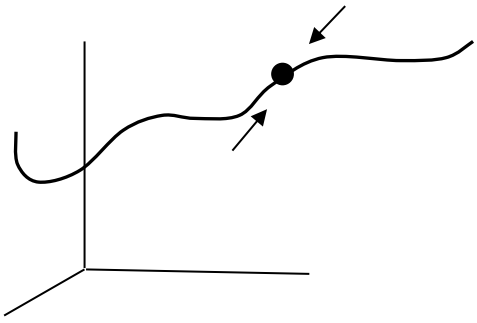


The wire snakes across the room in some arbitrary fashion and defines a path for the bead. Of course, the wire does not really exist; it is simply an aid to visualization. The "dimension of motion" is represented by the wire. The *motion itself is one dimensional* but requires three dimensions of spatial displacement and one dimension of progressive time displacement to describe its movement.

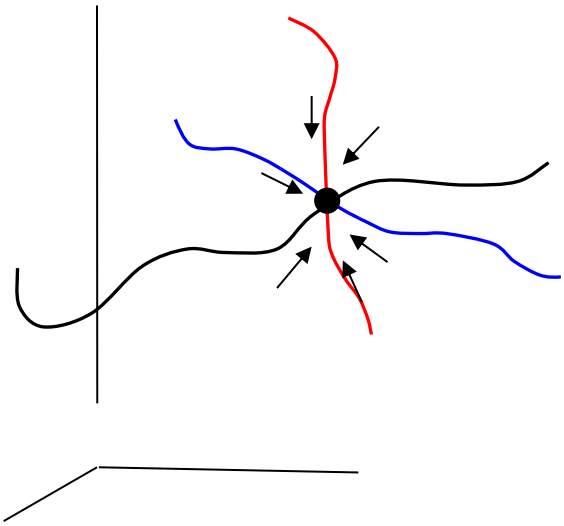
The terminology here is intended to be different from what you learned in high school. Back then you would say "a pyramid is three-dimensional" but you would not mean that there are three dimensions of "pyramidism". You meant that the pyramid extends itself in space in three independent ways. In the illustration, the wire represents the ***one*** dimension of motion as seen by the bead. You could also call it one "motional dimension".

Suppose instead of the bead moving on the wire, the ***wire*** is moving and the bead is stationary relative to the room. The bead can only "see" the wire, and as far as the bead is concerned, it is still moving.

Now let's split the wire into two pieces inside the bead. Now we can have the ***wires*** move inwards or "towards" the bead. (We will say that the wire is "consumed" inside the bead, because the wire does not really exist anyway.) There is still only one dimension of motion, but now the motion is ***non-directional*** in the only defined dimension of motion. It still has a "polarity" in that the motion can be "towards" or "away". But otherwise it is non-directional.



Suppose we now add two more wire paths and make them all mutually perpendicular, each with a split segment that is moving into the bead.



We now have *three dimensions of motion* which are all non-directional.

This is not just an academic exercise in mental gymnastics. It illustrates the way gravity actually behaves. This kind of motion does not have a "trajectory" but instead the word "potential" is used (as in "gravitational potential"). In fact, we can derive Newton's law of Universal Gravitation from it.

Additionally, this *motion* is inherently scalar; it has only a magnitude. The conventional reference system can represent only one dimension of *motion*. The magnitude of the gravitational motion is distributed across three dimensions of motion. Consequently, only one dimension of this motion can be represented in the conventional reference system. This makes gravity appear much weaker than it really is. (See "COW effect")

Derivation of Newton's gravitational equation from E = mc2

Replace the bead with a planet. Let *m*, stand for mass or motion. Then because this motion is non-directional, its intensity will be inversely proportional to the distance between *m* and a detector. It is like light from a light bulb. When you hold your hand (a detector) near the bulb, you feel a certain amount of heat. As you move your hand away from the bulb, you feel less heat. The total amount of light emitted is constant, and the area of your hand is constant also. What changes is the distance. The light is effectively being spread out on an invisible spherical surface. Your hand is part of that surface. As your hand moves away, the surface gets rapidly bigger relative to your hand. The surface area of a sphere is proportional to the radius squared, and so the intensity at your hand is inversely proportional to the square of the radius. Hence, we have a reduction factor of r^2 and so:

$$\text{Motional potential} = m/r^2$$

We need to adjust this form so as not to introduce extraneous units, like square meters, into what at this point is purely a geometry problem. Hence, we will divide out the units (meters, feet, etc.) by using a radius that represents a unit area. We will call it r_0. Hence, we have

$$= m/(r^2/r^2_0)$$

This leaves *m* as pure motion, multiplied by a pure number that accounts for the geometry. (The r^2_0 term is numerically equal to one; it represents the area of your hand, treated as one unit.)

What if we had twice as much mass? Obviously, we would have twice as much motion. We have to account for this too. We have to multiply *m* by another factor that accounts for a multiplicity of mass units. Again, we use a unit mass and create a pure number just like we did with r, except now we will rename the original mass, *m*, and call it m_1. Then we have:

$$\text{Motional potential} = \frac{(m_1/m_0)}{(r^2/r^2_0)}$$

If we have two separate masses with this behavior (like the Earth and the Moon), they will behave as though each acts on the other. This results in a multiplicative effect. If we call the additional separate mass m_2, then we get:

$$\text{Motional potential} = \frac{m_2\,(m_1/m_0)}{(r^2/r^2_0)}$$

This is equivalent to Newton's Universal Law of Gravity equation without G as the proportionality constant (which is not needed if unit quantity amounts are used).

So here we have derived the Law of Gravity by using the concept of temporal motion, which in turn came from $E = mc^2$. Note that there are no gravitons, gravitational waves, space warps, four dimensional space-time or eleven dimensional strings. The only thing needed was the concept of temporal motion—a simple explanation for a simple phenomenon. Gravity *is* temporal motion.

But temporal motion is not the *cause* of gravity. More on this later.

You may, in general, suspect temporal motion is operative when physicists use the term "force fields".

The speed of gravity is MUCH faster than the speed of light

There are still a lot of questions that need to be asked and answered at this point. First and foremost is about the speed of gravity. How fast is it? Specifically, is it faster than light?

According to Einstein, as well as most of today's physicists, the answer would definitely be, No! But Einstein's Special Relativity of 1905 was specifically and intentionally a "local" theory, which limits all speeds to that of light. Speeds greater than light are simply "out-of-scope" and are not addressed by the theory. Non-local effects like the action-at-a-distance of gravity and electric and magnetic fields were conceptualized back then as "local" by the Faraday/Maxwell "field" concept. This treated space as a connecting medium, instead of something that separates. Additionally, this was all before Quantum Mechanics (1925-1927) and other non-local behaviors began to be noticed, even, ironically, Einstein's own EPR paradox of 1935.

Gravity has no aberration

Today we have more facts at hand to help resolve this question. Consider what astronomer Dr. Tom Van Flandern says about the speed of gravity.

> "The most amazing thing I was taught as a graduate student of celestial mechanics at Yale in the 1960s was that all gravitational interactions between bodies in all dynamical systems had to be taken as instantaneous. . . .Indeed, as astronomers we were taught to calculate orbits using instantaneous forces; then extract the position of some body along its orbit at a time of interest, and calculate where that position would appear as seen from Earth by allowing for the finite propagation speed of light from there to here. . . . That was the required procedure to get the correct answers." (" The Speed of Gravity - What the Experiments Say" , Tom Van Flandern, *Physics Letters A*, 250 (1-3) (1998) pp. 1-11; see also http://www.metaresearch.org/cosmology/speed_of_gravity.asp)

The most obvious and incontrovertible experimental evidence for an extremely high speed of gravity is that gravity has no aberration (see figure below). Gravity from an object always coincides with that object's position. If the object moves, there is no gravity still on its way from the "retarded position", as there would be from a light or sound source. Evidence from the motions of celestial bodies, from radar ranging, and from a binary pulsar lead to the conclusion that the speed of gravity is at least 20 billion times (20×10^9) faster than the speed of light.

Other experiments have led to similar conclusions. Consider this from "Measurement of the Speed of Gravity", Yin Zhu (2013) http://arxiv.org/ftp/arxiv/papers/1108/1108.3761.pdf

> Appendix B
> The speed of Gravity:
> An Observation on Satellite Motions
> Abstract
> "The radius of orbit of the geosynchronous satellite can be observed at the precision of less than 8cm. And, a force about $\sim 10^{-9} m/s^2$ can make the orbit of satellite shifted. Here, the gravitational forces of the Sun acting on the satellite from the present and retarded positions are calculated respectively, assuming that the retarded position is determined with that the speed of the gravitational force is equal to the speed of light. It is shown that the difference of the force between the present and retarded positions of the Sun acting on a geosynchronous satellite can be larger than $1 \times 10^{-7} m/s^2$. And, the difference of the radius of the orbit of the satellite perturbed by the gravitational force of the Sun from the present and retarded positions in 3000s can be larger than 8.2m. It indicates that the gravitational force of the Sun acting on the satellite is from the present position of the Sun and that the speed of the gravitational force is much larger than the speed of light in a vacuum."

Clearly, if gravity propagated at the speed of light instead of instantaneously, the effects on orbits of satellites and solar system planets would be very obvious. However, these are relatively small systems. Instead of a solar system, consider the effects on something the size of a galaxy:

> "We know, the solar system and other stars are orbiting around the center of the Milky Way and the radius of the Milky Way is larger than $5X10^4$ light-year. . . . But, we know, the Milky Way is moving with a speed on the level of $5X10^2$ km/s.[6] Therefore, the distance between the retarded position and present position of the center of the Milky way is .. . 25 light-year. And, a galaxy is usually older than . . . $1X10^{10}$ years . . . . The distance between the retarded and present positions of this center should become larger than 5×10^6 ly. In this case, a spiral galaxy could not maintain with the form of a disc. Instead, it was a very long strip along the direction of the galaxy moving. However, no galaxy has become such a long strip one. " ("The speed of gravity: An observation on galaxy motions ", Yin Zhu (September 2016) DOI: 10.13140/RG.2.2.30917.45287 https://www.researchgate.net/publication/308409482_The_speed_of_gravity_An_observation_on_galaxy_motions)

And this one from “The Cosmic Ether: Introduction to Subquantum Kinetics” Paul A. LaViolette (2012) http://www.sciencedirect.com/science/article/pii/S1875389212025205 :

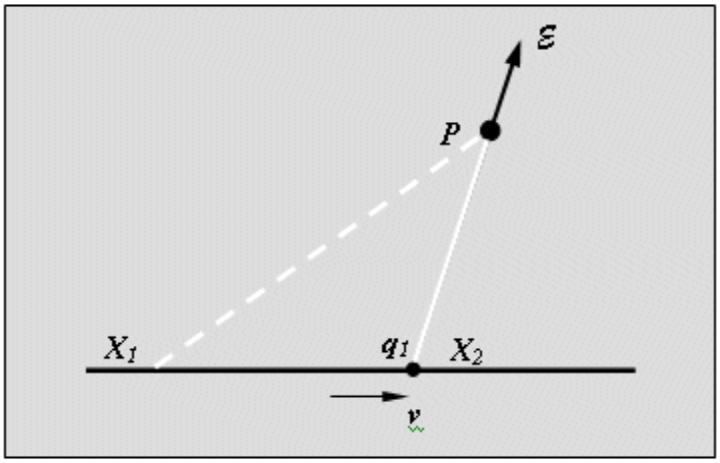
> “ . . . a moderately simple experiment performed by Alexis Guy Obolensky has clocked speeds as high as 5c for Coulomb shocks traveling across his laboratory (LaViolette, 2008a). Furthermore Podkletnov and Modanese (2011) report having measured a speed of 64c for a collimated gravity impulse wave produced by a high voltage discharge emitted from a superconducting anode.”

Electric charge has no aberration (A.P. French)

Professor of Physics, A. P. French, has a relevant note in his very informative book, *Special Relativity* (1968), p. 242-243; 267 "Relativity and electricity":

> "Now the electric field due to a stationary source charge is radial and, of course, spherically symmetrical; that is, it is the same in all directions. It is simply the Coulomb field . . . . If the source charge is moving uniformly, the electric field is no longer spherically symmetrical. Its strength is different in different directions. But, at each instant, the direction of the electric field is still radial with respect to the position of the source charge at that same instant.
>
> If you think about this last result a bit—that at each instant the electric field due to a uniformly moving source charge is directed radially away from the position of the source charge *at that same instant*—you may begin to realize that this is a very surprising result."

To see why this is so surprising, consider the following illustration:



The electric field from a moving electric charge has no aberration.

Electric charge, q_1, is moving at high speed in a particle accelerator from X_1 to X_2. A charge detector is located at P and it can detect both the intensity and direction of the field associated with q_1. Hypothetically, q_1 is emitting an electric field which propagates at the speed of light. As q_1 passes through location X_1, the field is on its way to P, but takes a finite time to get there. But by the time the field reaches P, q_1 has actually moved to X_2. From what direction then does the detector at P see the electric field as q_1 arrives at X_2. Does it see the field as though it were at the "retarded position" of X_1? Or does it see it as emanating from X_2 where q_1 is presently located?

French continues:

"Nevertheless, the field at *P* points away from the *present position* of q_1. Nature behaves in such a way that, for a uniformly moving source charge, even though the field produced at some point *P* originated from the location and behavior of the source charge at an *earlier time*, nevertheless the field points away from the position of the source charge at the present time. It is as though nature calculates where the source charge should be at the present time and acts accordingly. . . . Thus a result which at first glance may seem rather obvious is seen, upon closer examination, to be quite surprising—but nevertheless true."

But it is surprising only if, as French says, "if we believe that no effect—no mass, no energy, no force—can be transmitted with a speed greater than *c*". If the electric field propagates instantaneously, then the lack of aberration is no surprise at all. We just simply have a different problem requiring a different explanation, namely, how can electric fields propagate instantaneously?

The answer to that problem is simple. Electric fields don't propagate. They are "non-local" in a spatial reference system, much like the concept of time, which is not affected by spatial position. Gravitational fields are likewise. Below, three more lines of evidence support this conclusion.

The Sherwin-Rawcliffe experiment

"The Sherwin-Rawcliffe Experiment – Evidence for Instant Action-at-a-distance" , Thomas E. Phipps, Jr., *Apeiron* Vol. 16, No. 4, October 2009 (http://www.dtic.mil/dtic/tr/fulltext/u2/625706.pdf)
http://redshift.vif.com/JournalFiles/V16NO4PDF/V16N4PHI.pdf

"Since the nineteenth century physical theorists have considered that electromagnetic mass must exhibit tensor properties if causal delays characterize the interactions of electric charges. In 1960 Chalmers W. Sherwin and Robert D. Rawcliffe enlisted the help of mentors of the A. O. Nier high resolution mass spectrograph to test this hypothesis, using the predicted mass line-splitting of a football-shaped Lu175 nucleus of spin 7/2 (a highly asymmetrical charge distribution). No line-splitting was observed. This null result showed that mass behaves in just the way Newton thought, as a scalar, never as a tensor. What, then went wrong with the theory? We argue that the basic assumption of retardation of distant action was at fault, and that the null result in fact provides strong inferential evidence of instant action-at-a-distance of a Coulomb field."

"In Memory: Chalmers W. Sherwin"**,** Thomas E. Phipps (1998)
http://www.worldnpa.org/pdf/abstracts/abstracts_1276.pdf

“While at Illinois he conceived and caused to be performed the Sherwin-Rawcliffe experiment (“Electromagnetic Mass & the Inertial Properties of Nuclei,” Report 1-92, March 14, 1960, Coordinated Science Laboratory, University of Illinois, Urbana, Illinois), an experiment establishing the *lack of tensor properties of nuclear mass* that I personally consider to rank in significance with Michelson-Morely, as one of the great, all-encompassing null results of our time. It is a commentary on the prevailing state of the scientific literature that this experiment was never reported in the regular journals.”

Wolfgang Gasser experiment

Experimental Clarification of Coulomb-Field Propagation
Superluminal information transfer confirmed by simple experiment
Wolfgang G. Gasser (May, 2016) PDF Version– Kurze Version auf Deutsch

Abstract

A simple experiment has been performed in order to measure propagation speed of the electric field. The results show that the Coulomb interaction propagates substantially faster than at speed of light c.

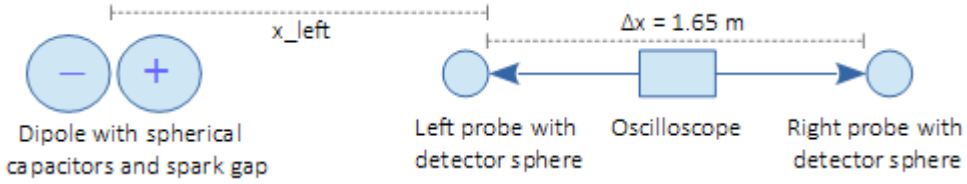


Fig. 1: Schematic of the experiment

The experiment uses a spark gap between two conducting spheres acting as capacitors of opposite electric charge. After spark-formation, this rapidly collapsing dipole field is measured by an oscilloscope connected via probes to conducting detector-spheres. Whereas the mutual distance between the detector spheres connected to the oscilloscope remains at Δx = 1.65 m (from left probe tip to right probe tip), different distances from the spark-gap have been measured.

Id.	x_left	x_right	Δx	Δt	v = Δx/Δt
config_a	1.85 m	3.5 m	1.65 m	3.3 ns	1.7 c
config_b	2.6 m	4.25 m	1.65 m	1.1 ns	5.0 c
config_c	3.35 m	5 m	1.65 m	1.7 ns	3.2 c
config_d	4.85 m	6.5 m	1.65 m	2.1 ns	2.6 c
config_e	6.35 m	8 m	1.65 m	2.9 ns	1.9 c
config_f	7.85 m	9.5 m	1.65 m	3.8 ns	1.5 c
config_g	9.35 m	11 m	1.65 m	4.0 ns	1.4 c

Tab. 1

The measured propagation speeds v = Δx/Δt from the left to the right detector sphere, with Δt averaged over each five measurements, range from around 1.4 c to 5 c, and show a dependence on the distance from the spark gap.

The by far simplest explanation of the experiment is the hypothesis that the Coulomb interaction conforms to Coulomb, who assumed instantaneous interaction at a distance. The dependence of the measured propagation speed on the distance of the measurement setup from the spark gap is explained by dissipative losses and "image charge" complication, leading to electric currents in the ground and the walls.

Credits:

http://www.pandualism.com/d/instantaneous.html
http://www.pandualism.com/c/coulomb_experiment.html

Evanescent waves and electromagnetic radiation

"Experimental Evidence of Near-field Superluminally Propagating Electromagnetic Fields", William D. Walker*(Submitted on 6 Sep 2000)*

A simple experiment is presented which indicates that electromagnetic fields propagate superluminally in the near-field next to an oscillating electric dipole source. A high frequency 437 MHz, 2 watt sinusoidal electrical signal is transmitted from a dipole antenna to a parallel near-field dipole detecting antenna. The

phase difference between the two antenna signals is monitored with an oscilloscope as the distance between the antennas is increased. Analysis of the phase vs distance curve indicates that superluminal transverse electric field waves (phase and group) are generated approximately one-quarter wavelength outside the source and propagate toward and away from the source. Upon creation, the transverse waves travel with infinite speed. The outgoing transverse waves reduce to the speed of light after they propagate about one wavelength away from the source. The inward propagating transverse fields rapidly reduce to the speed of light and then rapidly increase to infinite speed as they travel into the source. The results are shown to be consistent with standard electrodynamic theory.

Comments:17 pages, Presented at Vigier III Symposium: Gravitation and Cosmology, Berkeley, California, USA, August 21-25, 2000 Subjects: **General Physics (physics.gen-ph)**; Classical Physics (physics.class-ph) Cite as:arXiv:physics/0009023 [physics.gen-ph] (or https://arxiv.org/abs/physics/0009023v1 [physics.gen-ph] for this version)

This should have important practical and theoretical implications.

See also:
https://en.wikipedia.org/wiki/Superlens

"Superluminal Behaviors of Electromagnetic Near-fields", Z Y Wang, C. D. Xiong (December 2003)
https://www.researchgate.net/publication/2169792_Superluminal_Behaviors_of_Electromagnetic_Near-fields
https://arxiv.org/vc/physics/papers/0311/0311061v6.pdf

"Superluminal propagation of evanescent modes as a quantum effect", Z Y Wang, C.D. Xion, Bing He (May 2008) *Annalen der Physik* 17(5):319 - 325 DOI: 10.1002/andp.200710288
https://www.researchgate.net/publication/227708157_Superluminal_propagation_of_evanescent_modes_as_a_quantum_effect

"Apparent Superluminal Speeds in Evanescent Fields, Quantum Tunnelling and Quantum Entanglement", Arne Bergstrom http://pubs.sciepub.com/ijp/3/1/7/index.html

"The fact that evanescent waves travel with superluminal speeds (cf. e.g. Fig. 4) has actually been verified in a series of famous experiments, performed since 1992 onwards by R. Chiao, P.G. Kwiat and A. Steinberg's group at Berkeley [44], by G. Nimtz et al. at Cologne [20], by A. Ranfagni and colleagues at Florence [30], and by others at Vienna, Orsay and Rennes [30], which verified that "tunnelling photons" travel with superluminal group velocities.7 Let us add also that extended relativity had predicted [50] evanescent waves endowed with faster-than-c speeds; the whole matter therefore appears to be theoretically consistent." (*Physics Before and After Einstein*, Edited by Marco Mamone Capria (2005) p. 272)

Speed of Einstein's gravity in GR was arbitrarily chosen

But doesn't Einstein's theory of General Relativity prove that gravity propagates at the speed of light? No. This was simply a presupposition by Einstein:

"Einstein's gravitational waves do not have a unique speed of propagation. The speed of the waves is coordinate dependent, as the condition at Eq.(A.6) attests. It is the constraint at Eq.(A.6) that selects a set of coordinates to produce the propagation speed c.

A different set of coordinates yields a different speed of propagation, as Eq.(A.3) does not have to be constrained by Eq.(A.6). Einstein deliberately chose a set of coordinates that yields the desired speed of propagation at that of light in vacuum (i.e. $c = 2.998 \times 10^8$ m/s) in order to satisfy the presupposition that propagation is at speed c. There is no a priori reason why this particular set of coordinates is better than

any other. The sole purpose for the choice is to obtain the desired and presupposed result." ("A critical "Analysis of LIGO's Recent Detection of Gravitational Waves caused by Merging Black Holes", Stephen J. Crothers (4 March 2016) http://vixra.org/pdf/1603.0127v4.pdf

———

All the coordinate-systems differ from Galilean coordinates by small quantities of the first order. The potentials $g_{\mu\nu}$ pertain not only to the gravitational influence which has objective reality, but also to the coordinate-system which we select arbitrarily. We can 'propagate' coordinate-changes with the speed of thought, and these may be mixed up at will with the more dilatory propagation discussed above. There does not seem to be any way of distinguishing a physical and a conventional part in the changes of $g_{\mu\nu}$. "The statement that in the relativity theory gravitational waves are propagated with the speed of light has, I believe, been based entirely upon the foregoing investigation; but it will be seen that it is only true in a very conventional sense. If coordinates are chosen so as to satisfy a certain condition which has no very clear geometrical importance, the speed is that of light; if the coordinates are slightly different the speed is altogether different from that of light. The result stands or falls by the choice of coordinates and, so far as can be judged, the coordinates here used were purposely introduced in order to obtain the simplification which results from representing the propagation as occurring with the speed of light. The argument thus follows a vicious circle." Eddington [38 §57]

Reference: [38] Eddington, A.S., *The Mathematical Theory of Relativity*, Cambridge University Press, Cambridge, (1963, reproduction of 1923 publication; the paperback edition is from Forgotten Press and the quote is on p. 130-131) (If you search the reprint of this book using Amazon's Look Inside feature, use "vicious circle" for the search text.)

The Propagation of gravitational waves, A.S. Eddington (October 1922)
https://royalsocietypublishing.org/doi/pdf/10.1098/rspa.1922.0085

"Einstein had also become suspicious of these waves (in so far as they occur in his special co-ordinate - system) for another reason, because he found that they convey no energy. They are not objective, and (like absolute velocity) are not detectable by any conceivable experiment. They are merely sinuosities in the co-ordinate-system, and the only speed of propagation relevant to them is "the speed of thought." "

Here is another one from *Einstein, Relativity and Absolute Simultaneity*, edited by William Lane Craig and Quentin Smith (2008) "Global Positioning System and the twins' paradox", Tom Van Flandern :

". . . it is entirely possible that reality is Lorentzian, not Einsteinian, with respect to the relativity of motion. In that case, physics may have no speed limit when the driving forces are gravitational or electrodynamic rather than electromagnetic in nature. And that may be the most important thing that the GPS has helped us to appreciate."

"Gravitational waves" have NO Doppler shift, NO diffraction limit

The LIGO experiments (https://en.wikipedia.org/wiki/LIGO) presume that gravitational waves exist and that the waves propagate at the speed of light. So it is appropriate to ask, Do the presumed "gravitational waves" have a Doppler shift? This would be true if they were physical waves like

those in light, sound, or water, which carry energy from one place to another. But consider (again) what Eddington had to say about this:

> "The Propagation of gravitational waves", A.S. Eddington (October 1922)
> https://royalsocietypublishing.org/doi/pdf/10.1098/rspa.1922.0085
>
> "Einstein had also become suspicious of these waves (in so far as they occur in his special co-ordinate -system) for another reason, because he found that they convey no energy. They are not objective, and (like absolute velocity) are not detectable by any conceivable experiment. They are merely sinuosities in the co-ordinate-system, and the only speed of propagation relevant to them is "the speed of thought." "

Hence, there is no Doppler shift for such "waves". The waves are a result of Einstein's choice of a coordinate system, and are not something physical. Likewise, there are no such shifts for electric and magnetic fields. The INTENSITY of these "field effects" can change with distance (as per the inverse square rule) but the TIME of the change is the same for all detectors regardless of their spatial position. The relevant forces here are gravitational or electrodynamic, but NOT electromagnetic.

It follows that actual gravitational effects do not have a diffraction limit. A "gravity beam" would not be limited by diffraction or scattering effects, but only by the geometry and precision construction of the generator.(https://medium.com/predict/eugene-podkletnovs-impulse-gravity-generator-8749bbdc8378)

Also, the output energy in the beam of such a generator seems to be much higher than the input energy used to generate the beam. Possibly relevant here is that gravitational motion is THREE-dimensional, but only ONE of the motional dimensions can be represented in the conventional reference system that consists of three dimensions of space and one dimension of progressive time. There is actually more to gravity than meets the eye!

Reference system effects

Photons have no motion

Einstein said that the photon does not experience the passage of time. Objections to Special Relativity have been raised on this point because it implies that photons have no trajectory. In other words, photons are stationary. Although physicists in Academia are shocked when I suggest this, it is apparently not a new idea:

> "There is no physical phenomenon whatever by which light may be detected apart from the phenomena of the source and the sink . . . Hence from the point of view of operations it is meaningless or trivial to ascribe physical reality to light in intermediate space, and light as a thing travelling must be recognized to be a pure invention." (*The Logic of Modern Physics*, P. W. Bridgman (1960) p. 153)
>
> "According to special relativity the photon is stationary in time and the inertial mass is stationary in space; . . . Since a photon is bereft of rest mass and it is stationary in time it cannot be a projectile and it cannot have a trajectory;" http://www.einsteinsmethod.com/Nonlocality.html (*Einstein's Method: A Fresh Approach to Quantum Mechanics and Relativity* by Paul A. Klevgard (2008))

But if the photon has no trajectory, how can physicists freely manipulate photons with mirrors, lenses, diffraction gratings, etc., as though they *do* have trajectories. Therefore, it is argued, Special and General Relativity must be fundamentally flawed.

The only obvious counter argument is that if the trajectory cannot be attached to the photon, then it must attach to the reference system. But isn't this like saying if the photon were a basketball, the ball would be stationary and *the court would move* instead? At first that seems ridiculous. But on second thought, it reminds us of the bead on the wire illustrations. And so maybe it is not so ridiculous. But still . . . ???

In non-local physics, you have to get used to some really weird thinking patterns. Suppose, just suppose, that we require the reference system to do the moving instead of the photon. What would be required? Two things seem to be clear: First, because the photon can be deflected in any direction, the reference system must be moving in any and every direction. Secondly, photons move at the speed of light. If the photon is to be stationary, then the reference system must be moving at the speed of light. Are those insurmountable requirements?

No. The concept of temporal motion makes it all possible. As has already been explained, gravitation, is non-directional temporal motion (t^3/s^3). That means that the reference system actually *is* moving in all directions simultaneously. If I jump out of a tree, I am temporarily in "free fall". There are no forces acting on me. I am in an "inertial reference frame" (as per Einstein). It is the Earth that then moves up to meet me (as per Einstein). But if I jump out of a tree from another spot on Earth diametrically opposite to the first one, the same thing happens. In fact, I could do this anywhere, and get the same result. The Earth—the reference system we are using—is engaged in the very kind of motion that is needed to assign a seeming trajectory to the photon, exactly as required.

That gravitation acts in all directions has also been shown by experiments performed by Colella, Overhauser, and Werner (the "COW effect"). They used a neutron interferometer to show that gravity has an active horizontal component. In other words, this means that gravity has three "motional dimensions", but the effects of only one of those can be represented in the common spatial reference system.

Ok. Now how do we get a laboratory to move at the speed of light. Simple. We attach it to Earth! Again, Earth has that t^3/s^3 temporal motion. We can assert that the reference system "stays put" ***in space***, but that it moves at the speed of light ***in time.*** That means that even though the ***spatial*** coordinate remains fixed, the ***time*** coordinate associated with that position continually changes. When I sit stationary in a chair, I am actually still moving, because time is progressing, and my time coordinate keeps changing. We sense this intuitively. All we need to say is that ***time*** is progressing at the speed of light. Remember that equation with the gamma factor (above). It said that all things move at the speed of light, and that the total speed is composed of a temporal speed and a spatial speed. Compared to the speed of light, the spatial speed of the Earth is nearly zero. Hence, the vast majority of its motion is in time, and that is in fact the meaning of t^3/s^3.

So when a mirror, moving at the (temporal) speed of light, collides with a photon, the photon is reflected (re-emitted) from the mirror, but it itself does not move in the fundamental picture. Instead, it is the mirror that does the moving, and it only requires a particular "open dimension of motion" for the whole path to reproduce what we see in the laboratory. Because the mirror (and everything else) is moving in every "motional dimension", this requirement is easily met.

This is so conceptually weird the reader might be helped by this illustration:

> First, picture a locomotive sitting on a railroad track. The locomotive has no steering wheel and can only move forwards or backwards. Any directional changes it experiences are determined by the track it sits on, and by the various track switches it encounters.

Second, visualize the locomotive as completely stationary. We could say that it moves, but it is really the track that does the moving.

This is how we have to view the photon. It is fundamentally stationary (in space and in time). But it appears to be moving and switched around by mirrors and lenses, which, as part of a gravitational system, are doing the actual moving.

The static Aether was not detectable

There is yet another consequence to this non-directional, non-vectorial, scalar, isotropic, motion the Earth is engaged in. Remember the Michelson-Morley experiment? It attempted to detect the absolute motion of the Earth through the Aether, which was supposed to be some sort of invisible substance which filled the Universe as a medium for light waves and which was thought to be stationary. But as the Earth moved around the Sun, no "Aether wind" could be detected by this clever experiment. Physicists then concluded that the Aether did not exist, nor did absolute motion, and that all motion must therefore be "purely relative".

This experiment depended on vector addition of velocities, but the *fundamental* (or "absolute") motion of the Earth is *scalar* (in all directions, like an expansion). The design of the experiment was simply not capable of detecting this kind of motion; the non-directional motion described here would affect the perpendicular beams equally, and result in no fringe shift. There may still be an "ether" (a specific structure of space and time), but it must be a dynamic, non-directional one, quite unlike the static Aether of the 1800s. Space and time must be "emergent" at the speed of light. The Ether is like the wires in the wire/bead illustration, but with the wires moving ***out*** of bead instead of inward. Objects with mass move "anti" to this outward motion (which originates everywhere and everywhen). And we call that motion "gravity".

(**Afternote:** there are claims that a small fringe shift was indeed detected but got buried by institutional politics because of prevailing views about Relativity. Read *Michelson-Morley: was it really "null"* by Jeremy Fiennes, https://www.academia.edu/44838680/Michelson_Morley_was_it_really_null_ and "Relativistic Interpretation (with Non-Zero Photon Mass) of the Small Ether Drift Velocity Detected by Michelson, Morley and Miller", J.P. Vigier , APEIRON Vol.4 Nr. 2-3, Apr.-July 1997 http://redshift.vif.com/JournalFiles/Pre2001/V04NO2PDF/V04N2VIG.PDF , "Absolute velocity of earth from our stationary Michelson-Morley-Miller experiment at CIF, Bogota, Colombia (presented at PIRT-2017 at Bauman University, Moscow, but not included in the Proceedings) Hector A Munera https://www.academia.edu/41459778/Absolute_velocity_of_earth_from_our_stationary_Michelson_Morley_Miller_experiment_at_CIF ; My gut feeling is that, because rotation is absolute, this loose end may have something to do with rotation.)

What about the photon? It has no mass. It is therefore motionless, as we have already concluded. The photon is swept along in the "Expansive Ether", or "Emergent Ether" like a leaf in a river, having no motion relative to it. The photon does not experience the flow of time, and does not even experience the flow of space. Photons are ***fundamentally*** stationary! From its own standpoint, it pops into existence and goes out of existence in one single act.

The speed of light is invariant in a vacuum

If space and time are three-dimensional (as has been noted), then all things must have a location in space and a location in time. Because the photon has no independent motion, it is locked into a location in space and in time and the Expansive Ether moves these locations away from their original locations. The speed of separation in the underlying reality is the total spatial separation divided by the total time separation. If two photons progress directly away from each other, the speed thus calculated becomes 2/2, 4/4, 6/6, etc. which always reduces to 1/1, the speed of light. Note that the speed is constant, even though the values in the numerator and denominator are continually changing.

The EPR paradox is resolved

Suppose the two photons in the above example were created in the same event, that is, at the same *time*. This can be done by "down converting" one violet photon into two red photons. The two photons then separate in space (in the context of the reference system) but they still remain in the same *time* location. An action on one photon can therefore produce an instantaneous action on the other photon, even though they may be separated by miles or light years of space. This seems to be the resolution of the EPR paradox, and Einstein's discomfort with "spooky action at a distance."

I think Einstein would have been thrilled.

The Twin Paradox is resolved

Anyone who studies Special Relativity soon encounters the Twin Paradox. This one has all sorts of versions but here is the essence: One twin stays on Earth and the other goes away in a rocket ship at some significant fraction of the speed of light. Upon his return, he has aged *less* than his twin on Earth.

But this is not the official paradox; this is just a simple prediction of Special Relativity. The paradox is that *either* twin can be viewed as being younger (or older) than the other, because the motion can only be "purely relative". The fact that the *cause* of one type of motion can be distinguished from the other is irrelevant to the paradox.

Observations of muon lifetimes and actual experiments with clocks do indeed show that clocks moving at high speed run slower than those that are "stationary". But this is only true of clocks that measure time. Remember that gamma correction factor? It shows that there are two kinds of motion: temporal motion and spatial motion. If you are going to mix these two kinds of motion, then you need to have two kinds of clocks: one that measures the flow of time and one that measures the flow of space. At high speeds the flow-of-time clock slows down, but the flow-of-space clock speeds up; at low speeds the opposite is true: time proceeds at its regular rate, and the flow of space is essentially zero. To get the total amount of "progression", the values on the two different types of clocks have to be added together with a Pythagorean-like "orthogonal sum". According to this reasoning, both twins age at the same total rate, but the different kinds of clocks individually show different times. If the comparison is done *between the two different reference systems* —one on a time clock and one on a space clock—then the ages will conflict. But back on Earth, with *one reference system*, they will be the same age. And so there is no paradox.

What is needed here is an "*orthogonal sum clock*" that incorporates *both* time and space progression effects. The effects of *both* local and non-local behaviors need to be taken into account.

(Here is another variation on the Twins Paradox: Two identical twins of the same height walk away from each other. Each sees the other as "shrinking in the distance". Which twin does the *real* shrinking? Is this an actual effect (a change in physical dimensions)? Or is it just a reference system effect (a matter of appearances only)? What happens when the twins come back together?

Accelerated reference system effects

Apparent bending of light by a gravitational field

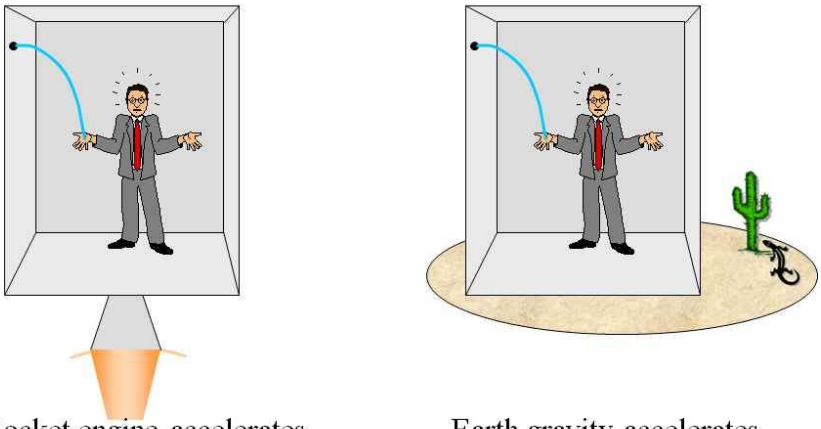
Einstein used an elevator to illustrate his Principle of Equivalence in General Relativity. The Principle can be stated as: "A homogeneous gravitational field is completely equivalent to a uniformly accelerated reference frame." In layman terms, that means that gravitational acceleration is equivalent (indistinguishable) from ordinary linear acceleration.

This is important because, although some of you don't know it, you are living on an accelerated reference system. When you stand on the floor or sit in a chair, "gravity" is accelerating you upwards at 9.8 m/sec^2 ; If this were not the case, you, and everything else would be floating around inside the room.

People understand elevators more readily than gravitation, so we'll stick with the elevator analogy, with a few Space Age modifications.

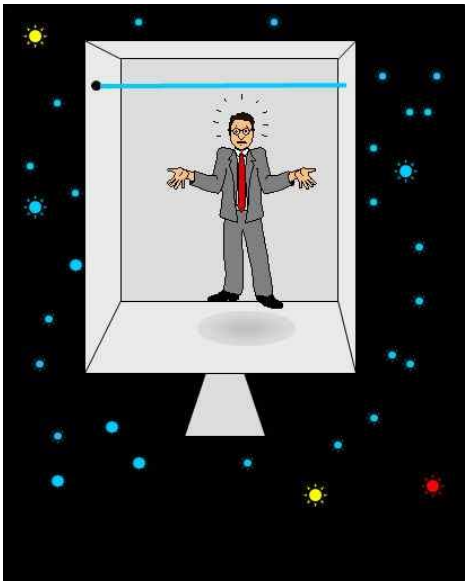
So if you were in a closed room inside a rocketship, and your acceleration meter (bathroom scales) indicated an acceleration of 9.8 m/sec^2 , you would not, from this one piece of information, be able to tell whether the rocketship was accelerating in outer space or whether it was still on Earth. (Presumably nobody is performing the Colella-Overhauser-Werner experiment which would detect a horizontal component of real gravity). This is shown in the illustration below. (The blue stuff is a stream of water squirting out of the wall.)

The "Einstein Elevator"



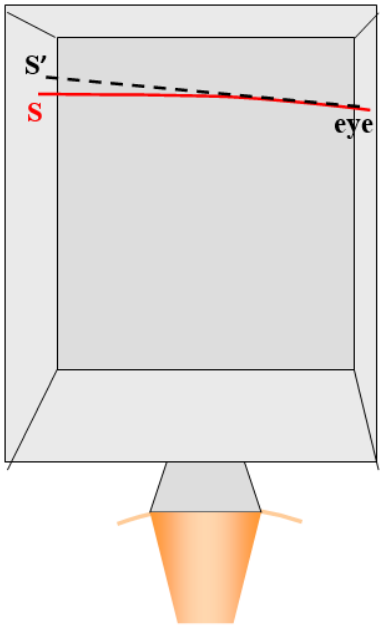
Rocket engine accelerates elevator at 9.8 m/sec^2

Earth gravity accelerates elevator at 9.8 m/sec^2



Rocket engine is shut off. Everything in the elevator is in “free float”, also known as an “inertial reference frame” because there is no acceleration. The stream of water goes straight across.

I used a stream of water in these illustrations because it is intuitive. Einstein used a light beam, as shown below.



Here a light beam shines left-to-right across the elevator which is being accelerated by a rocket engine (the curvature of the light beam is greatly exaggerated).

Note the following effects:

1. The light beam seems to bend downward.
2. The source of the beam, when viewed from the right end, seems to be displaced from S to S′.
3. The curvature adds extra length to the path.

It is important to understand the three effects noted in the illustration.

Effect #1: The light beam, or pulsed water stream if you will, is actually going straight relative to an ordinary reference system outside the elevator. Once it leaves the accelerating source at the wall, there are no more forces acting on it. We say it is in "free float". The room (*i.e.*, the reference system) is still accelerating. Its vertical velocity is *changing*, and no longer matches the (zero) vertical speed of the (detached) water. To an observer in the room, the water ***appears*** to be moving on a curved path, but this is due to the accelerating room, not the water itself.

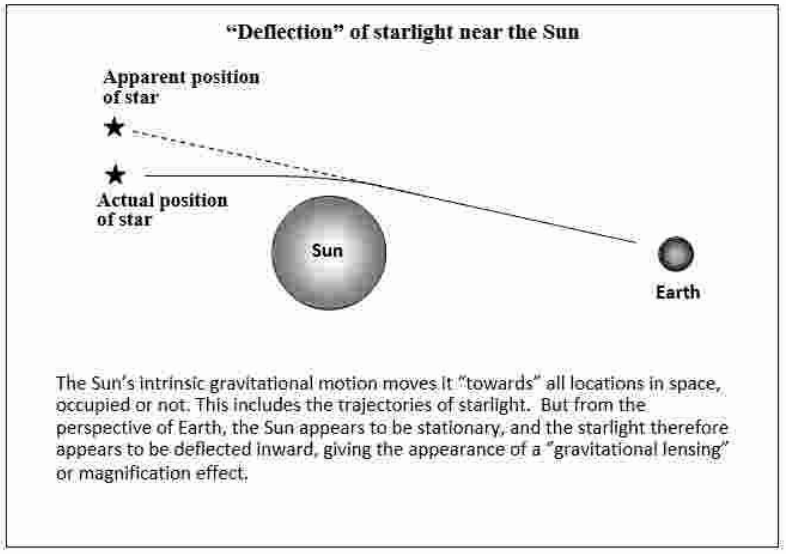
Effect #2: The image displacement should be intuitively obvious.

Effect #3: The extra path length should be intuitively obvious.

These effects will still occur irrespective of the source of acceleration (gravity or the rocket engine).

Gravitational lensing or image displacement

Effect #1 in the elevator has an equivalent in astronomy. Starlight seems to curve slightly in the presence of a strong gravitational field such as that near the Sun. See the illustration below.



In General Relativity, the effect is supposed to be due to the presence of mass causing a warping effect on space. But the critics don't regard this as an "explanation". How can mass grab ahold of space and warp it? This is like explaining a mystery with an enigma.

A much better explanation is simply that of effect #2 in Einstein's elevator. If the acceleration is upwards, the displacement of the source is upwards. If the acceleration were sideways, the displacement of the source would be sideways. What we need is an elevator that accelerates in all

directions simultaneously. But Aha! That is what we would call gravity. Remember it is a non-directional motion. It is that t^3/s^3 thing again.

When starlight passes the Sun, the Sun is moving “towards” the star light in the two dimensions that our telescope sees. But from our perspective, the Sun is stationary and the starlight is being “deflected inward”. This displaces the images in the star field outward (away from the Sun) and is equivalent to a magnification effect. The light is not actually bent. The apparent bending is just a reference system effect.

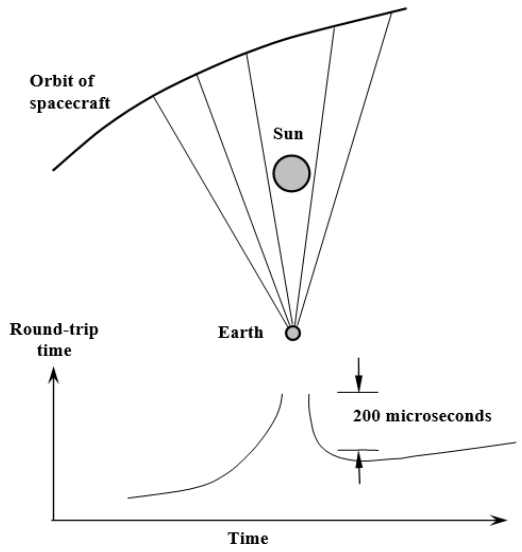
The effect near the Sun is only about an arcsecond of deflection and is difficult to detect. Far more precise measurements have become possible with radio astronomy. A radio source that is 90 degrees away from the Sun will show a deflection of a milliarcsecond –very small but still detectable. These observations are within 1% of Einstein’s predictions.

If you still have trouble visualizing all this, it might help to create your own version of curved space. When I was a kid, I went to a school that had a miniature merry-go-‘round. We kids would sometimes play "catch" on this rotating merry-go-‘round by throwing a ball straight across the center to another kid. To an observer on the ground, the ball traveled a straight path once it left our hands. But to us kids on a rotating platform the ball's path was strongly curved, and was very difficult to catch. The same effect could be produced by a kid on the stationary ground throwing a ball to a kid on the merry-go-‘round. We understood these effects because the mechanics of the situation could be clearly seen. But if we did not know the merry-go-‘round was rotating, we would have had to invent some other explanation. It probably would have been something like "Space becomes curved in the vicinity of merry-go-‘rounds".

Shapiro time delay

In the 1960s Irwin I. Shapiro predicted that there would be a time delay introduced into the round trip time of radar signals as they reflected off a planet passing behind a massive body like the Sun. The delay would be caused by the warpage of space due to the presence of the Sun's mass. (Shapiro, Irwin. I., 1964, *Physical Review Letters*. 13: 789; Shapiro, Irwin I. *et al.*, 1971, *Physical Review Letters*, 26, 1132) . This was another good test of General Relativity.

The tests were originally performed by reflecting radar signals off the planets Mercury and Venus. Decades later, the use of a transponder on the Viking Mars lander greatly improved the precision of the time delay measurement. See diagram below:



As a spacecraft moves behind the Sun, the roundtrip time (shown greatly exaggerated here) of its radar tracking signal becomes increased by hundreds of microseconds beyond that accounted for by the orbit itself. This additional delay ("Shapiro time delay") is believed to be due to the warpage of space in the vicinity of the Sun. (See *The New Physics*, Paul Davies, ed. 1989, p.14)

The 200 microseconds is the radar distance equivalent of about 40 miles (roundtrip). So this is like saying that the spacecraft, with a planet attached to it, jumped 20 miles out of its normal orbit as it passed behind the Sun. The observations are "explained" by claiming that the Sun's mass causes a warp in space, and consequently the path of a radar beam passing near the Sun has to go through space that is stretched out, and this causes the additional time delay.

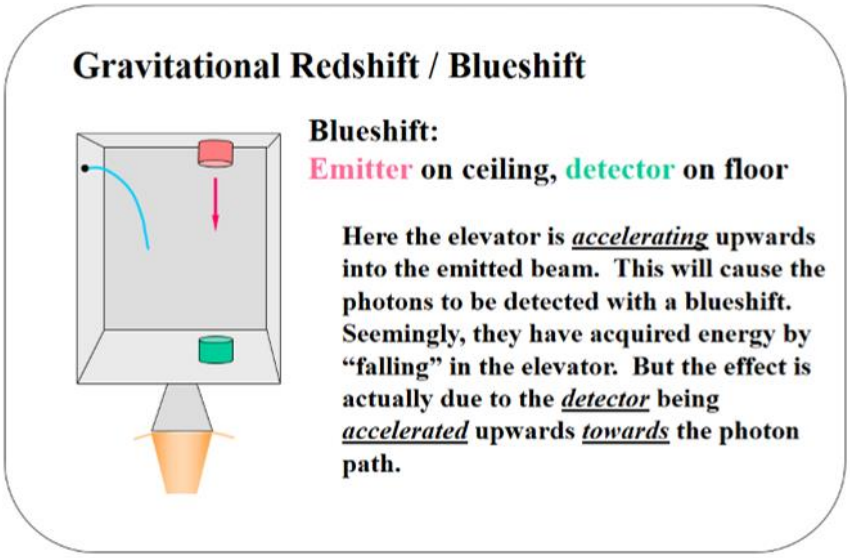
You have probably seen the illustrations of this effect. They show a rubber sheet stretched out across a hoop (like the top edge of a garbage can). Straight lines are then drawn on the sheet and some lines pass near the center of the sheet, and others are closer to the edge. A weight is then placed in the center of the sheet. The sheet deforms downward, with the greatest deformation being at the center. The lines are still at their same positions on the sheet, but the ones near the center are stretched out longer than the ones near the edges. The time delay for a radar beam is thus due to a change in the geometry of space itself, not to fluctuations in the orbital path, and is greatest for signal paths grazing the Sun.

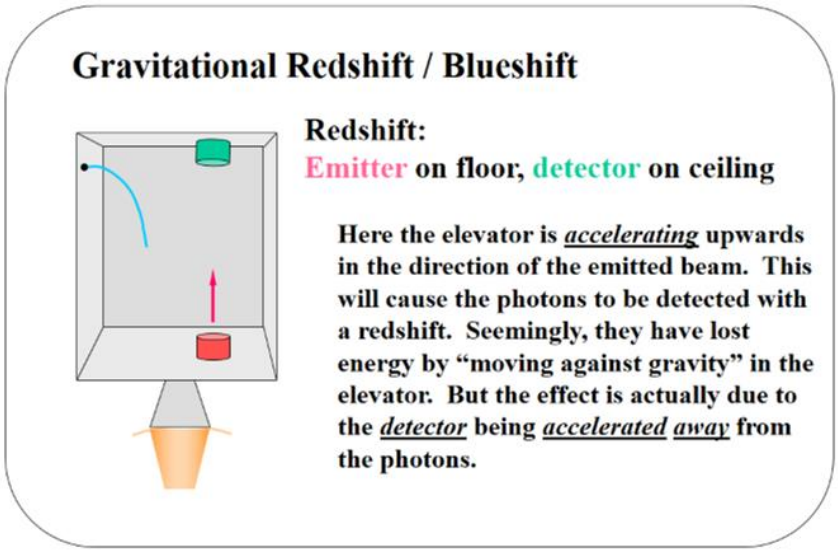
But there is a better explanation for this effect. Let's return to the Einstein elevator and forget about warps in space. This situation involves effect #3. In the elevator, the path of the light beam is actually straight, but the *acceleration* of the elevator and the observer within it, causes the path to appear curved. In the reference system, the curve adds extra length to the path, and therefore a time delay beyond what would be expected.

Gravitational redshift/blueshift, kinematic time shift

Experiments by Pound, Rebka, and Snyder at the Jefferson Physical Laboratory at Harvard circa 1960 have verified the existence of the gravitational redshift/blueshift effect to within one percent of the theoretical value. Those fascinating experiments were done with an extremely high resolution energy spectrometer that utilized the Mössbauer effect in iron 57.

The conventional explanations for the gravitational redshift and kinematic time shift are still valid, and are illustrated here only for completeness. Note that the explanations are actually intuitive, as is most of GR





Do temporally accelerated electric charges radiate?"

Spatially accelerated electric charges produce electromagnetic radiation, but temporally accelerated charges do not; they experience acceleration, just like I do when sitting in a chair (yet neither changing direction nor speed), but such charges do not radiate. Says https://mathpages.com/home/kmath528/kmath528.htm :

Does A Uniformly Accelerating Charge Radiate?

. . . if we accept the strong Equivalence Principle (i.e., the equivalence between gravity and acceleration), the simple idea that radiation is a function of acceleration becomes problematic, because in this context an object can be both

stationary *and* accelerating. For example, a charged object at rest on the Earth's surface is stationary, and yet it's also subject to a (gravitational) acceleration of about 9.8 m/sec^2. It seems safe to say (and it is evidently a matter of fact) that such an object does not radiate electromagnetic energy, at least from the point of view of co-stationary observers. If it did, we would have a perpetual source of free energy.

. . . the fact that a charged particle held stationary in a gravitational field (and therefore undergoing constant proper acceleration) does not radiate. For example, in Feynman's "Lectures on Gravitation" he says "we have inherited a prejudice that an accelerating charge should radiate", and then he goes on to argue that the usual formula giving the power radiated by an accelerating charge as proportional to the square of the acceleration "has led us astray" because it applies only to cyclic or bounded motions.

. . . the radiation reaction force (and therefore the radiated power) is proportional to the third derivative of position, so if the particle is undergoing constant acceleration it does not radiate . . . . If this is true, why do we so commonly regard radiation as being strictly a function of acceleration?

(For the reader's enlightenment, the first derivative of position is velocity, the second is acceleration, and the third is often called "jerk"; the latter is sometimes seen on T shirts in mathematical form as an engineering joke as in "Don't be a d^3s/dt^3 ."

A charged particle and an un-charged particle of the same mass will fall at the same rate in a gravitational field. "Paradox of radiation of charged particles in a gravitational field" https://en.wikipedia.org/wiki/Paradox_of_radiation_of_charged_particles_in_a_gravitational_field

Closely tied in with this equivalence is the fact that gravity vanishes in free fall. . . .

Putting together these two basic facts of general relativity and electrodynamics, we seem to encounter a paradox. For if we dropped a neutral particle and a charged particle together in a gravitational field, the charged particle should begin to radiate as it is accelerated under gravity, thereby losing energy and slowing relative to the neutral particle.

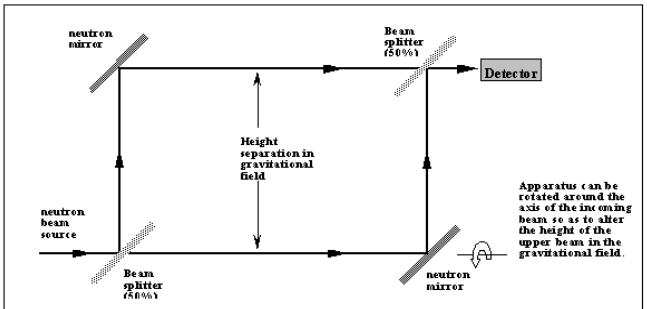
See also:

"Does A Uniformly Accelerating Charge Radiate?" http://www.mathpages.com/home/kmath528/kmath528.htm

The Feynman Lectures on Physics, Feynman, *et al.*(1964) Vol 2, p. 28-7) https://www.academia.edu/28997137/The_Feynman_Lectures_on_Physics_VOL2

Neutron Interferometer reveals horizontal gravitational effect

First a bit of background about this type of interferometer, illustrated below.



Schematic of a Mach-Zehnder type of neutron interferometer. Low energy neutrons enter from the neutron source at the left essentially one at a time. Each beam splitter reflects neutrons with a 50% probability. The first beam splitter splits the incoming beam into vertical and horizontal components. The second beam splitter coherently recombines them and passes them into the detector where they are counted. Note that each path is classically indistinguishable from the standpoint of the detector. Also, each path has a vertical segment over which equal work is done on the neutron by the gravitational force. And each path has a horizontal segment over which no work is done. The apparatus can be rotated about the axis of the incoming beam so as to change the height of the upper segment in the gravitational field.

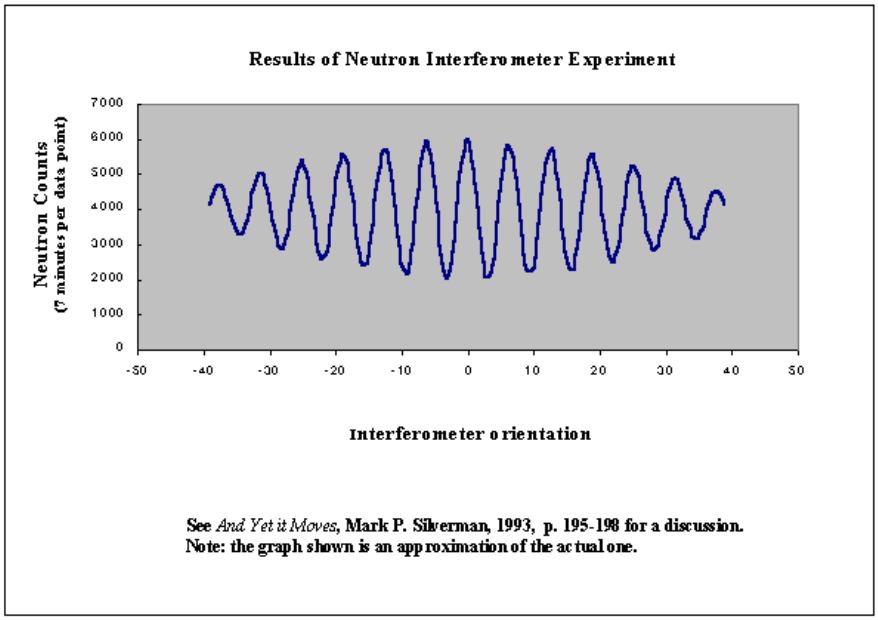
The object of the experiment is to determine if the neutron count is affected by the height of the upper segment in the gravitational field. If so, then it is being affected by the gravitational *potential*, not the gravitational *force*. This in turn would suggest that gravitational and inertial mass are *not* equivalent.

The Mach-Zehnder interferometer is one of several types of optical interferometers. Schematically it looks much like the illustration below, except of course it uses light instead of neutrons. Light comes in from the left and is split into a reference beam and a test section beam. The upper horizontal segment will have some sort of test apparatus inserted into it. It might be a simple tube (large or small, long or short) which has windows on each end. The test section is commonly used to study the flow of gases and is often a section of a wind tunnel, or a shock tube. The reference beam and test beam are recombined and form an interference pattern at the detector, which, in the case of an optical interferometer, could be a viewing screen or a photographic plate. Interferometers are *very* sensitive to minute changes in path length differences between the reference and test sections. The differences are caused by density variations in the gas due to flow patterns in the test section. What the observer will see is a series of fringes—a pattern of fuzzy dark lines that may look like curves or nested circles—that correspond to the flow contours of the gas.

For instance, this type of interferometer has been used to study the behavior of plasma in a tube. The tube is something like a common fluorescent light tube with clear windows at each end, and with a magnetic coil wound along the length. It is placed in the test section. The interferogram with the plasma and magnetic field off, is a series of parallel lines. When the plasma and magnetic field are turned on, the pattern of parallel lines then shows a series of fine, nested concentric rings embedded in it, which represent the "pinch" confinement of the plasma. (See *Optics*, Eugene Hecht, 2nd ed. 1987, p358-359).

For the case at hand, neutrons are used instead of light. Neutrons, like all particles, also have wave characteristics. The neutron wave function can be computed for an interferometer and used to predict the relative number of neutrons that will appear at the detector (a counter) for a specified circumstance. Neutrons have mass, and in this case we want to see how the presence of a gravitational field affects the neutron when it moves *horizontally* in the field. Classical physics predicts that it will not be affected. Quantum physics predicts that it will be, because the wave function has a potential energy term dependent on the *height* of the neutron in the field. The apparatus depicted schematically below compares the behavior of two neutrons following paths that have a height difference in the gravitational field.

When the experiment is actually done, the neutron intensity is found to vary periodically with the height of the upper horizontal section. This can be seen in the following diagram:



This result is relevant to studies of gravitation:

> "The observation of this neutron interference phenomenon . . . demonstrates convincingly that the Earth's gravity can affect the motion of elementary particles under circumstances where it is not the gravitational force itself, but the difference in gravitational potential energy, that has direct physical significance. Interestingly, it illustrates as well that the equivalence principle [of gravitational and inertial mass] may be of questionable validity in the realm of quantum mechanics." (For a discussion of the particulars, see *And Yet It Moves: Strange Systems and Subtle Questions in Physics*, Mark P. Silverman, 1993, p. 195-198)

The effect is as though a gravitational field has a kind of "index of refraction for mass" dependent on height in addition to manifesting a gravitational force. This effect might remind us of the interference effect that occurs when light is reflected from a pane of clear glass (see the third illustration in The mystery of interference). As the glass is made thicker and thicker the reflectivity cycles from 0% to 16% then back to 0% then back to 16% and so on. Similarly, as the neutron interferometer is tilted about the axis of the incoming beam so as to change the height of the upper horizontal beam in the gravitational field, the number of neutrons detected by the counter cycles from a maximum to a minimum, then back to maximum, then to minimum, and so forth. It is as though the path length in the upper section were changing as the apparatus is rotated.

The results indicate that the neutron has a gravitational effect operative in *all three linear dimensions of space* simultaneously. Only one of these can be readily depicted by the reference system.

Normally we would not be concerned about this effect. With ordinary massive objects the effect cannot be seen because the wavelength is too small. The wavelength of the neutron in this experiment was 1.4 Angstroms (essentially that of a thermal neutron at 300 K) This is comparable to interatomic distances in a crystal lattice, which in turn makes such crystals usable for neutron mirrors. In contrast, a one micron speck of dust with a mass of 10^{-15} kg and moving at a velocity of one mm/sec has a wavelength of 6.6×10^{-6} Angstroms. This is about a million times smaller than the interatomic distance. For something with the mass of a bullet, the effect would be utterly undetectable. Gravitational and inertial mass would therefore be equivalent "for all practical purposes."

This kind of experiment needs to be repeated with neutrons and atoms (such as hydrogen and helium) that have been *spin polarized*.

Perpendicular (or radial) reaction forces

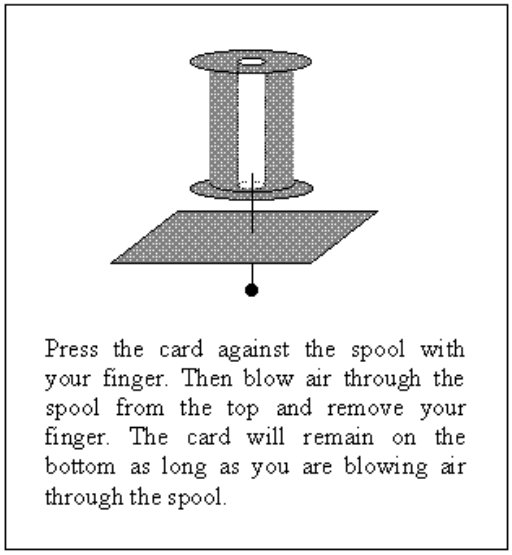
Gravitation is non-directional motion in three dimensions. What would happen to an object if one dimension of these motions was “cancelled” or counter-balanced?

A “motion canceller” (my own term) is a scheme that can be used to cancel (or counterbalance) one motion of a multidimensional motion so that the other motions, which are usually not apparent, become manifest. The resultant motions are perpendicular to the motion used for cancellation.

As applied to gravitation, it means that a canceling motion (or "force") can be applied to a stationary object, and it will begin moving (or exerting a force), *not* in the direction of the canceling motion, but in a direction *perpendicular* to it.

To get a better intuitive feel for this, consider a non-technical example. It consists of an ordinary spool of thread, a pin, and a card (a business card will do) assembled as shown in the illustration below. Hold the card on the bottom of the spool (using the pin to center it in the hole) and then blow air down the shaft with your mouth. While you are blowing, move your hand away from the card. What do you think will happen?

The spool and card demonstration

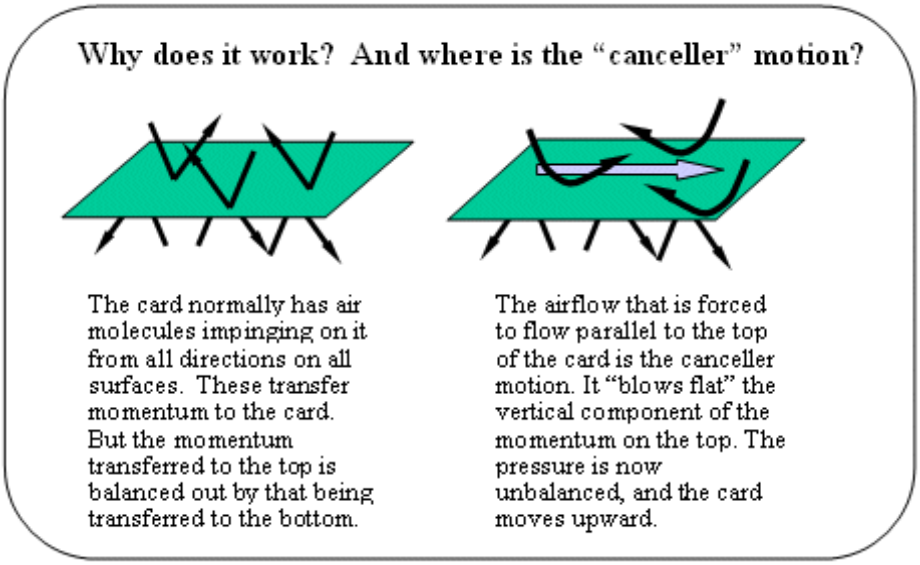


As every kid who has tried this in an elementary science class knows, the card will not be blown off the spool. It will remain attracted to the bottom as long as air is blown through the hollow shaft of the spool. This little experiment is used to illustrate the Bernoulli and Coanda effects of moving fluids. The principle has widespread applications in industry. A few obvious ones are carburetors in cars, steam jet ejectors used for refrigeration, perfume atomizers, and Bernoulli wands used by the semiconductor industry to lift and move silicon wafers without touching the circuit side (not to be confused with vacuum wands, which are used on the backside).

How does it work? The card is normally bombarded by air molecules coming from all directions and having every orientation. Each ricocheting air molecule has a momentum component that is perpendicular to the face of the card. All these components add up to produce a pressure on each face

of the card. As long as the card is fully immersed in air and the bombardment is random, the pressures will be equal, and the card does not move.

But when the card is placed near the spool, and air is blown through the shaft, the pressures become unbalanced. *The air flow bends parallel to the surface of the card*, and the perpendicular component on the spool side is literally "blown away" (partially). The perpendicular component on the other side of the card is thus unopposed, and an unbalanced pressure develops which moves the card towards the spool. The harder you blow, the more firmly the card moves towards the spool. (The pin simply keeps the card from sliding sideways.)



A slide from my presentation "The Quest for the Stardrive"

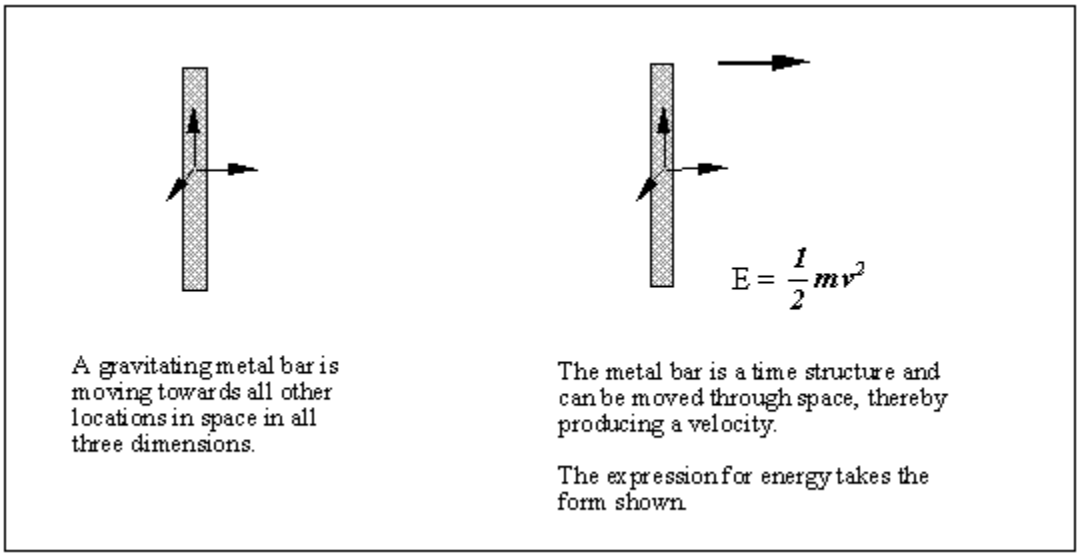
Note that air moving in two dimensions, in a plane parallel to the card, has caused the card to move perpendicular to the air flow. It has made apparent the existence of an effect that is otherwise not observable. One motion is used to cancel a hidden motion; the "canceller motion" does not directly produce the resulting motion, but allows an existing motion to become manifest. If you could repeat the equivalent of this experiment in the vacuum of outer space, the card would simply be blown off, as there is no opposing motion from air molecules.

See also:

https://en.wikipedia.org/wiki/Coand%C4%83_effect ,
https://en.wikipedia.org/wiki/Magnus_effect ,
https://en.wikipedia.org/wiki/Trench_effect)

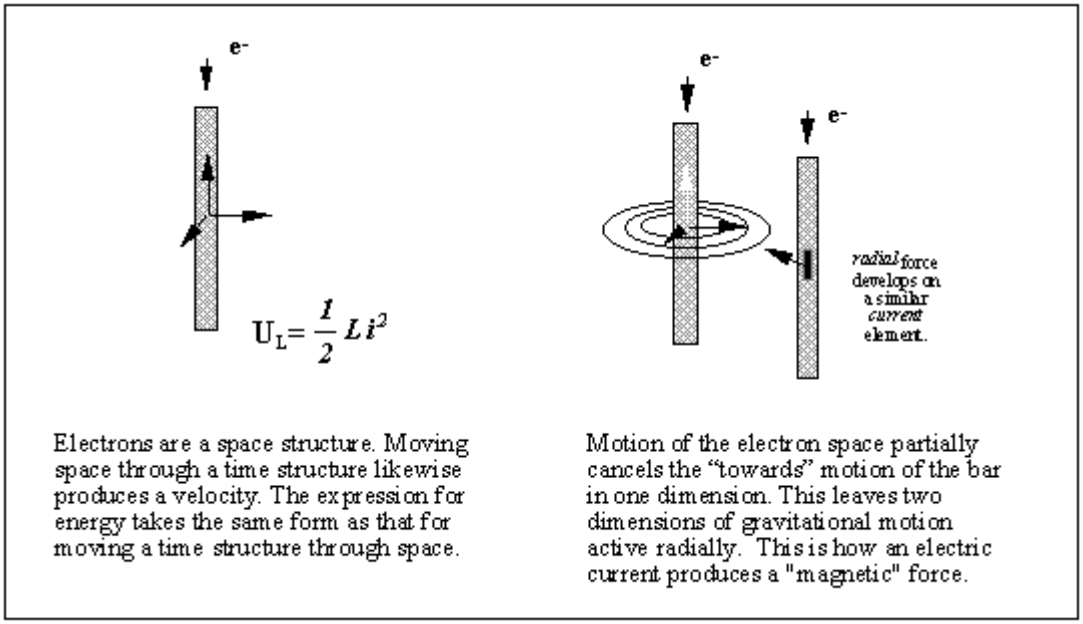
Moving matter through space

Let's now try a more technical example involving gravitational motion. We can move a metal bar through space as shown below.



Moving space through matter

A variation if possible here. Instead of moving the metal bar through space, we can move space through the bar. Electrons, it turns out, are "spin space" structures. Note what happens when they move through the bar.



The motion of "spin space" in the bar partially cancels one dimension of the gravitational motion. The residual two-dimensional motion is what we call "magnetic" (t^2/s^2) This is how magnetic fields arise from electric currents.

A little thought can reveal an inverse effect: the bar can be moved thru a magnetic field to generate a current. However there are some generally unappreciated details regarding this phenomenon. See:

https://en.wikipedia.org/wiki/Faraday_paradox
https://www.esotericscience.com/Magnetism.aspx

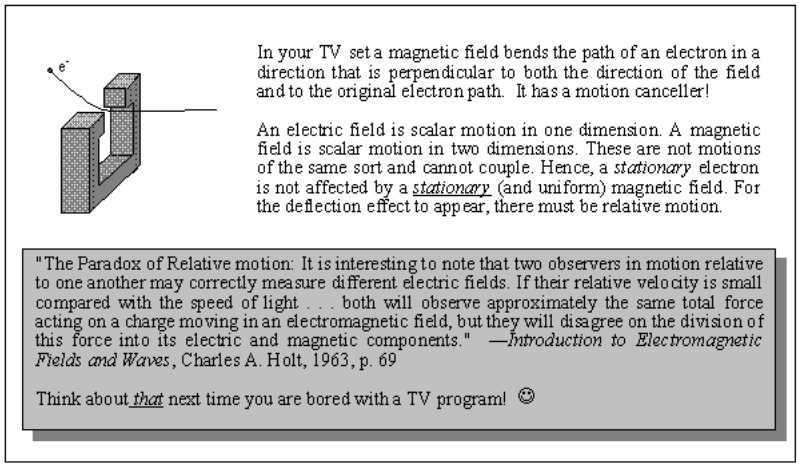
It is also illustrative to compare the space/time dimensions of mv^2 and Li^2 . Both must reduce to the dimensions of energy. Energy is t/s and mass is t^3/s^3. If electron current is space per time, then the dimensions of *L* (inductance) must be t^3/s^3, which is the same as that for mass. This makes perfect sense: the nature of the bar is not changed by moving it through space, nor is it changed by moving space through the bar. (See also Feynman, *Lectures*, Vol 2, p. 17-12)

(An Aside: This raises another question. Hypothetically, mass, inductance, and inertia have the same time/space dimensions. It has been demonstrated that a massive, rapidly spinning object, such as a flywheel, can affect the inertia of a nearby object. Could this also affect the electrical inductance of say, a transformer core, or an inductive element in an electronic oscillator? What effects would inertia reduction have on a homopolar generator? See Gravomechanical Effects below.)

In this example, the bar is moving in all three dimensions of extension space simultaneously. (This multidimensional motion of *one* object is somewhat difficult to visualize, and you might need to review the above section about Non-directional motion.) The motion of the electron space through the bar "cancels" the spatial motion of the bar in one dimension. The other two dimensions of the gravitational motion are still active and act perpendicularly (radially) to the long axis of the bar. This resultant is a still a scalar motion and will become manifest with another object possessing the same type of motion. Hence, two wires so treated will be moving "towards" each other. This is an effect that we call "electro-magnetic attraction". Also, because it is two-dimensional, the resulting motion is "orientable" in the context of a gravitational reference system.

Moving electrons through a magnetic field

Here is yet another example:



Railgun recoil

An effect similar to that implied by the illustration above has been seen in rail guns.

"DTIC ADA473387: An Investigation of the Static Force Balance of a Model Railgun", Defense Technical Information Center (2007-06-01) https://archive.org/details/DTIC_ADA473387

> An interesting debate in railgun research circles is the location, magnitude, and cause of recoil forces, equal and opposite to the launched projectile. The various claims do not appear to be supported by direct experimental observation. The goal of this research paper is to develop an experiment to observe the balance of forces in a model railgun in a static state. By mechanically isolating the electrically coupled components of such a model it has been possible to record the reaction force on the rails and compare that force with the theoretical force on a projectile. The research is ongoing but we have observed that the magnitude of the force on the armature is at least seventy times greater than any predicted equal and opposite reaction force on the rails.

In other words, there seems to be some "missing recoil" in connection with radial electromagnetic forces. Investigating, I found this comment (quoted in part; enjoy the controversy) on the Internet (http://sci.tech-archive.net/Archive/sci.physics.research/2008-12/msg00010.html)

> "There is very little room for skepticism about the paper. Large scale tests performed by the US Navy of a prototype rail gun involved a 3.35 Kg projectile with a muzzle velocity of 2520 meters/sec. This gives a momentum in excess of 8000 Kg-meters/sec, enough to send a 200 Kg rail gun backward at over 40 meters per second. A conventional gun with similar performance would require a massive and extensive recoil absorption apparatus. There is none needed with a rail gun. . . . ("Rail Guns don't recoil", Canup, Robert E., December 2008)

And this:

"An Experimental Study of Electromagnetic Lorentz and Rail Recoil", Michael J. Putnam (December 2009) https://web.archive.org/web/20150924130034/http://www.dtic.mil/get-tr-doc/pdf?AD=ADA514371

> "Force measurements show that the force on the armature increases as the square of the current while the indicated reaction force on the rails is an artifact of the experiment. These recoil forces measured <1% of the force on the armature. We conclude that the recoil, or corresponding equal and opposite reaction force to the force on the armature, is not seated in the rails."

The literature shows some confusion over the answer to the question "Where is the recoil in railguns?" It is apparently NOT "equal and opposite" to the action on the projectile as Newtonian physics would lead us to believe. That is, it is not parallel to, or seated in the rails. The reaction forces are perpendicular (sideways), and cancel each other out within the fame of the gun. And that requires a very strong frame:

> "The rails need to withstand enormous repulsive forces during firing, and these forces will tend to push them apart and away from the projectile." http://en.wikipedia.org/wiki/Railgun

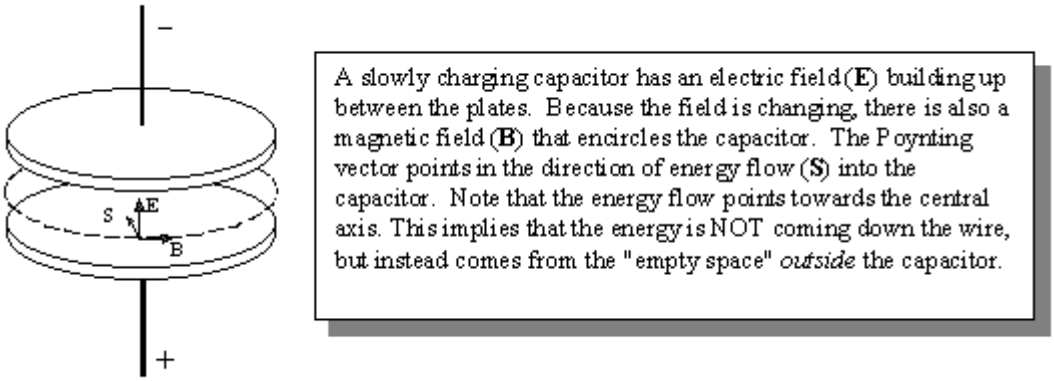
Some people may have a hard time accepting this because they are simply not familiar with non-local physics or electrodynamics. The concepts are just too counter-intuitive for them.

Poynting vector and a charging capacitor

The motion canceller idea can also give us insights on physical concepts that otherwise seem to be flat-out weird. One class of problems of this sort involves the Poynting vector. This vector, $\mathbf{S} = \varepsilon_0 c^2\, \mathbf{E} \times \mathbf{B}$, tells us how electromagnetic energy flows in space. It is often encountered in discussions about the properties of light, but it applies to other things too, like electric current in capacitors, electric current in a resistance wire, magnets combined with static charges, and so on. It often implies some

surprising, and seemingly awkward things. Here is a textbook example from *Feynman Lectures on Physics:*

> "Now we take another example. Here is a rather curious one. We look at the energy flow in a capacitor that we are charging slowly. . . . There is a nearly uniform electric field inside which is changing with time. . . . So there must be a flow of energy into that volume from somewhere. Of course, you know that it must come in on the charging wires—not at all! It can't enter the space between the plates from that direction, because ***E*** is perpendicular to the plates; ***E*** X ***B*** must be *parallel* to the plates.
>
> You remember, of course, that there is a magnetic field that circles around the axis when the capacitor is charging. . . . Its direction is shown in [the figure]. So there is an energy flow proportional to ***E*** X ***B*** that comes in all around the edges as shown in the figure. The energy isn't actually coming down the wires, but from the space surrounding the capacitor." (*Feynman Lectures on Physics*, Vol II, p. 27-7; https://www.academia.edu/28997137/The_Feynman_Lectures_on_Physics_VOL2)



See also:

> "Observation of static electromagnetic angular momentum *in vacuo*", M.Graham, D.G.Lahoz. *Nature*, 285, 154, 1980. https://inis.iaea.org/search/search.aspx?orig_q=author:%22Lahoz,%20D.G.%22)

This also brings to mind a topic of popular interest: the Biefeld-Brown effect. Suppose the capacitor is ***asymmetric*** in that it has plates with very different areas. The electric field will be shaped somewhat like a cone, instead of a cylinder, and will be highly divergent. The "lifters" constructed with such principles are usually "leaky", due to corona effects, and require electric current to keep them charged. The current is of course accompanied by a magnetic field. The resultant Poynting vector is directed inward toward the central axis, but now also has a vertical component. Could this flow of energy/momentum be related to the source of lift claimed for these devices? The asymmetric construction may be one way of dealing with the non-directional gravitational symmetry.

But this Poynting vector interpretation has apparently *not* been addressed in the literature. First, some history, found at https://handwiki.org/wiki/Physics:Biefeld%E2%80%93Brown_effect

> The "Biefeld–Brown effect" was the name given to a phenomenon observed by Thomas Townsend Brown while he was experimenting with X-ray tubes during the 1920s while he was still in high school. When he applied a high voltage electrical charge to a Coolidge tube that he placed on a scale, Brown noticed a difference in the tubes mass depending on orientation, implying some kind of net force.[1][8] This discovery caused him to assume that he had somehow influenced gravity electronically and led him to design a propulsion system based on this phenomenon.

Eventually the thrust was "explained" by the effects of ion wind or, alternatively, by ion drift. ("Calculation and measurement of a neutral air flow velocity impacting a high voltage capacitor with asymmetrical electrodes" *AIP Advances* **4**, 017137 (2014); https://doi.org/10.1063/1.4864181) But these experiments aren't particularly convincing. X-ray tubes during the 1920s used 200kV, not the 16 kV used in the ion wind experiments. And X-ray tubes are *vacuum* tubes; they do not produce ion wind. Brown also claimed that his thruster would work in a vacuum. Hobbyists run theirs in air.

Another reference says this:

> "Pulsing of the electrostatic fields with a sawtooth or ideally a capacitor discharge relaxation oscillator type of waveform (in which the voltage rise is not a straight line as in a sawtooth but exponentially decreases) is also necessary. ("Electrokinetic Propulsion", http://www.meridian-int-res.com/Aeronautics/APS.htm)

There is no mention of pulsed fields or asymmetric waveforms in the former reference.

Anyway, the Poynting vector thrust explanation requires that the capacitor be in a state of continually charging. The production of ion wind would easily serve this purpose. This does not exclude operation in a vacuum, but does require a configuration that does not depend on air ionization.

The alternative scheme generates thrust by using asymmetric electrical fields, combined with high mass, high K asymmetric capacitors. This type of device will produce thrust in a high vacuum (10^{-6} Torr), or when the electrodes are enclosed in Plexiglas shields (or plastic bags) to contain the ion wind or when immersed in transformer oil to suppress corona and ion wind effects. Operation is more efficient without corona leakage, and higher voltages are also possible (the thrust effect scales approximately as the square or cube of the voltage). Cone shaped dielectrics work better than cylindrical dielectrics. High K, high mass dielectrics (like barium titanate) work better than, say, glass or polyethylene. Capacitors with a symmetric construction produce no thrust. High voltages (50-100 kV) are required to produce moderate thrust. The thrust is towards the larger, (usually positive) electrode; during spark discharges, thrust appears to be independent of electrode geometry or polarity. Pulsed DC, DC with an AC waveform imposed, or even AC itself, works better than constant polarity DC. Thrust characteristics may depend on electrical waveform asymmetry. (See Brown's patent, Electrokinetic apparatus (1965-06-01) http://www.freepatentsonline.com/3187206.pdf)

These two effects (ion wind versus asymmetric construction) are different and are often confused. A study sponsored by NASA is an example:

> This paper reports on the results of tests of several Asymmetrical Capacitor Thrusters (ACTs). . . .The model assumed the thrust was due to electrostatic forces on the leakage current flowing across the capacitor. It was further assumed that this current involves charged ions which undergo multiple collisions with air. These collisions transfer momentum. All of the measured data was consistent with this model. Many configurations were tested, and the results suggest general design principles for ACTs to be used for a variety of purposes. ("Asymmetrical Capacitors for Propulsion", Francis X. Canning, Cory Melcher, and Edwin Winet, Institute for Scientific Research, Inc., Fairmont, West Virginia, 2004; http://gltrs.grc.nasa.gov/reports/2004/CR-2004-213312.pdf)

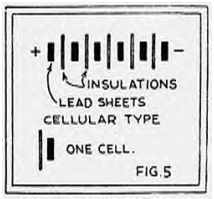
Their use of the term "Asymmetrical Capacitor Thrusters" notwithstanding, what was tested here was clearly an ion wind effect. Contrast this study with Brown's comments in his article "How I Control Gravitation" , T.T. Brown , *Science & Invention* (August 1929):

> Since the time of the first test the apparatus and the methods used have been greatly improved and simplified. Cellular "gravitators" have taken the place of the large balls of lead. Rotating frames supporting two and four gravitators have made possible acceleration measurements. Molecular gravitators made of solid blocks of massive dielectric have given still greater efficiency. Rotors and pendulums operating under oil have eliminated atmospheric considerations as to

pressure, temperature and humidity. The disturbing effects of ionization, electron emission and pure electro-statics have likewise been carefully analyzed and eliminated. . . .

Let us take, for example, the case of a gravitator totally immersed in oil but suspended so as to act as a pendulum and swing along the line of its elements. When the direct current with high voltage (75-300 kilovolts) is applied the gravitator swings up the arc until its propulsive force balances the force of the earth's gravity resolved to that point, then it stops, but it does not remain there. The pendulum then gradually returns to the vertical or starting position even while the potential is maintained. The pendulum swings only to one side of the vertical. Less than five seconds is required for the test pendulum to reach the maximum amplitude of the swing but from thirty to eighty seconds are required for it to return to zero. . . .

MASS of the dielectric is a factor in determining the total energy involved in the impulse. For a given amplitude an increase in mass is productive of an increase in the energy exhibited by the system (E = mg).



In particular, note the reference to "totally immersed in oil", and "solid blocks of massive dielectric" and the use of ***lead*** sheets, and the momentary (not continuous) impulse, in Brown's cellular type of thruster. This is clearly NOT a device that depends on "charged ions which undergo multiple collisions with air" (NASA). Brown's 300311 patent also states that "said linear force or motion is furthermore believed to have no equal and opposite reaction that can be observed by any method commonly known and accepted by the physical science to date" (page 1, line 24) and "This motion seems to possess no equal or opposite motion that is detectable by the present day mechanics" (page 2, line 63;. This is in contrast to the NASA document which states "These collisions transfer momentum." It is very clear that the NASA study investigates a completely different device and a completely different effect.

Others have recognized this too:

"Stress in Dielectrics (Biefeld-Brown Effect", http://www.qualight.com/portal.htm/brown/

> The "Biefeld-Brown Effect," sometimes referred to as the "Townsend Brown Effect," is frequently erroneously associated with ionic wind "lifters," . . . . The pure Biefeld-Brown Effect does not incorporate an ionic wind component.

The Wikipedia article on the Biefeld–Brown effect seems to add to the confusion: "This creates a high field gradient around the smaller, positively charged electrode." But in Brown's patents, the positive electrode is actually the larger one. http://en.wikipedia.org/wiki/Biefeld%E2%80%93Brown_effect (accessed 4-4-11) , http://www.freepatentsonline.com/3187206.pdf

Another problem is spelled out in the Wikipedia article:

> Critics and supporters alike have called throughout the years for vacuum experiments, in order to eliminate ion wind contributions from the devices. While there have been a handful of such experiments, most notably the efforts of Dr. R.L. Talley in the late 1980s and early 1990s, there is still a great deal of discrepancy over whether the effect is directly related to gravity or not,[*citation needed*] mainly because it isn't predicted by conventional electrostatics or general relativity.[*citation needed*][3] (http://en.wikipedia.org/wiki/Biefeld%E2%80%93Brown_effect)

The effect is not predicted by conventional physics. It is therefore easy to write it off as more "internet mythology" and "crazy patents" by delusional people and "air-head techno babblers" (of which there are many). Additionally, these topics are often mixed in with other "stuff" about UFOs, extraterrestrials, psychic phenomena, teleportation, and so forth. The physical theories offered might not use your favorite terminology, and some words, like "ether" and "gravitational radiation" may raise red flags. Scientists would likely conclude that investigating this effect, and others like it, is probably a waste of time and money. This simply shows how hard it is for an idea that has no peers to get "peer reviewed". Public investigation/implementation of the effect has been left to hobbyists and inventors.

Another effect noted by Brown (above) and Piggott:

> Less than five seconds is required for the test pendulum to reach the maximum amplitude of the swing but from thirty to eighty seconds are required for it to return to zero. . . .

The possibility that this has something to do with spin relaxation times should be investigated:

> "an atom can retain a particular spin polarization for a substantial amount of time. The "relaxation times" of spin polarized atoms are affected by the environment. "If the inside walls of the cell are suitably coated, collisions with the walls have little effect on the spin state of the atoms. . . . For example, for hydrogen atoms bouncing off teflon walls, tens of thousands of collisions are required for the magnetic moment of the hydrogen atom to become disoriented." (*Quantum Mechanics*, C. Cohen-Tannoudji, *et al.*, 1977, p. 452)

See also:

> Gravomechanical effects (below)
> "Head full of Xenon" https://www.ibric.org/science/97now/99_3now/990323c.html
> "polarized helium" https://medical-dictionary.thefreedictionary.com/polarized+helium

See also: "Guidelines to Antigravity", Robert L. Forward, *American Journal of Physics*, Vol. 31, No. 3, 166-170, March 1963. Abstract:

> "This paper emphasizes certain little known aspects of Einstein's general theory of relativity. Although these features are of minor theoretical importance, their understanding and use can lead to the generation and control of gravitational forces. Three distinctly different non-Newtonian gravitational forces are described. The research areas which might lead to methods for the control of gravitation are pointed out and guidelines for initial investigation into these areas are given." http://u2.lege.net/culture.zapto.org_82_20080124/antigravidity/Robert%20L.Forward%20-%20Guidelines%20to%20Antigravity.pdf

For some ideas, see http://www.amazing1.com/hv-dc-power-supplies.htm

Other Refs:

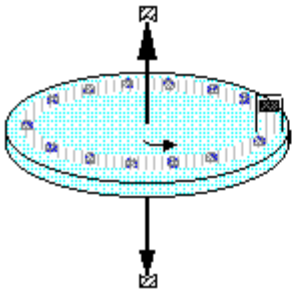
> http://jnaudin.free.fr/lifters/main.htm ,
> http://jnaudin.free.fr/html/nasarep.htm ,
> http://www.meridian-int-res.com/Aeronautics/APS.htm

Poynting vector and angular momentum

In the previous section you saw how motion of the wire in space produces mechanical energy and how *motion of space in the wire* also produces energy, but of a different sort, namely electrical energy with an attendant magnetic field. Let us suppose now that we replace *linear* motion with *rotational* motion for these cases. Do we still get a picture that is self-consistent? Can we still extract energy

from either system? More particularly, can we extract *momentum*? Energy has only a magnitude, but momentum has both a magnitude and a direction. Seeing what is going on with momentum would be even more illuminating than seeing what is happening with the energy.

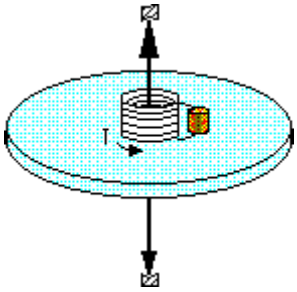
To illustrate the issues, consider the behavior of the device shown in the illustration below. The marbles are revolving at high speed in a frictionless tube which is anchored to a turntable. The turntable is initially stationary, but is able to rotate freely. The system clearly has angular momentum, but if the tube is opaque, this is not obvious to an external observer. The observer can command the gate valve to close however. When it suddenly closes, the marbles will stop "flowing" in the tube and collide with the gate valve, which is securely mounted on the turntable. This rotational equivalent of "water hammer" will cause the turntable to start rotating.



A disc has a tube full of marbles. The marbles inside the tube are rapidly revolving around the central axis of the disc inside a frictionless tube. The disc itself is stationary but is free to rotate.

If the gate valve suddenly stops the flow of marbles, will the disc start to rotate?

Now suppose we have a coil of wire (a solenoid) with current circulating through it instead of a tube with marbles. According to the "Motion Cancellers" discussion on the previous page, this system will likewise have angular momentum, but in this case, it is caused by space rotating in the wire, instead of the wire rotating in space. Suppose we command the battery to disconnect. The electric current must suddenly stop. The space revolving in the wire (electric current) comes to a halt. What then happens to the alleged angular momentum of the system? Does it just disappear? Or does it cause the turntable to rotate as in the previous (mechanical) example?



I can tell you from personal experience what will happen. You'll see a big, fat spark when the battery disconnects, but the turntable will not rotate.

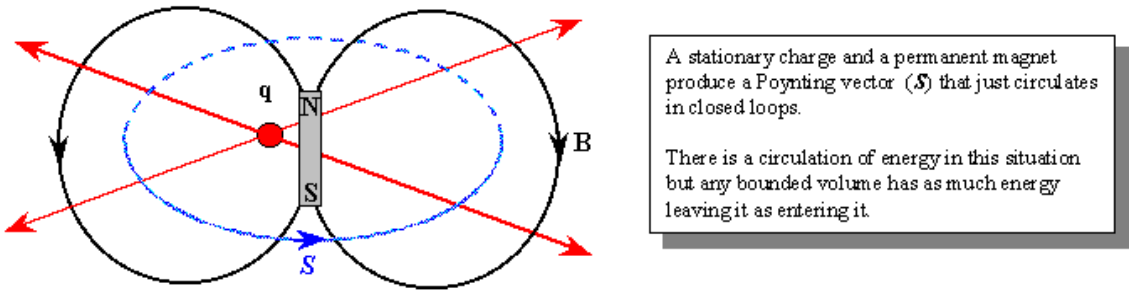
As a kid I used to play with inductors and batteries. I would connect a battery to a couple of wires from an old audio transformer, or a couple of wires from an old fluorescent light ballast. I noticed that some hookups would produce a little spark, some would produce a big, fat snappy spark, and others would produce nothing. When I got a couple of fingers across the terminals and disconnected the wire, I would sometimes get one heck of a shock. How could a little 6 volt battery and a little coil of wire produce such a high voltage?

Years later I would learn about V = L(dI/dt). This says that the voltage across an inductor is proportional to the time rate of change of the electric current. Disconnecting the wire caused the current (I) to change very suddenly. The time derivative of this is numerically large, and this causes the high voltage and fat spark. The energy which is stored in the (now) collapsing magnetic field suddenly returns to the wire.

Electrical engineers will tell you that inductors act like an electrical flywheel and capacitors act like an electrical storage tank Either can store considerable energy. When you disconnect a capacitor from a battery, you leave it with a "full tank of electric fluid" (so to speak). The energy remains stored, and does not have to go anywhere. But when you disconnect an inductor, the "flywheel" suddenly stops, and you get the electrical equivalent of water hammer. This is usually not desirable, and protective devices are inserted into circuits to dissipate the high voltage pulse. A diode, or a small lamp, for instance, will allow the current to circulate momentarily and come to a gradual stop even when the battery is disconnected suddenly.

So this little experiment demonstrates that an inductor stores *energy*, but does not specifically demonstrate storage of *angular momentum*. Mechanical momentum and electrical momentum still seem to be rather separate concepts. Yet according to the Motion Cancellers discussion (above) these should be equivalent. We should be able to show, without "cheating", that the *electrical* angular momentum can be turned into *mechanical* angular momentum by using fundamental electromagnetic principles directly, and without interposing some sort of energy conversion device like a generator.

This is NOT an intuitively easy problem to solve. However, the Poynting vector, and Feynman's comments about it, will serve to educate our intuition:

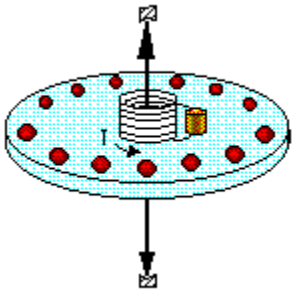


"Suppose we take the example of a point charge sitting near the center of a bar magnet, as shown in [the figure]. Everything is at rest, so the energy is not changing with time. Also, ***E*** and ***B*** are quite static. But the Poynting vector says that there is a flow of energy, because there is an ***E*** X ***B*** that is not zero. If you look at the energy flow, you find that it just circulates around and around. There isn't any change in the energy anywhere—everything which flows into one volume flows out again. It is like incompressible water flowing around. So there is a circulation of energy in this so-called static condition. . . ."

"You no doubt begin to get the impression that the Poynting theory at least partially violates your intuition as to where energy is located in an electromagnetic field. . . . The circulation of energy around a magnet and a charge seem, in most circumstances, to be quite unimportant. It is not a vital detail, but it is clear that our ordinary intuitions are quite wrong." (*The Feynman Lectures on Physics*, Vol. 2, p. 27-8)
https://www.academia.edu/28997137/The_Feynman_Lectures_on_Physics_VOL2

Remember that the sources of the E and B fields can be independent. Feynman points out that the energy (and momentum) is just going around in circles. But a circulating momentum is angular momentum. So this is kind of like a flywheel, but it is constructed from the "ether" so to speak. To extract energy from it, something has to change

With that in mind, consider a little gizmo Feynman describes. It is very similar to our problem, except that it includes some spheres that are charged with static electricity:



A plastic disc has charged metal spheres around its periphery. A small battery powers a solenoid (a coil of wire) on the disc. The disc is stationary but is free to rotate.

If the battery is disconnected and the current I stops, will the disc rotate?

> "Do you remember the paradox we described in Section 17-4 about a solenoid and some charges mounted on a disc? It seemed that when the current turned off, the whole disc should start to turn. The puzzle was: Where did the angular momentum come from? The answer is that if you have a magnetic field and some charges, there will be some angular momentum in the field. It must have been put there when the field was built up. When the field is turned off, the angular momentum is given back. So the disc in the paradox *would* start rotating. This mystic circulating flow of energy, which at first seemed so ridiculous, is absolutely necessary. There is really a momentum flow. It is needed to maintain the conservation of angular momentum in the whole world." (p. 27-11)

(Of course, this is not a good way to make an electric motor. Motors must operate continuously.)

What really seems to matter in all this is, not just power flow, but ***momentum*** density. Says Feynman:

> "There is an important theorem in mechanics which is this: whenever there is a flow of energy in any circumstance at all (field energy or any other kind of energy), the energy flowing through a unit area per unit time, when multiplied by $1/c^2$, is equal to the momentum per unit volume in the space. In the special case of electrodynamics, this theorem gives the result that **g** is $1/c^2$ times the Poynting vector:
>
> $$\mathbf{g} = 1/c^2\,\mathbf{S}$$
>
> So the Poynting vector gives not only energy flow but, if you divide by c^2, also the momentum density."

In a charging cylindrical capacitor, or even a current in a resistance wire, the Poynting vector is directed radially inward, and therefore the momentum is likewise. The radial components balance out, and so in the case of the resistance wire, heat, not mechanical motion is the result. If the capacitor is asymmetrical the momentum components will not balance as in the radial case, and there will be "leftover" momentum pointing in some direction.

The c^2 factor suggests enormous electric and magnetic fields will be required for "motional effects". But momentum is also related to radiation reaction, and that in turn, according to Feynman, is related to the third time derivative of position (something engineers and physicists call "jerk") of the electric charge used to produce the radiation. (Feynman, Vol 2, p. 28-7) The "back reaction" force on a radio antenna emitting 1 kW of radiation is equivalent to the weight of a few fleas. But these systems use sinusoidal acceleration fields and the "jerk" is relatively mild, and the charge motion is cyclic. In contrast, the fields in experiments giving levitation effects are described as very intense, unidirectional, and pulsed in such a way that the "jerk" on the charge has an extremely high value.

See also:

"Impulse Gravity Generator Based on Charged YBa2Cu3O7-y Superconductor with Composite Crystal Structure", Evgeny Podkletnov, Giovanni Modanese
http://xxx.lanl.gov/abs/physics/0108005
http://lanl.arxiv.org/PS_cache/physics/ps/0108/0108005v2.figure1and2.jpg (current as of Sept 2012)
http://lanl.arxiv.org/PS_cache/physics/ps/0108/0108005v2.figure3.jpg (current as of Sept 2012)
http://lanl.arxiv.org/PS_cache/physics/ps/0108/0108005v2.figure5.jpg (current as of Sept 2012)
http://lanl.arxiv.org/PS_cache/physics/ps/0108/0108005v2.figure4.jpg (current as of Sept 2012)
http://lanl.arxiv.org/PS_cache/physics/ps/0108/0108005v2.figure6.gif (, current as of Sept 2012)
http://lanl.arxiv.org/PS_cache/physics/ps/0108/0108005v2.figure7.gif (current as of Sept 2012)
http://lanl.arxiv.org/PS_cache/physics/ps/0108/0108005v2.figure8.gif (current as of Sept 2012)
http://www.youtube.com/watch?v=AgyAFElQZcU&feature=related

These illustrations simply show that motion of mass through space, and motion of space through mass have analogous behavior.

The physics of electromagnetism has a lot of concepts that seem strange and awkward on first encounter. The physics of space/time ratios and the concepts of multidimensional motion will, hopefully, allow you to become more comfortable with these concepts.

"The problem of creating something which is new, but which is consistent with everything which has been seen before, is one of extreme difficulty. "
(*The Feynman Lectures on Physics*, Vol. II, p. 20-10 to 20-11)
https://www.academia.edu/28997137/The_Feynman_Lectures_on_Physics_VOL2

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See also:

"Observation of Static Electromagnetic Angular Momentum *in vacuo*," Graham and Lahoz, Nature V. 285, May 15, 1980, p.129;

"Although this result is to be expected by classical electromagnetism, it leads inexorably to the acceptance of the physical reality of the Poynting vector, even though **E** and **H** arise from independent sources. . . . permanent magnets and electrets can be used to build a flywheel of electromagnetic energy steadily flowing in circles in the vacuum gap of a capacitor as if Maxwell's medium were endowed with a property corresponding to superfluidity."

"Engineering the Zero-Point Field and Polarizable Vacuum for Interstellar Flight ", H.E. Puthoff, S.R. Little, and M. Ibison http://www.stealthskater.com/Documents/Puthoff_1.pdf :

"This raises the issue as to whether static (i.e., non-propagating) **E**x**H** fields also constitute momentum (as the mathematics would imply), and in particular whether changes in static fields could result in the transfer of momentum to an attached structure. As it turns out, the answer can be yes as illustrated in the example of the Feynman disk paradox. . . . Even though nothing is apparently in motion, if we take the **E**x**H** momentum concept seriously, it would appear that there is angular momentum "circulating" about the disk in the static fields. . . ."

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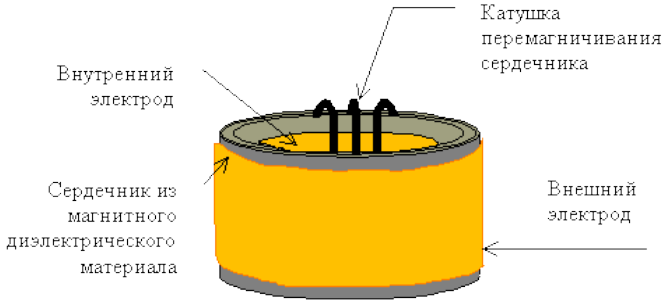
https://www.academia.edu/29960224/The_Feynman_Lectures_on_Physics_Vol_II_Electromagnetism_and_Matter

https://www.semanticscholar.org/paper/Feynman-Cylinder-Paradox-Belcher-McDonald/07c641170895661ee59668cc6b7e078465efc8a2

https://www.semanticscholar.org/paper/Electromagnetic-Field-Angular-Momentum-of-a-Charge-McDonald/07a66f870f61dece8256e752dcb973ccd081c477

More gizmos to think about



Rice.3. Scheme of a device capable of performing an unlimited (infinite) movement in space due to the non-reactive force created in it
http://ivanov-georgij2010.narod.ru/amper/neutron.html

1. D.G. Lahoz, G.M. Graham Can. J Phys. Vol. 57, 1979, p. 667
2. G. P. Ivanov, Yu. G. Ivanov. Way to get traction. RF patent No. 2172865, M., 2001.
3. Physical encyclopedia, ed. Prokhorova et al. M., 1998, v. 5, p.522(2)

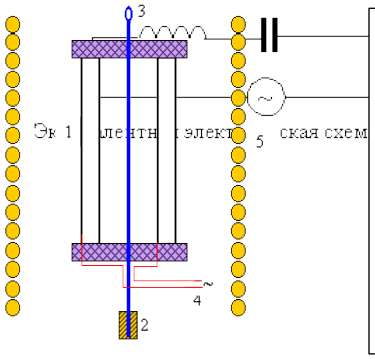


Fig. 1. 1 - cylindrical capacitor, 2 – torsion-oscillator system, 3 – mirror for optical lever, 4 – radial leads, 5 – superconducting solenoid.

The authors write: "Our programme of measurement of forces related to electromagnetic momentum at low frecuencies in matter has culminated in the first direct observation of free electromagnetic angular momentum created by quaststatic and independent electromagnetic fields E and B in the vacuum gap of a cylindrical capacitor. A resonant suspension is used to detect its motion. The observer changes in angular momentum agree with the classical theory within the error of ~20%. This implies that the vacuum is the seat of something in motion 5 vhenever static fields are set up with non-vanishing Poynting vector, as Maxwell and Poyntin foresaw." Fluctuations are present only with the alternate intensivity E. https://vixra.org/pdf/1407.0076v5.pdf

"Asymmetry and Energy in Magnetic Systems",
http://www.steorn.com/images/asymmetry-and-energy-in-magnetic-systems.pdf

> "This document provides an overview of tests conducted on asymmetric permanent magnetic arrangements in closed loop trajectories. . . .
>
> The test results documented in this section demonstrate that asymmetry with a linear MH relationship always produces a zero energy result. Symmetry with a non-linear MH relationship always produces a zero energy result.
>
> However, the key principle demonstrated in these experiments is that asymmetry with a non-linear MH relationship can produce energy results that are non-zero. The results also show that there is a clear relationship between the level of asymmetry and the energy result."

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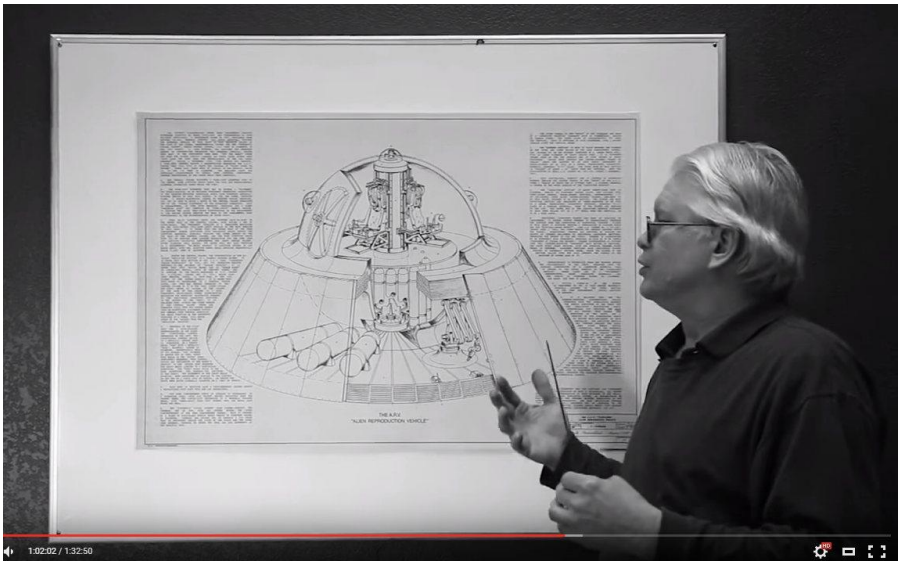
Get out the popcorn and watch the movie below:

"Zero Point - The Story of Mark McCandlish and the Free Energy Fluxliner Space Craft"
https://youtu.be/t67876ch95M?t=2188
https://youtu.be/aJqGuEUV-Yo?t=350



"California Drones" (aka "Dragon-fly drone"*)

http://www.youtube.com/watch?feature=endscreen&v=BXpVJnpu8Ac&NR=1 http://www.youtube.com/watch?feature=endscreen&v=BXpVJnpu8Ac&NR=1

https://www.ufocasebook.com/bestufopictures10.html

http://droneteam.com/mediawiki/index.php/Chad_details ;
http://www.bibliotecapleyades.net/ciencia/ciencia_flyingobjects11.htm (separate photos)
https://www.google.com/search?q=katakana+font
http://screenrant.com/sarah-connor-chronicles-california-drones-mystery-brusimm-4647/
http://www.youtube.com/watch?v=ehxixQxVxg8
http://www.theoutpostforum.com/tof/showthread.php?831-California-type-drone-seen-in-germany
http://droneteam.com/history/yosemite/

*It is called a "dragonfly drone" because "it moves like a dragonfly". Its motion is jerky, not smooth and continuous. This is consistent with the idea that field propulsion systems would use point-to-point, start-stop navigation. As for the photos, some regard them as 'too detailed to be faked'; others regard them as 'having too much detail to be real'. (Similar claims can probably be made about the 1969 moon landings!)

Want to get your students interested in STEM programs? Have them look at these photos. Ask them if a combination of electrical and magnetic fields could be used to *fundamentally* oppose gravity.

Recommended reading for more on the Biefeld-Brown effect and related effects:

Secrets of Antigravity Propulsion by physicist Paul A. LaViolette (2008).

"Progress in Electrogravitics and Electrokinetics for Aviation and Space Travel", Thomas F. Valone, presented at the Space Tech. App. Info. Forum, Albuquerque, NM; http://users.erols.com/iri/ProgressElectrograviticsElectrokinetics.PDF , http://www.integrityresearchinstitute.org/

Electrogravitics Systems, Vol I, Thomas Valone, 6th ed., 2008

Electrogravitics II, Thomas Valone, 3rd ed., 2008

T.T. Brown's Electrogravitics Research, Thomas Valone, Integrity Research Institute

https://www.researchgate.net/publication/271560470_Electrokinetics_as_a_Propellantless_Propulsion_Source

T.T. Brown Family web site, http://www.qualight.com/portal.htm/brown/

"Electric Flying Machines", T.T Brown, http://www.bibliotecapleyades.net/ciencia/ciencia_flyingobjects25.htm

"Electrogravitics systems reports on a new propulsion methodology", Thomas Valone, 2001; http://www.bibliotecapleyades.net/archivos_pdf/electrogravitics_systems.pdf

"Can Electricity Destroy Gravitation?", Prof. Francis E. Nipher Electro-Gravitic Experiments, (1918) http://www.rexresearch.com/nipher/nipher1.htm

"Theoretical explanation of the Biefeld-Brown Effect",Takaaki Musha, http://www.thelivingmoon.com/41pegasus/03PDF_files/Biefeld_Brown_Effect.pdf

"Explanation of dynamical Biefeld-Brown Effect from the standpoint of ZPF field", Takaaki Musha http://jnaudin.free.fr/lifters/musha/Musha.pdf

"Force on an Asymmetric Capacitor", Thomas B. Bahder and Chris Fazi, March 2003.http://arxiv.org/ftp/physics/papers/0211/0211001.pdf

"Asymmetric capacitor operating in high vacuum", http://www.youtube.com/user/hec031 (in this experiment the direction of thrust is towards the negative, smaller electrode. Max voltage was 18kV @ 3 micro amp)

"Study on the influence that the number of positive ion sources has in the propulsion efficiency of an asymmetric capacitor in nitrogen gas", A A Martins1 and M J Pinheiro2, http://arxiv.org/ftp/arxiv/papers/1009/1009.6111.pdf

"T. T. Brown's 1955-1956 Paris Experiments Revealed", http://starburstfound.org/electrograviticsblog/?p=49

Brown's patents:

A Method of and an Apparatus or Machine for Producing Force or Motion (Nov. 15, 1928) British Patent 300311; "How I control gravitation" http://www.rexresearch.com/gravitor/gravitor.htm

Electrostatic motor (1934-09-25, http://www.freepatentsonline.com/1974483.pdf

Electrokinetic apparatus (1960-08-16) http://www.freepatentsonline.com/2949550.pdf

Electrokinetic transducer (1962-01-23) http://www.freepatentsonline.com/3018394.pdf

Electrokinetic generator (1962-02-20) http://www.freepatentsonline.com/3022430.pdf

Electrokinetic apparatus (1965-06-01) http://www.freepatentsonline.com/3187206.pdf

Electric generator (1965-07-20) http://www.freepatentsonline.com/3196296.pdf

Method and Apparatus for Producing Ions and Electrically-Charged Aerosols (1967-01-03) 3296491

Fluid Flow Control System (1970-06-30) http://www.freepatentsonline.com/3518462.pdf

(Motion of contaminants http://www.electrotechnik.net/2013/04/breakdown-in-liquids-due-to-presence-of.html)

A. H Bahnson patents:

Electrical Thrust Producing Device http://www.freepatentsonline.com/2958790.pdf

Electrical Thrust Producing Device http://www.freepatentsonline.com/3263102.pdf

http://jnaudin.free.fr/lifters/bbsv2/index.htm

George Samuel Piggott "Electro-Gravitation" references:

http://www.rexresearch.com/piggott/piggott.htm (includes a "dark belt" observation)
http://www.keelynet.com/gravity/piggott.txt
http://www.freepatentsonline.com/1006786.pdf (1911, Piggott's static generator for a space telegraph)
http://borderlandresearch.com/book/lost-science/electric-flying-machines-thomas-townsend-brown/9
http://www.ttbrown.com/forum/viewtopic.php?f=10&t=12&start=90&st=0&sk=t&sd=a

Electro and Gravo mechanical effects

What about inertia? Inertia of mass is due to temporal motion. The mass is actually moving (temporally) but this has no trajectory in a spatial reference system. Still, it resists a change in speed or direction. We call this property "inertia". Does a "motion canceller" affect inertia? Full cancellation of one (fundamental) dimension of mass would make the object act like a massless particle. Partial cancellation would show up as a weight loss, or alternatively, as an inertia loss. A magnetic effect is also possible.

Apparently, there are many electrodynamic methods of doing this. A few of these are mentioned in:

"Research needed on monopolar pulsed high voltage levitation"
https://www.academia.edu/29945834/Research_needed_on_monopolar_pulsed_high_voltage_levitationn

And apparently there are mechanical methods too.

"Anomalous weight reduction on a gyroscopes right rotation around the vertical axis of the earth", H. Hayasaka and S. Takeuchi (1989) https://www.slideshare.net/ssuser5ee816/anomalous-weight-reduction-on-a-gyroscopes-right-rotations-around-the-vertical-axis-on-the-earth https://www.newscientist.com/article/mg12517042-700-science-does-a-spinning-mass-really-lose-weight/

"Responding to Mechanical Antigravity", Marc G. Millis, Nicholas E. Thomas (2006)
https://www.researchgate.net/publication/267837612_Responding_to_Mechanical_Antigravity

Shaken sand

http://www.rexresearch.com/brown2/brown2.htm#90 :

91. Triboexcitation of Sorrento (FL) Red Sand.

Catalina Island; March 30, 1973.
Test No. 90 has been repeated today, making sure that the weighing was accurately done at the Avalon Post Office (It is now confirmed by the Postmaster, Pete G. Salamunovich).

The sample of red sand which was tested was contained (as in Sec. 90) in a glass Mason jar. In two day since the last excitation test on March 28, the weight had returned to normal; i.e., 1 lb-14-1/2 oz. It was then shaken for 30 minutes and then immediately (within 3 minutes) weighed. It then weighed less than 1 lb-4-1/4 oz, having lost at least 1/2 oz, possibly 0.3 oz.

This loss of weight (if 0.3 oz is considered) represents a greater degree of excitation than that recorded in Test 90. This may have been expected, as the duration of shaking was increased 10 minutes. This represents a loss of weight of 1 part in 101.6 or 0.984%. This represents an excitation of 9.84 millighos or a value of g approx 970.6 cm/sec^2 !

This apparent confirmation is intriguing, to say the least!

T.T. Brown (3-30-73)
Witnessed: J.P. Quillin (3-30-73)

Gyro drop experiment

"Aether Vibrations-A Wave Based Universe" (2012)
http://www.bibliotecapleyades.net/ciencia/ciencia_fisica36.htm ;
http://exo-science.com/aspden.html

A very remarkable phenomenon that Kozyrev discovered by rotating gyroscopes is that they lose very small but measurable amounts of weight. Also firmly shaking objects could make objects lose weight. Now from our current understandings of physics this is quite impossible! It violates all physical laws, how can solid matter lose weight when it is spun at high speeds or shaken?

• • •

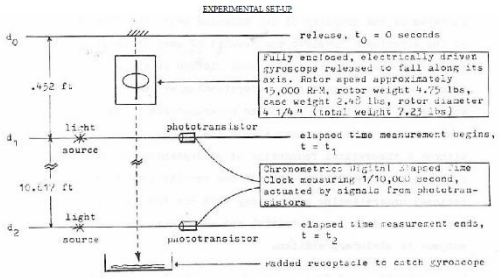
Dr. Harold Aspden of Cambridge University discovered a related phenomenon. He attached a powerful magnet to a gyroscope and spun it at high speeds. He measured the amount of energy required to accelerate the gyroscope to full speed to be a 1000 Joules. Now to his surprise when he stopped the gyroscope from spinning and restarted the gyroscope to spin again within 60 seconds after it stopped, it required 10 times less energy to spin the gyroscope to the same speed.

https://depalma.pairsite.com/gyrodrop.html

"In this experiment a fully enclosed, electrically driven gyroscope is released to fall freely under the influence of gravity. The elapsed time taken to fall a measured distance of 10.617 feet was measured, with the rotor stopped and also with the rotor spinning at approximately 15,000 RPM.

Data was gathered on a Chronometrics Digital Elapsed Dime Clock measuring 1/10,000 second, actuated by two phototransistor sensors placed in the paths of two light beams which were consecutively interrupted by the edge of the casing of the falling gyroscope.

The gyroscope, of total weight 7.23 lbs (rotor weight 4.75 lbs, case weight 2.48 lbs) was released to fall along its axis. Electrical leads supplying power to the 41/4" diameter rotor were disconnected just prior to release."



"A hypothetical, fictitious force increment which would have to be applied to the non-rotating gyroscope to impart the increased acceleration noticed in its rotating mode, was calculated for comparison purposes.

Force increment: $\Delta F = (F_R - F_{NR}) = .024$ lbs. = .38 oz "

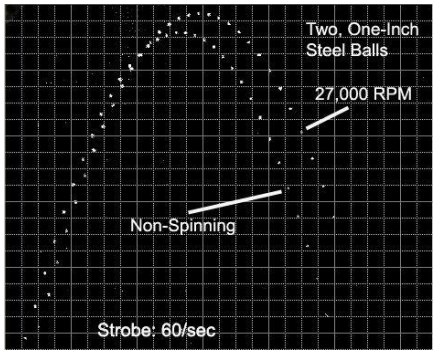
(Alternatively, the increased acceleration of the gyro when rotating could be due to a slight decrease in inertia; the gravitational field itself was constant. Note that this effect is independent of *weight*: a hammer and a feather will fall at the same rate in a vacuum.

———

DePalma Spinning ball experiment

Bruce DePalma is also remembered for his spinning ball experiment

> . . . early on Bruce introduced me to the simplest - yet, probably, the most profound - of all his many rotational experiments. He just called it (fittingly...) "the spinning ball."
>
> Conceptually, the experiment could not have been much cheaper, or easier to carry out:
>
> Two 1-inch steel balls (like those found in every pinball machine in America...) were positioned at the business end of an ordinary power drill; one ball was in a cup attached to the drill's motor shaft, so it spun - at a very high rate of speed; the other ball was in an identical cup, attached by a bracket to the stationary drill casing, adjusted so that it was level with the first ball.
>
> The experiment consisted of positioning the drill vertically, cups "up," and pressing the drill switch on the motor.
>
> The drill motor (and its associated cup, containing one of the steel balls) rapidly spun up to approximately 27,000 RPM. The cup attached to the side of the drill (with the second steel ball inside it...) was not rotating...
>
> When the drill motor had attained its maximum speed, DePalma (or, more often, Ed Delvers, his assistant...) would shove the drill into the air with a fast, upward motion - suddenly stopping the drill it in mid-flight. This would, of course, cause both 1-inch pinballs to fly out of their retaining cups in the same upward direction - the "spinning ball" (hence the name...) and the non-spinning ball, right beside it.
>
> DePalma, from his years spent working with Dr. **Herald Edgerton** at MIT - the famed inventor of "stroboscopic photography" - was an expert in such stop-motion photography as well.
>
> By positioning Delvers against a gridded black background, in a darkened laboratory (below), and then illuminating the two upward-flying steel balls with a powerful strobe light, DePalma was able to take time-exposure photographs with the camera's shutter open, the "pin-balls" only illuminated (at 60 times per second) by the strobe's periodic flash...
>
> The result was a striking "stroboscopic, time-lapse photograph" of the parabolic arc of both steel balls - flying upward and then downward under Earth's gravitational acceleration (below).



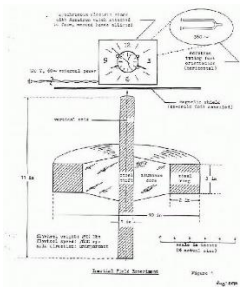
"Von Braun's 50-Year-Old Secret",
https://www.bibliotecapleyades.net/exopolitica/exopolitics_vonbraun02.htm

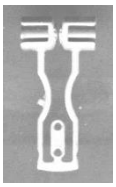
> Looked at even casually, one can instantly see in the resulting time-lapse image (above) that the two pin-balls did NOT fly along identical parabolic arcs (as they should have); unmistakably, the steel ball that was rotating (at ~27,000 rpm) flew higher... and fell faster... than the companion ball that was not rotating!
> An experimental result in direct violation of everything physicists have thought they've known about both Newton's Laws and Einstein's Relativity... for almost (in the case of Newton...) three full centuries!

(BF: I have never found "an ordinary power drill" that could output 27,000 rpm. An rpm of 2,700 is more believable).

DePalma Accutron experiment

Another one from DePalma is his famous Accutron experiment. The first (crude) version is shown below.





http://depalma.pair.com/Absurdity/Absurdity09/nature5.jpg
http://depalma.pair.com/Absurdity/Absurdity09/NatureOfElectricalInduction.html

"Simple Experimental Test for the Inertial Field of a Rotating Real Mechanical Object"
18 June 1975

Introduction: For the last five years, this investigator and others1, have studied the mechanical properties of rotating objects for the purpose of application of certain heretofore undiscovered properties of rotation . . . .

The Experiment: A good way to detect a field whose effect is a spatial inertial anisotropy is to use a time measurement based on an inertial property of space and compare it to a remote reference. With reference to figure (1) we have a situation where the timekeeping rate of an Accutron tuning fork regulated wrist watch is compared to that of an ordinary electric clock with a synchronous sweep second hand . . . .

With the flywheel spinning at 7600 r.p.m. and run steadily for 1000 seconds (17 minutes), the Accutron loses .9 second relative to the electric clock.

Much experimentation has shown that the effect is greatest with the position of the tuning fork as shown. Magnetic effects from leakage fields from the gyro drive motors are almost entirely absent; any remaining leakage is removed by co-netic magnetic shielding. The Accutron is also in a "non-magnetic" envelope.

The purpose of the experiment is a simple demonstration of one of the effects of the od [odd] field of a rotating object. The demonstration may easily be repeated using any one of a variety of rotating objects, motor flywheels, old gyrocompasses, etc. The rotating mass of the flywheels used in these experiments is 29 1/2 pounds. The rotational speed of 7600 r.p.m. is easily accessible. The effect is roughly proportional to the radius and mass of the rotating object and to the square of the rotational speed.

Finer measurements can be made using an external electrically powered tuning fork oscillator and an electronic frequency counter. In this case the inertial anisotropy of the od field of a rotating object can be much more quickly and precisely measured. Field strength lines can be plotted along contours of constant frequency shift for the two orientation conditions of fork vibration direction parallel to, and perpendicular to, the axis of rotation of the test object.

And from "Von Braun's 50-Year-Old Secret"
https://www.bibliotecapleyades.net/exopolitica/exopolitics_vonbraun02.htm

> DePalma proposed, as a result of his wide-ranging rotational experiments, that "rotating masses" in general set up some kind of hitherto unrecognized "inertial field" in their vicinity (the more widely-used term for this field now, because of how it's accessed, is a "torsion field" - because "torsion" means literally "rotation").
>
> DePalma's exhaustive measurements . . . eventually revealed that this "torsion field" was "anisotropic," i.e. it was NOT spherical (like a gravitational or electromagnetic "bubble," decreasing sharply in intensity with distance...) - but seemed to have radically different effects, and different geometric properties, depending on the geometric relationship and orientation of the detecting sensor to the axial spin of the object being measured.
>
> This new "spin field" (another term now in use...) seemed to be, as scientists term it, polarized...
>
> What this means is simple.
>
> If measured along the rotational axis (as seen in the diagram - above)... this "torsion field" from the resulting rotation seemed to increase the inertia of other moving objects (such as the tuning fork inside the Accutron); but, if the watch was rotated 90 degrees (below) - into the plane of the masses rotation - the Accutron's tuning fork inertia abruptly decreased...!

———

Motion has a both spatial component and a temporal component (not the same thing as clock time). Gravitation is mostly temporal motion. Any added spatial motion will oppose the gravitational motion. This includes linear motion, harmonic motion, rotational motion, orbital motion, even an increase in temperature. Apparently, the atoms seek a new equilibrium with the combination of the two motions; the added spatial component would express itself as a potential, and would have a sign opposite to the normal gravitational motion. The effect would be very small but would manifest itself as a weight loss or as an inertia loss, depending on the experimental method. When the added excitation, stops, this kind of motion should "decay", somewhat like a diffusion (i.e., non-directional). Hence, these experiments might not be as crazy as they at first seem.

The Ether is non-directional and so, relative to the Ether, the spin orientation does not matter. It is possible to mount two counter-rotating masses coaxially on the same shaft. The momentum vectors will cancel out, but the energy (which is scalar) still remains. Energy has the space/time dimensions of t/s and mass is t^3/s^3 . This *form* of the spin energy is, from the standpoint of the Ether, analogous to that of the intrinsic spin systems of the atom, especially the 4π spin system (which is likewise sort of a "rotationless rotation". The expected manifested effect will either be something akin to a massless particle (i.e., a reduction of inertia) or a magnetic effect. Both of these have the space/time dimensions of t^2/s^2 (massless momentum or a magnetic field).

Interestingly, we know about the Barnett effect (https://en.wikipedia.org/wiki/Barnett_effect)

> The **Barnett effect** is the magnetization of an uncharged body when spun on its axis. It was discovered by American physicist Samuel Barnett in 1915. An uncharged object rotating with angular velocity ω tends to spontaneously magnetize . . . . The magnetization occurs parallel to the axis of spin. . . . He established the effect with a long series of experiments between 1908 and 1915.

And the "Einstein-de Haas Effect"
https://en.wikipedia.org/wiki/Einstein%E2%80%93de_Haas_effect
http://encyclopedia2.thefreedictionary.com/Einstein-de+Haas+Effect

> "The **Einstein–de Haas effect** is a physical phenomenon in which a change in the magnetic moment of a free body causes this body to rotate. The effect is a consequence of the conservation of angular momentum. It is strong enough to be observable in ferromagnetic materials."

There is also the London moment (https://en.wikipedia.org/wiki/London_moment):

> The **London moment** (after Fritz London) is a quantum-mechanical phenomenon whereby a spinning superconductor generates a magnetic field whose axis lines up exactly with the spin axis

Related to this is the Tampere experiment
(https://www.bibliotecapleyades.net/ciencia/secret_projects/project124.htm):

> In 1992, an experiment at Tampere University was reported by Podkletnov [26,27]. A torroidal shaped type II superconductor disk was suspended via the Meissner effect by a constant vertical magnetic field, and was rapidly rotated by a time varying horizontal magnetic field. Masses located in a cylindrical spacial geometry above the rotating disk were found to lose up to 2% of their weight. A gravitational shielding effect is claimed.

There is a huge amount of literature and patents devoted variously to these topics. Most of it is "politically incorrect" and is ignored by our science institutions. This makes research into these topics slow, marginal, and less precise. Be discerning when reading the literature. Gravity, weight, mass, and inertia are all different things. A reduction in mass or weight will not change the rate at which something falls. A feather and a hammer will fall at the same rate in a vacuum.

See also:
Anomalous gravitational effects of rotation on spacecraft (below)
https://www.academia.edu/41485052/Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems
https://depalma.pairsite.com/index.html
https://www.bibliotecapleyades.net/exopolitica/exopolitics_vonbraun02.htm (very interesting!)
https://yandex.ru/search/ (Russian search engine)

Are gravitational mass and inertial mass equivalent?

Gravitational mass is measured as a response to acceleration under gravity. Inertial mass is measured as a response to acceleration under any force. The more mass an object has, the more it resists acceleration. According to Einstein's General Theory of Relativity gravitational mass and inertial mass are equivalent. Various precise experiments have "proven" that the two are equivalent. But these experiments did not take into account the effect of rotation on a mass.

Consider the two gyro drop experiments described above. In the first experiment, a gyro was spun up to full speed, then stopped, then spun up to full speed again. Note that "it required 10 times less energy to spin the gyroscope to the same speed". This would easily be explained by a (temporary) loss of inertia.

In the second experiment, the speed of a falling gyro was clocked between two measuring points. In one configuration, the gyro WAS NOT rotating. In the other, it WAS rotating at 15,000 rpm. The result was that the rotating gyro fell at a slightly faster speed than the non-rotating gyro. This would easily be explained by a slight loss of inertia (not mass) in a constant gravitational field.

So, Are gravitational mass and inertial mass "equivalent"? The "unequivocal" answer is that if the mass is measured under the same conditions, then the measurements are equivalent. But if one is moving, rotating, shaken, heated, etc. and the other is not, then the measurement of inertia will be slightly different.
See also
Anomalous gravitational effects of rotation on spacecraft (below)
https://www.newscientist.com/article/mg12517042-700-science-does-a-spinning-mass-really-lose-weight/

Electroaerodynamic Mitigation/Elimination of Sonic Shock Waves

There is another technology that some people regard as producing a gravitational effect but which has little to do with non-local physics or the (formal) Biefeld-Brown effect. It is an electroaerodynamic technology that reduces aerodynamic supersonic *drag* but does not produce *thrust*. Its primary application is to missile systems used by the United States, Russia, and other countries. I am mentioning it here just for clarification.

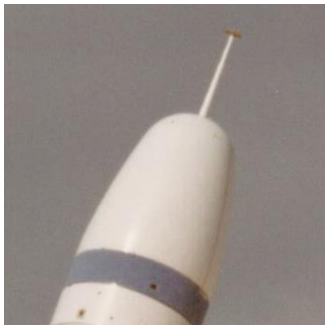
An article in *Aviation Week & Space Technology* (AW&ST, May 15, 1995 pages 66-67, titled" 'Air Spike' Could Ease Flight Problems") describes research in electroaerodynamic technology. The article says that the aerospike technology "could reduce the drag and heat transfer problems associated with hypersonic flight." It mentions that vehicles so designed could travel at Mach 25 (orbital velocity) but be subject to Mach 3 conditions in the region behind the shock wave. The ultimate goal is to build earth-to-orbit vehicles that reduce transportation costs by a factor of 100 to 1000. Such a vehicle might be "blunt bodied, lens-shaped or saucer-shaped" and would fly blunt face forward (like an Apollo heat shield). The electric energy drives the air radially away from the craft and transforms the traditional conical shock wave into a weaker parabolic one. The air behind the shock is very low in density and this reduces the heat transfer effects. The article also mentions a magnetohydrodynamic fan engine and how it could eliminate sonic booms so that a lens shaped craft "is silent but very bright in hypersonic operation." One photo and a drawing are shown.

Another article from Meridian International Research has this note (in part) about electroaerodynamic technology:

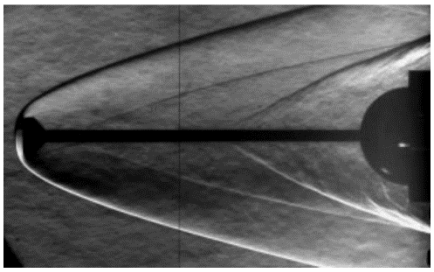
> **Electroaerodynamic Sonic Boom Elimination**
> It is already known that shock waves can be eliminated by applying an electrostatic charge to the leading edge of an airfoil. Experiments carried out by Northrop Norair in the late 1960s on a model airfoil immersed in silicone oil, showed that the intensity of the shock wave could be reduced or the shock wave eliminated altogether. The drag on the airfoil was also reduced, the drag reduction increasing exponentially with applied voltage.
>
> . . . maximum drag reduction of 0.6g was obtained at ~26kV and again at 30kV.
>
> Tests were further carried out in a supersonic windtunnel of 1.5 by 3 inch test section using Schlieren photography.In one test at Mach 1.5, an 8 degree double wedge airfoil model 1.5 inches in span and 0.375 inches in chord was used. When a charge of 70kV at 0.01milliamperes was applied to the leading edge, the shock wave disappeared. The power used was 0.7 watts.
>
> For a 20 metre span straight wing, this would equate to less than 400W of electrical power. ("Electroaerodynamic Sonic Boom Elimination", Meridian International Research, http://www.meridian-int-res.com/Aeronautics/SSonic.htm)

"Drag-reducing aerospike" https://en.wikipedia.org/wiki/Drag-reducing_aerospike

> A **drag-reducing aerospike** is a device . . . used to reduce the forebody pressure aerodynamic drag of blunt bodies at supersonic speeds. The aerospike creates a detached shock ahead of the body. Between the shock and the forebody a zone of recirculating flow occurs which acts like a more streamlined forebody profile, reducing the drag.
>
> This concept was used on the UGM-96 Trident I and is estimated to have increased the range by 550 km. The Trident aerospike consists of a flat circular plate mounted on an extensible boom which is deployed shortly after the missile breaks through the surface of the water after launch from the submarine. The use of the aerospike allowed a much blunter nose shape, providing increased internal volume for payload and propulsion without increasing the drag.



"Experimental results on the feasibility of an aerospike for hypersonic missiles", NASA Langley Research Center, *et al.*
https://www.cs.odu.edu/~mln/ltrs-pdfs/aiaa-95-0737.pdf



> A series of wind tunnel tests have been performed on an aerospike-protected missile dome at a Mach number of 6 to obtain quantitative surface pressure and temperature-rise data, as well as qualitative flow visualization data .

See also:

http://plasmastreamtech.com/technology/ (application to trucks, cars, trains, missiles)
https://www.rotaryforum.com/threads/electro-aerodynamics.1146621/

"The Northrop shock wave reduction experiment", Electroaerodynamics in supersonic flow" ,
http://jnaudin.free.fr/html/ehdaero.htm

"Validation of Plasma Injection for Hypersonic Blunt-Body Drag Reduction", J.S. Shang (2002)
https://apps.dtic.mil/dtic/tr/fulltext/u2/p014177.pdf

"Airfoil fluid flow control system", John R. Boyd (1960) http://www.freepatentsonline.com/2946541.pdf

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"Sliding discharge in air at atmospheric pressure: electrical properties"
https://www.academia.edu/2977723/Sliding_discharge_in_air_at_atmospheric_pressure_electrical_properties

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Two kinds of non-locality

There are two kinds of non-locality. One originates from a unit space boundary and the other from a unit speed boundary. The first is addressed by Quantum Mechanics, and the second is addressed partially by Special and General Relativity.

The need for Quantum Mechanics arose because the "mechanics" of the microphysical realm proved to be very different from the "mechanics" of Newton. The problem, in the oversimplified version, is that two atoms can approach each other in space until the one unit spatial boundary is encountered. At this point the atoms cannot come closer in space, because the space is fixed at one unit. There is no "inside" to this space, and therefore no spatial positions or trajectories are definable. The momentum continues in three-dimensional time but it cannot vary in space. However, time in our ordinary reference system is both scalar and non-local. Vectorial directions in three dimensional time are meaningless from the standpoint of a spatial reference system. Temporal motions in that realm map into the ordinary spatial reference system with a sort of "definite randomness". The overall behavior can be precisely predicted, but behaviors at an individual level are seemingly random. Quantum Mechanics (1925-1927) was developed to address these problems, which were not understood at the time, and which still baffle many physicists.

The other kind of non-local physics arises from a unit ***speed*** boundary. It does not have the spatial restrictions of quantum mechanics and remains non-local even at the size of stars and galaxies. The "temporal mechanics" of this region has no official name, and no official applications. It could be used to design aircraft the size of football fields that have no visible or conventional means of

propulsion. Other potential applications are incompatible with our world's political and social systems. It is perhaps fortunate that this kind of know-how remains obscure and hard to recognize by today's physicists and engineers.

We have seen that at *c*, the relationship with our reference system inverts. The measure of speed, represented by *c* (s/t) inverts and becomes energy (t/s). Instead of a matter/antimatter Universe, we have a local/non-local Universe, or a space/time and time/space Universe. Our perception of the non-local Universe, or non-local phenomena in a local setting, becomes inverted. Low density temporal stars still in the spatial system are seen as ultrahigh density stars. High frequency radiation (gamma rays) from the temporal system becomes low frequency (microwaves) from our standpoint. The intuitive relations become non-intuitive.

Example: What would non-local infrared radiation look like to our telescopes? The inversions have to be worked out in terms of unit quantities. The Rydberg frequency is a possible unit quantity for frequency. So for approximations we will take infrared as 10^{12} Hertz and Rydberg as 10^{15} Hertz. The calculation is thus $1/(10^{12}/10^{15})$ times 10^{15} or 10^{18} Hertz. That is in the X-ray range, and so there should be a diffuse X-ray background appearing in our skies. There is in fact such a background, and for a diffuse background, it is even rather bright:

> "Even the most contentious people usually agree that the night sky is dark. Don't try arguing the point with an astronomer, however. In 1962 researchers discovered that when seen through instruments sensitive to X-rays, the sky glows with a bright and oddly uniform intensity. This pervasive radiation, rather unpoetically known as the diffuse X-ray background, has eluded easy explanation. Roughly 25 to 30 percent of the background has been attributed to quasars. . . . The origin of the rest has been a persistent mystery. . . . The spectrum of the X-ray background closely resembles that of a thin, hot gas. (*Scientific American*, March, 1991, p.26, "X-ray Riddle: Cosmic background is still unexplained." See also *Astronomy*, April 1991, p.22, "X-rays Light Up Philadelphia")

See also Reference System inversion effects (below)

Special and General Relativity addressed the behavior and perception of phenomena that have high speeds but which are still below that of *c*. That met the scientific needs of 1905, when things like the diffuse X-ray background and the diffuse cosmic microwave background were not known. But both SR and GR are specifically "local" theories by design and intent: the speed of light cannot be exceeded *in space*; cause and effect are *in space* (which is conceptualized as a *connecting*, rather than separating, medium). The theories work fine for coping with reference system limitations (especially at high spatial speeds), but they are simply out-of-scope when applied to fundamentally non-local phenomena.

Example1: The speed of gravity and electric fields are clearly above that of light (as presented above). But SR insists that gravity and electric fields can propagate no faster than light speed. But in fact these fields are non-local; they have no spatial velocity at all, and act instantaneously, even over long distances.

Example2: Consider Faraday's law of induction:

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \iff \oint_C \mathbf{E} \cdot d\mathbf{l} = -\frac{d}{dt} \iint_S \mathbf{B} \cdot d\mathbf{S}$$

This says that a time-changing magnetic flux through the area enclosed by a loop of wire will induce a voltage in the loop (a principle used in the Betatron to accelerate a ring of electrons in a vacuum). In other words, a change in a magnetic flux is "felt" instantaneously everywhere by a wire loop enclosing the flux, even if the loop is extremely large. There is no mathematical term suggesting a propagation delay. In fact the integral sign, depicting a global quantity, implies that the voltages in each segment of wire appear all at once.

The out-of-scope restrictions imposed by mistaken beliefs about SR and GR limit are limiting our imagination and the actual use of non-local science.

Example: there are two kinds of position and two kinds of velocity. Remember those two terms in the non-local form of gamma? We are using only one of them for propulsion—the spatial velocity one that depends on Newtonian mechanics. The other possibility, that of non-local motion, has been left unexplored. Using that, an aircraft could move from one position in the sky to another without traversing the intervening space. It would appear at one location, then disappear, then re-appear at another location. It could move at extremely high speeds without generating a sonic boom. It would use "field propulsion" based on the non-local characteristics of electric and magnetic fields. It would be completely self-contained because there is no action/reaction (exhaust) as in conventional propulsion (in this case, the reaction forces are radial, and cancel out within the structure of the aircraft, making the preferred shape one of something with radial symmetry, like a saucer or cigar).

Utilization of field propulsion technology has been the dream of engineers and scientists for many decades. But research into such possibilities gets labeled as "science fiction" and "junk science" because of mistaken ideas about the scope of SR and GR. And there is lots of outright censorship.

Incidentally, these two different types of non-locality make SR and GR irreconcilable with quantum gravity. Gravity would "invert" at the unit space boundary

The cause of gravity

We have seen how gravity ***behaves*** and how it gives rise to numerous reference system effects. But what is the ***cause*** of gravity? We have seen that the space/time dimensions of mass are t^3/s^3. But that is not much of a clue. How does that turn into ***acceleration*** which has the dimensions of s/t^2 ? Furthermore, the t^3/s^3 seems to be saying that the overall observable motion of mass (gravitation) is "anti" to the progression of the Expansive Ether, which is s^3/t^3 from our perspective. There does not seem to be anything in these dimensions that says a planet sized chunk of mass will ***accelerate*** objects placed on its surface.

We need to know more about the structure of mass, and that can be derived from the Periodic Table.

The number of elements on each row of the Periodic Table are commonly displayed as 2, 8, 8, 18, 18, 32, 32. This can be expressed as the following pattern:

$2x1^2 = 2$ (this line is not displayed on the Table; it represents massless particles and the photon)
$2x1^2 = 2$ (this line and those below all represent actual atoms)
$2x2^2 = 8$
$2x2^2 = 8$
$2x3^2 = 18$
$2x3^2 = 18$

$2x4^2 = 32$
$2x4^2 = 32$

This makes a total of 118 elements (which, incidentally, implies a mass limit for the Table of 236 a.m.u.). The pattern is based on four integers (1,2,3,4) and squares of those integers, and a factor of 2. If we worked out all the details, we would find that any element in the Periodic Table can be designated by a set of three numbers: $\{n_1,n_2, m\}$. These three numbers apparently correspond to three discrete "physical" structures within the atom. What are they?

If the atom is going to be made from structures of space/time ratios like mass, they must evidently be the 4π and 2π spin systems (well-known to physicists). They would be organized as "shells" like in layers of an onion (spins of spins).

But is this going to answer the question of acceleration? First take this pre-employment exam for physicists: There are three controls in your car that allow you to smoothly control acceleration. Can you name them?

They are the gas pedal, the brake pedal, and the steering wheel. What? The steering wheel? Yes, a change of speed *or a change of direction* result from acceleration.

Spin is rotation and rotation is acceleration. So intrinsic spin *is* accelerated motion.

What is it that is spinning? Nothing really. Intrinsic spin is not a spin *of something*. It is just pure spin, an unusual relationship between space and time. Time progresses but the space does not (like in a centrifuge). In the ultimate reality intrinsic spin is a "direction that has no motion" and it moves against the Expansive Ether, which is a "motion that has no direction". Well, *that* is certainly Beyond Einstein!

Incidentally, the combination of these two motions—spin and translation—lead to the question of "Is it a wave or a particle"? Spin makes it a discrete physical entity (having an identity and a physical location in space). The translational motion combined with intrinsic spin, makes it look like a wave (something that varies in amplitude in space and is "spread out"). The former is addressed by Newtonian Mechanics, and the latter by Quantum Mechanics.

Much more information on the subject of the 4π and 2π spin systems is available in this article:

> "Intuitive Concepts for Atomic and Photon Spin Systems"
> **https://www.academia.edu/41485052/Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems**
> https://www.researchgate.net/publication/338293585_Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems

Anomalous gravitational effects of rotation on spacecraft

Baffling navigation problems were noticed with rotating spacecraft or spacecraft with rotating components. From the book *Hidden Agenda: NASA and the Secret Space program*, Mike Bara (2016) p. 89-93:

> "The [elliptical] orbit of *Explorer 1* . . . . came in at 225 miles , and 1,594 miles, an increase of almost *600 miles*! That's a 60% higher orbit than they expected, and it's also why the spacecraft was 11 minutes late to the tracking station."

"When *Explorer 3* was launched in March 1958, it . . . . attained a maximum altitude of 1,750 miles, more than *750 miles* higher than estimated."

"When *Explorer 4* was launched . . . it also attained an orbit nearly 400 miles higher than calculated."

"But when *Luna 1* arrived in the vicinity of the Moon, it missed by *3,700 miles* . . . ."

"Pioneer 4 was unique in that it was the first spin-stabilized satellite ever launched. . . . It ended up missing the Moon by over *37,000 miles*, more than 17 times its diameter."

"Despite this improved design, *Ranger 3* also missed the Moon by nearly 23,000 miles, or nearly *12 times* the Moon's diameter."

"*Ranger 4* was launched in April 1962 and performed flawlessly until it solar panels failed to deploy. Without solar power, the batteries were quickly drained and the spacecraft became a dead clump of metal on a ballistic trajectory toward the Moon. By all logic, without a working guidance system or the ability to make a mid-course correction, it should have missed the Moon as badly as all the other missions had. But it didn't. It actually impacted the Moon, pretty much exactly where it was supposed to!"

". . . something in the dead spacecraft was different from what was in all the "live" ones that had problems. . . . The difference was in the rotation. All of the spacecraft which had shown this anomalous overperformance had major components or subsystems which rotated at high RPMs.. In fact, there was a direct correlation between the amount and duration of the spin and the spacecraft's performance. The *Explorer 1* Juno rocket for instance had a rotating third stage. . . . The Pioneer and Ranger spacecraft were both spin stabilized and they also had rotating gyroscopic guidance systems of board. When *Ranger 4* went dead, the gyros stopped spinning and suddenly all their calculations worked, and it actually hit the Moon!"

See also Gravomechanical effects (above)

Even a rotating *Earth* has an effect on spacecraft:

As McCulloch explains, the Tajmar effect is closely related to another odd observation: the unexplained acceleration of some spacecraft. For instance, when interplanetary probes fly by the (spinning) Earth, some of them undergo unexplained jumps in velocity. In a previous paper, McCulloch showed that the MiHsC model agrees fairly well with these flyby anomalies if a spacecraft's acceleration is determined relative to all the particles of matter in the spinning Earth. He also showed that the model could explain the Pioneer anomaly: as the two Pioneer spacecraft flew out of the Solar System, they slowed down more than predicted, which can be attributed to the spacecrafts' small decrease of inertial mass, which increased their acceleration toward the Sun. https://phys.org/news/2011-07-gyroscope-unexplained-due-inertia.html ; (https://arxiv.org/pdf/1106.3266.pdf)

More on the Tajmar effect:

It has been found experimentally by [1-3] that when rings of niobium, aluminium, stainless steel and other materials are cooled to 5K and spun, then accelerometers and laser gyroscopes, not in frictional contact, show a small unexplained acceleration in the same direction as the ring, with a size $3\pm1.2\times10-8$ times the acceleration of the ring for clockwise rotations, and about half that value for anticlockwise ones. This is called the Tajmar effect and is similar to the Lense-Thirring effect (frame-dragging) predicted by General Relativity, but is 20 orders of magnitude larger and shows the added parity violation. The effect has not yet been reproduced in another laboratory. (https://arxiv.org/pdf/1106.3266.pdf)

See *illustration* https://homepage.univie.ac.at/Franz.Embacher/Rel/Thirring-Lense/ThirringLense1.pdf

See also:

"Von Braun's 50-Year-Old Secret",
https://www.bibliotecapleyades.net/exopolitica/exopolitics_vonbraun02.htm (very interesting)

"The German approach to antigravity",

http://igorwitkowski.com/The-German-approach-to-antigravity.pdf

https://en.wikipedia.org/wiki/Allais_effect (behavior of pendulums during a solar eclipse)

Hence, there is a clear indication here that gravitation (or inertia) is somehow linked to rotation. In general, *any* added spatial motion will oppose the gravitational "towards" motion. In these examples, the motion was rotational (which is regarded as absolute, not relative) and it opposes Earth's gravity. Thus, each spacecraft got an unexpected boost.

An overview of various claims about inertia or gravity reduction schemes can be found at:
Science of Oneness, David Wilcock, https://divinecosmos.com/books-free-online/the-science-of-oneness/84-the-science-of-oneness-chapter-06-gravity-magnetism-and-rotation-the-missing-link

A non-local alternative to the nuclear model of the atom

The common nuclear model of the atom is based on the concept of locality ("touching in space"), not non-locality.

Go back to Rutherford's original experiment (circa 1911) . He discovered that a material aggregate (gold foil) has an array of tiny massive objects ("kernels") in it, each containing most of the mass of the atom, and each separated by plenty of "space" (or some kind of emptiness) . What were these massive objects? The previously existing model was based on spatial contact, *viz.* atoms in an aggregate are pictured as touching each other, like billiard balls in a shoe box. The volume of a ball could be estimated by calculations from soap film experiments and by known molar volumes of metals. Rutherford found something that was 10,000 times smaller in diameter than that implied by this volume. Both pictures had factual support and so the tiny massive objects became "nuclei". Hence, the atom "has" a nucleus.

But that is not what *his* picture really showed. The tiny massive objects, which contain virtually all the mass of the atom, and ultimately account for all the properties of the atom, could be the atoms themselves! The "emptiness" is simply *between* the atoms, not *within* the atoms. Physicists could have developed a whole new different form of atomic physics if they had accepted this realization! But historically, they were neither fluent nor comfortable with the concept of non-locality.

Some years later, quantum mechanics began to be developed. It had features that clearly pointed to a non-locality model. Originally, electron orbits were thought to be clearly defined (like the orbits of planets around the Sun), but later the orbits turned into a fuzzy "electron cloud"; it was not that the electron orbits could not be found and measured, but it was that they did not *have* any sort of actual spatial trajectory in the first place. Later, more and more conceptual problems developed with the atomic electrons. It now seems that this model should be discarded and a new one created based on the concept of non-locality. Atoms exist and they can have various energy levels based on different types of intrinsic spin systems. Electrons can be an agent to express those energy levels without actually being "parts" of an atom. A conceptually "cleaner" model of the atom could lead to additional useful insights that are not readily apparent in the current model.

See
https://www.academia.edu/45461890/Atom_Or_Nucleus
https://www.researchgate.net/publication/349961631_AtomOrNucleus

https://www.academia.edu/41485052/Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems

https://www.researchgate.net/publication/338293585_Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems

The interatomic distance problem

One unit of space, as inferred from the speed of light and the Rydberg frequency, should be fixed at about 454 Angstroms or 909 Angstroms, (Ry = 3.29 x 10^{15} Hz, c = 3 x $10^{8)}$ depending on a couple of different interpretations. There are four unresolved problems with this view:

1. Interatomic distances are MUCH less than 500 Angstroms.

2. Interatomic distances vary depending on the substance under consideration.

3. Interatomic distances can vary due to external influences like pressure and temperature.

4. Condensed matter strongly resists forces of both tension and compression.

The realm of space of our ordinary experience is "gravitational space" or "non-inertial space". In this realm the Ether moves objects towards increasing spatial and increasing time separation. Gravitation in space moves them "anti" to the outward flow of the Ether, and if the gravitational motion is stronger than the Ether spatial motion, such objects will be gradually coming together. Eventually the spatial separation is reduced to one unit (the minimum possible). The Ether datum normally associates one unit of space with one unit of time (or vice versa). Each unit of space or time is different from the previous. But at unit spatial distance, the association changes. Now one unit of the *same space* is continually associating progressively with a flow of different units of time. Space is stuck at one unit but time is still progressing towards increasing temporal separation magnitudes.

This extra temporal separation has the effect of making the space seem less effective. It is similar to gravitational space, in that it is not really fundamentally *space*. It is a different type of reference system space (or "emptiness"); it is the way the quantum world relates to our ordinary world. Some sort of conversion factor will be required here. The "space " is effectively 1/t and so the ***motion*** would be (1/t)/t or $1/t^2$. (Unfortunately, things don't seem to be this simple.)

This "rubber space" concept may seem a bit strange. But you have encountered something like it before. Remember the Lorentz-FitzGerald contraction from high school physics? Here is a refresher:

> "Lorentz-FitzGerald contraction, also called space contraction, in relativity physics, the shortening of an object along the direction of its motion relative to an observer. Dimensions in other directions are not contracted. The concept of the contraction was proposed by the Irish physicist George FitzGerald in 1889, and it was thereafter independently developed by Hendrik Lorentz of the Netherlands." https://www.britannica.com/science/Lorentz-FitzGerald-contraction

Motion takes place in BOTH space and time . The spatial and temporal components can be summed together, but only if the temporal component is converted into a spatial equivalent. See gamma (above). In the quantum mechanical realm, the spatial component is fixed at one unit, but the temporal motion ("motionless motion"◊, or non-directional motion, remember?) progresses and makes the spatial separation shrink from the standpoint of an outside (common) reference system. The temporal and spatial motion apply in all three dimensions of motion ("mass" has the dimensions of t^3/s^3). Hence, in the quantum world, all three interatomic distances shrink, not just one.

And while we are on this topic, it should be noted that speeds generated by extremely energetic processes add a temporal dimension to what would otherwise be motion in 3D space with respect to (scalar) progressive time. The motion becomes dimensionally mixed, resulting in various weird effects, including "space contraction". See Transitional Space/Time below.

Item #4 clearly implies some sort of equilibrium between the Ether and gravitation.

At this unit boundary, the reference for the motion changes. The Ether flows away from the unit physical boundary, which is also towards the "zero" space of the conventional reference system. This is a kind of "pseudo space". Gravitation always opposes the motion of the Ether. Both the *Ether and gravitation continue in their normal directions*, but the ***relationship*** between them ***inverts***. In this region, the Ether acts as a force of compression, and gravitation acts as a force of repulsion.

(I had, and still have, a lot of difficulty with this picture, and "putting numbers to it" in particular. As my mind kicked it around, the phrase "Maybe it's your starter Bendix, son" kept coming to mind. My dad said this decades ago when my old yellow car would not start. The starter motor would whirr freely, but the engine would not turn over. The auto industry eventually upgraded the Bendix to an engagement solenoid and a one-way roller clutch. When the driver starts the engine, the solenoid thrusts the starter motor pinion gear into mesh with the flywheel ring gear. After the engine starts, the one-way roller clutch prevents the starter motor from being over-spun (and destroyed) by the high speed of the flywheel ring gear. Apparently, my mind was telling me that during engine start, the motor and the flywheel rotate in the appropriate directions, and then after the engine starts, they are ***still*** rotating in their same respective directions. But the ***relationship*** between the two motions inverts: the flywheel is now trying to drive the starter motor. I got the feeling that my mind knew the answer to the Ether reversal problem, but did not know how to explain it to me in a more analytical form. And that was the end of that.)

A choice of a distance metric also affects interatomic distance measurements, and we know something weird is going on with that. When certain salts are melted, the volume of the melt increases compared to the volume of the unmelted solid. This would lead us to expect that the interatomic distances in the melt would increase slightly. But in fact the distance decreases:

> "There is another important fact about the melting process. When many ion lattices are melted, *there is a 10 to 25% increase in the volume of the system* (Table 5.10). This volume increase is of fundamental importance to someone who wishes to conceptualize models for ionic liquids because one is faced with an apparent contradiction. From the increase in volume, one would think that the mean distance apart of the ions in a liquid electrolyte would be greater than in its parent crystal. On the other hand, from the fact that the ions in a fused salt are slightly closer together than in the solid lattice, one would think that there should be a small volume decrease upon fusion. How is this emptiness—which evidently gets introduced into the solid lattice on melting—to be conceptualized?" (*Modern Electrochemistry: ionics*, John O'M.Bockris, Amulya K. N. Reddy, 2nd ed, 1998, p. 611-612)
>
> "Such "volumes of nothingness" must be present to account for the large increase in volume upon fusion while at the same time the internuclear distance decreases (see Tables 5.9 and 5.10)" (Bockris, *ibid.*, p. 619)
>
> ". . . this space is counterintuitive to the internulcear distances given by X-ray or neutron diffraction. The internuclear distances found in molten salts are smaller, not bigger, as might be thought from the increase in volume." (Bockris, *ibid.*, p. 620)

It is common knowledge that when a liquid cools and turns into a solid, there is usually a change in volume. Liquid water, for example, will expand when it changes into ice. Melted paraffin, however, will contract when it cools and turns into solid paraffin. This is easily seen by filling two small beakers with liquid water and melted paraffin. When they are each cooled to solidification, the water

(ice) will have a slightly raised center (showing that it expanded) but the solidified paraffin will show a depressed or indented center, showing that it contracted. The pattern for most substances is that they expand when heated, and so the liquid is more voluminous (less dense) than the solid. Water is an obvious exception. So are the metals antimony and bismuth, which expand rather than contract when they solidify.

Regardless of what happens to the volume, we would at least expect one thing to always be true: if the substance expands, then the average distance between molecules (or atoms) should increase. If the volume gets smaller, then the average distance should decrease. Although this makes perfect sense, nature does not always accommodate our expectations. Crystalline potassium chloride (a common dietary salt substitute) when melted, will increase in volume some 17%. That the "fused salt" has greater volume than the solid crystal at the same temperature might not be a surprise to most people. But it *is* surprising that the average distance between ionic centers is 326 picometers for the solid form, yet only 310 for the liquid form. The liquid is *more* voluminous but has *smaller* distances between its atomic constituents. The distances are measured by X-ray and neutron diffraction.

The following tables illustrate this situation with some common ionic salts:

Table 5.9
Internuclear Distances in an Ionic Crystal and the Corresponding Fused Salt

	Distance between Oppositely Charged Ions (picometers)	
Salt	Crystal, m.p.	Molten Salt
LiCl	266	247
LiBr	285	268
LiI	312	285
NaI	335	315
KCl	326	310

Table 5.10
Volume Change on Fusion

Substance	% Increase of Volume on Fusion
NaCl	25
NaF	24
NaI	19
KCl	17
$CdBr_2$	28
$NaNO_3$	11

(Partial tables from *Modern Electrochemistry: ionics*,
John O'M. Bockris, Amulya K. N. Reddy,
2nd ed, 1998, p. 611, 613)

Explanations are offered for this difficulty, but they seem to boil down to little more than a restatement of the problem in terms that make it look like a solution.

The problem may also be appearing in astronomy in the form of ultradense structures that expand over time. This would apply to condensed matter (stars and planets) but is not limited to them. Some articles:

"Global Expansion Tectonics a More Rational Explanation", James Maxlow
http://tmgnow.com/repository/global/expanding_earth.html

"The Expanding/Growing Earth", David Bressan (2011)
http://historyofgeology.fieldofscience.com/2011/01/expandinggrowing-earth.html:

> "A much stranger idea to explain the assumed phenomena was proposed by the German physicist Pascual Jordan in 1966 - the increase of earth was imputable to the general dilatation of the space-time continuum."

"In 1966, Jordan published the 182 page work *Die Expansion der Erde. Folgerungen aus der Diracschen Gravitationshypothese* (The expansion of the Earth. Conclusions from the Dirac gravitation hypothesis)[4] in which he developed his theory that, according to Paul Dirac's hypothesis of a steady weakening of gravitation throughout the history of the universe, the Earth may have swollen to its current size, from an initial ball of a diameter of only about 7,000 kilometres (4,300 mi)." http://en.wikipedia.org/wiki/Pascual_Jordan "

Real, satisfying answers to these problems have not been found and more research is needed.

A Brief Cosmology

Professional astronomy has access to an enormous amount of observational data and extraordinary technology. But the theories that should unify and explain the observations are so "fact impervious" and so outright ridiculous, it is hard to believe that astronomers and physicists take these ideas seriously. Yet, they are published in peer reviewed, respected, professional journals. Some samples:

- Space is warped and can have holes in it.
- Space transmits gravitational waves
- Speeds greater than light are forbidden instead of common
- Stars power themselves by converting hydrogen to helium
- Stars can gravitationally collapse
- Stars can be made of neutrons
- Some rotating stars beam light like a light house
- Young stars are believed to be old
- Astronomical synchrotron radiation is very common

Your taxes are at work here! YOU are paying for these fantasies!

As part of a "pot stirring exercise" some common sense alternatives are presented below.

The Expansive Ether and the "Big Bang"

Beyond Einstein: non-local physics (2nd ed.) offered simple explanations for the nature and behavior of gravity, the stability of galaxies and globular clusters, Dark Matter, the EPR paradox, the twin paradox, the constancy of the speed of light, the concept of non-directional motion, the negative result of the Michelson–Morley experiment, the wave-particle duality, observational effects of accelerated

reference systems, etc.—all on the general theme of non-local physics. Additionally, some suggestions on atomic structure were published at
https://www.academia.edu/41485052/Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems
https://www.researchgate.net/publication/338293585_Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems

The key to these explanations was the concept of an "Expansive Ether". This was *not* the *static* Aether of the late 1800s. Instead it is a *dynamic progression* of space and time in three independent directions. It is a fundamental type of "non-directional motion" (a.k.a. "scalar motion"), and apparently serves as the "nothing datum" for the *physical* Universe.

People usually agree that space is three-dimensional and that time progresses. Additionally, astronomers are seeing clues that space progresses like time, except that the progression of space is three-dimensional (witness their use of terminology like "Dark Energy", "expansion of the Universe"). To construct the Ether, we only need to add that time itself is also three-dimensional.

The Ether is thus more like an empty framework, not a medium. It cannot be warped, bent, polarized, etc. It does not have Black Holes, White Holes, Worm Holes, or variable index of refraction. It is homogeneous and isotropic in its properties. Upon reflection, the concept seems almost self-evident to anyone not enculturated and blinded by today's fictional "science".

The preferred terminology to describe it is space/time or time/space ***but not space-time***. The short hand notation is s^3/t^3 and t^3/s^3, respectively. Note the three dimensions of space and time each. More importantly, note that the ratio itself is three dimensions of *motion*, which could be denoted as $(s/t)^3$ or $(t/s)^3$.

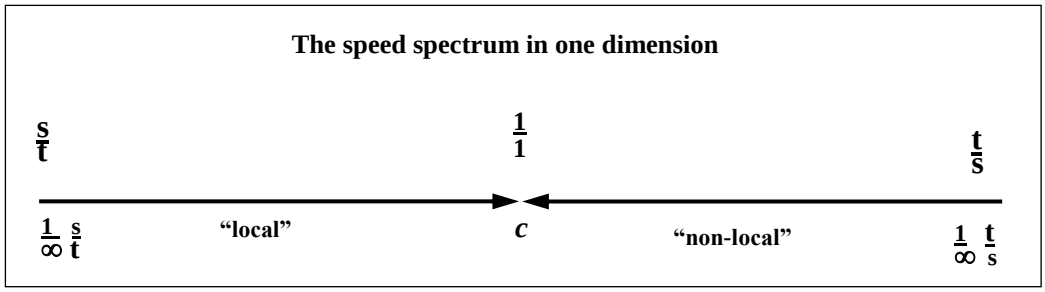
The Expansive Ether (s^3/t^3) sweeps locations "away" in *all directions* from *every* ***initial*** *location* at the speed of light. The spatial manifestation is that of a linear, *centerless* expansion of the Universe; no spatial location has any special status, like the center of an explosion would have. If a group of photons were to originate in this environment, they would be swept outward and away from their original locations. Directions are initially random (spherically distributed) but become definite and specific from the standpoint of a conventional reference system. The photons are carried along in the Expansive Ether and do not experience the flow of space or time. A photon, from its own standpoint, pops into existence and goes out of existence in one single act.

For decades the "Big Bang" explanation for the expansion of the Universe was the favorite of astronomers. It is losing favor today, as the "Hubble expansion" (Dark Energy) is more and more regarded as a property of space itself. In fact, the explosion explanation should have been discarded back in the 1940s:

> "In December 1941, Hubble reported to the American Association for the Advancement of Science that results from a six-year survey with the Mt. Wilson telescope did not support the expanding universe theory. According to an LA Times article reporting on Hubble's remarks, "The nebulae could not be uniformly distributed, as the telescope shows they are, and still fit the explosion idea. Explanations which try to get around what the great telescope sees, he said, fail to stand up. The explosion, for example, would have had to start long after the earth was created, and possibly even after the first life appeared here."[45][46] (Hubble's estimate of what we now call the Hubble constant would put the Big Bang only 2 billion years ago.)" https://en.wikipedia.org/wiki/Edwin_Hubble

For our purposes, the Expansion occurs at the rate of one unit of space per one unit of time (1/1), which is presumed to be the speed of light. The numerator and denominator are always increasing numerically, but the *ratio* remains constant. This unchanging value is a type of "zero datum" without being a numerical zero. Numerical displacements away from the 1/1 ratio can be identified as "not

nothings" (particles, or some type of phenomena). The effect of progressive time in the denominator negates the effects of progressive space in the numerator. Fundamentally, from the standpoint of a "natural" reference system, the Universe is "doing nothing" —neither expanding nor contracting— at the speed of light. (And that, incidentally, has some strange reference system effects.) But from the standpoint of a *spatial* reference system, the Universe is expanding.



This diagram shows a simplified speed spectrum in the framework of the Expansive Ether. The left half shows the range of (spatial) speeds of our ordinary experience. This is the "local" or spatial realm of planets, stars galaxies, etc. Gravity operates here to make things appear stationary spatially, but mass, as explained in *Beyond Einstein*, is still "moving" temporally at the speed of light. The type of speed in this section can be a mixture of spatial and temporal speeds. Spatial speeds are described by vector equations; temporal speeds are non-directional and are described by diffusion equations, wave equations, and the inclusion of concepts like entropy.

The right half depicts speeds greater than that of light. This realm is "non-local" from the standpoint of a spatial reference system. That system would look statistically identical to the spatial system if it could be viewed from an observer within that system. It is presumed to have planets, stars, galaxies, etc., but all the space and time relationships are inverted from our standpoint (instead of "antimatter" it is "inverse matter"). Speed (s/t), a change of spatial position with respect to progressive time, is a measure of motion in the spatial realm but in the temporal realm (where space is scalar) it is energy (t/s). From our standpoint all its structures are dispersed in space and move at the speed of light. We see its contents as a more-or-less uniform "background" of cosmic rays, cosmic microwaves, the diffuse gamma ray background, the X-ray background, the ultraviolet background, the visible light background, etc.

The left and right ends depict zero speed in space and in time, respectively. But the "zero" is understood to be, for example, one unit of space associated with an unlimited amount of time (there is no actual, numeric "zero speed" anywhere, ever; "zero speed" is actually a reference system concept that is not used by nature). At the center of the diagram, the spatial and temporal speeds are equal and are assigned a value of 1/1 (i.e., one unit of space per one unit of time, or vice versa), which is presumed to be the speed of light. The extreme left and right ends of the spectrum are therefore separated by 2c.

Three quantization boundaries are apparent in this diagram. At the left is a unit space limitation on speed. This is the realm of Quantum Mechanics where all activity is temporal, and spatial trajectories cannot be defined. It is still within the overall spatial system. At the center is a unit speed boundary. This is the region of some strange reference system effects and some extremely weird physics that do not have the spatial limitations of Quantum Mechanics. The extreme right is a realm of spatial activity that is within the overall realm of non-locality; there is speculation about whether "happenings" in

this realm can momentarily localize into the (left-side) spatial system. This is also the "zero temporal speed" end of the spectrum and, from the spatial standpoint, represents extremely high energies (say 10^{20} eV; for a single particle, that is an energy equivalent to that of a baseball moving at 60 mph). Extraordinarily high mass densities are also possible (1000 kg/cc). The extreme right of this spectrum can also be viewed as infinite spatial speed (in other words, instantaneous action-at-a-distance). Such speeds are manifest in phenomena such as gravitational fields (t^3/s^3), magnetic flux (t^2/s^2) and electric charge (t^1/s^1).

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Readers may ask: "Is the space we perceive the same thing as the spatial component of the Expansive Ether?"

No, it is not. The space of the Ether moves all locations apart at the speed of light. You, your desk, your house, etc. are not flying apart in all directions at the speed of light. The "space" we perceive is actually a manifestation of a *gravitational* reference system. Likewise, the perceived characteristics of "free space impedance" and permittivity, and permeability, and apparently even the *measured* speed of light attach to the same reference system.

———

Readers may ask, "Where Is The Center of the Universe?"

This question was asked in a science magazine. (*Popular Science* 4-20-2012, by Rose Pastore http://www.popsci.com/technology/article/2012-04/fyi-where-center-universe)

> "First, it's important to know that the big bang wasn't an explosion of matter into empty space--it was the rapid expansion of space itself. This means that every single point in the universe appears to be at the center. . . . In the beginning, the universe was a single point. Where was that? It was, and still is, everywhere."

This anywhere/everywhere location of a "center" clearly has a non-local character. Said differently, it is simply a centerless expansion. And following that line of thought leads to the conclusion that it is also edgeless. The edge must be everywhere too. We cannot say "the Universe stops here—at the Edge" because the Expansion does not stop or have a boundary, neither in space nor in time. The amount of mass in the Universe can still be finite, but very extremely distant galaxies probably become non-local from our standpoint much like the cosmic ray background.

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Readers may wonder: Experiments have been devised to make time seem to slow down. Is it possible to make time seem to speed up?

———

Transitional Space/Time

◊Note that the above diagram depicts *one*-dimension of *motion*. But motion can have *three* dimensions. If speeds become great enough to exceed the speed of light, an additional dimension (or two) of time can become active. The resulting motion is thus a mixture of spatial and time components that are foreign to our everyday experience. This kind of motion could be said to be a mixture of locality and non-locality. Objects possessing this kind of motion will have a baffling appearance in the common spatial reference system. They may appear ultradense (e.g., white dwarf stars). They may regularly divide their radiation between spatial and temporal systems (e.g., pulsars). They may disappear from view, then later re-appear. The gamma and X-rays they emit may also be detected as microwaves. Due to dimensional effects the radiation is usually polarized, with

subsequent partial depolarization in interstellar space. They may show extremely high redshifts in their spectra (e.g., quasars) This natural non-locality is due to extremely energetic processes.

There can also be an artificial non-locality due to technological application of electric and magnetic fields. This may explain some of the UFO and UAP sightings. But that subject is out-of-scope here. See:

https://www.academia.edu/29945834/Research_needed_on_monopolar_pulsed_high_voltage_levitation

https://www.researchgate.net/publication/319002136_Research_needed_on_monopolar_pulsed_high_voltage_levitation

"Review of Electrogravitics & Electrokinetics Propulsion", Thomas F. Valone (2015) *International Journal of Geosciences*, 6, 413-428. http://file.scirp.org/pdf/IJG_2015042015204020.pdf
http://dx.doi.org/10.4236/ijg.2015.64033

No astronomical synchrotron radiation

Astronomers need an explanation for polarized, non-thermal radiation (a.k.a. "continuum radiation") found in Active Galactic Nuclei, galactic radio emission (halo and disk), quasars, pulsars, shells of supernova remnants, etc. They seem to have settled on the idea of "synchrotron radiation" which has the right characteristics and is well known to physicists. Although this kind of radiation can be produced in a laboratory setting, there are serious problems with producing it in the natural Universe, namely:

1. production requires relativistic electron beams
2. production requires large scale, powerful magnetic fields
3. production requires a stable source of enormous energy that lasts for millions of years
4. production requires sources that are abundant and widely distributed

The Universe just does not have anything like this. Astronomers need to devise a much better explanation for non-thermal radiation.

See Nonthermal Radiation below.

The "Gravipause"

Einstein recognized that a "static" Universe (the accepted view in the early 1900s) could not be a stable one. The Universe would eventually collapse due to the action of gravitation. To counter that problem, Einstein introduced the "cosmological constant" to General Relativity in 1917. It represents what is now viewed as "dark energy" which keeps the Universe from collapsing. However, it was recognized that its inclusion still did not lead to a static Universe, because the equilibrium was unstable. If stars moved closer, the gravitational force would increase, moving closer still. If stars moved farther apart, then the gravitational effect would be lessened, and "dark energy" would more readily move them even farther apart. The whole situation was unstable, and to this day the cosmological constant is still regarded as an "outstanding theoretical challenge" in cosmology.

In 1929 Edwin Hubble uncovered evidence that the Universe is actually expanding. Decades ago, this was thought to be caused by a "Big Bang" that blew a tiny dense something-or-other apart, resulting in the observed Universe and its redshifts. Besides being ridiculous, the Cosmological Principle points to an additional problem with that view. If everything is supposed to look statistically the same

from all viewpoints, then observers in other galaxies must be seeing the same kind of redshift behavior. In other words the redshift must result from a ***centerless*** expansion of space, not from an explosion.

The view that is gaining currency today is that space itself expands or is "emergent" (new spatial units are being generated by some unknown process). It is like time, in that it progresses. But it progresses in three dimensions, and we call that an expansion.

Opposing the expansion is gravitation, which is centered on an object (planet, star, galaxy). We interpret the resulting motions in terms of forces, the cosmological expansion force, which is not affected by distance, and the gravitational force, which has a $1/d^2$ dependence. Because of this, there is necessarily a distance where the forces are at equilibrium, a distance I call the "Gravipause" (which, in this definition, involves only ***one*** body, and space itself). For stars it is apparently a few light years, and for galaxies it is apparently a few million light years. Inside this distance, objects come together, and outside this distance, objects move apart. This is the "beyond Einstein" view that reconciles the issues of stability and instability. It explains why globular clusters are stable, even though they do not rotate sufficiently to keep them from collapsing (individual stars in the cluster are outside each other's gravitational limit, but not outside the limit of the cluster as a whole). It explains why stars are separated by light years, but not by light weeks. It may explain some of the problems in calculating the Hubble constant, because the "constant" would be dependent on the location from which the observations are made (a large versus small galaxy). And the Big Bang now needs to be thrown in the trash can, especially since there are other explanations for the diffuse microwave background, the diffuse gamma ray background, diffuse X-ray background, the diffuse ultraviolet background, the diffuse visible light background, and the diffuse cosmic ray particle background, etc.)

Gravitation seems to have three regions. Gravitational force near a star starts out strong but declines rapidly with distance (the $1/d^2$ region). At the Gravipause, gravitation is still present, but falls off less rapidly (the $1/d^1$ region, or "Hubble space" as it could be called). Far beyond that, quantization causes the gravitation to disappear completely (the $1/d^0$ region, where it does not decrease at all, because there isn't any).

Alternatives to Newton's gravity (MOND theories)

"Milgrom noted that this discrepancy could be resolved if the gravitational force. . . came to vary inversely with radius (as opposed to the inverse square of the radius, as in Newton's Law of Gravity). https://en.wikipedia.org/wiki/Modified_Newtonian_dynamics

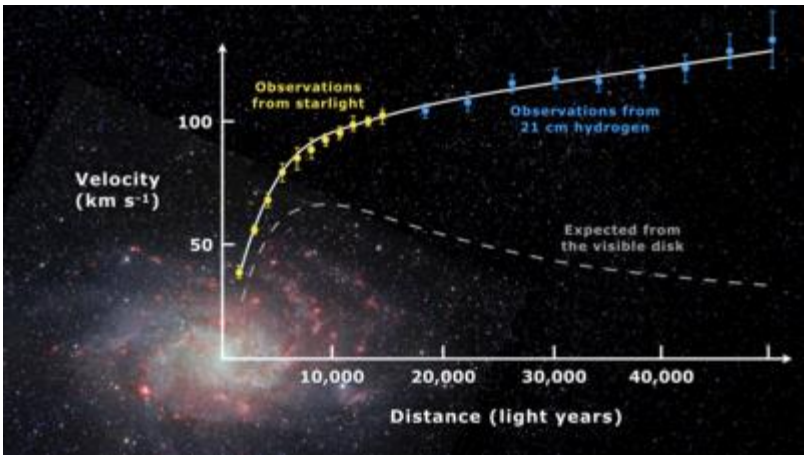
"Milgrom's correction allows gravitational attraction to fall off with distance more slowly than expected (rather than falling off with the square of distance as per Newton) when the local gravitational acceleration falls below an extremely low threshold. This threshold could be linked to other cosmological properties such as the 'dark energy' that accounts for the accelerating expansion of the Universe. "

"MOND, however, proposes that, at very large radii and small accelerations, gravity decays with distance more slowly than Newton's inverse square law. This removes the need for dark matter, providing a clear explanation for the tight non-Newtonian correlation between visible matter and radial acceleration." "Galaxy rotation study rules out modified gravity, or does it?" 21 Jun 2018 https://physicsworld.com/a/galaxy-rotation-study-rules-out-modified-gravity-or-does-it/

Galactic rotation: no "dark matter" is needed

The problem:

> "The rotational/orbital speeds of galaxies/stars do not follow the rules found in other orbital systems such as stars/planets and planets/moons that have most of their mass at the centre. Stars revolve around their galaxy's centre at equal or increasing speed over a large range of distances. In contrast, the orbital velocities of planets in planetary systems and moons orbiting planets decline with distance according to Kepler's third law. This reflects the mass distributions within those systems. The mass estimations for galaxies based on the light they emit are far too low to explain the velocity observations.
>
> . . . These results suggested either that Newtonian gravity does not apply universally or that, conservatively, upwards of 50% of the mass of galaxies was contained in the relatively dark galactic halo."



https://en.wikipedia.org/wiki/Galaxy_rotation_curve

The Dark Matter assumption:

> "From Kepler's Second Law, it is expected that the rotation velocities will decrease with distance from the center, similar to the Solar System. This is not observed.[48] Instead, the galaxy rotation curve remains flat as distance from the center increases.
>
> If Kepler's laws are correct, then the obvious way to resolve this discrepancy is to conclude the mass distribution in spiral galaxies is not similar to that of the Solar System. In particular, there is a lot of non-luminous matter (dark matter) in the outskirts of the galaxy." (http://en.wikipedia.org/wiki/Dark_matter#Galactic_rotation_curves)

The existence of "dark matter" is inferred mostly from the characteristics of galactic rotation: "most stars in spiral galaxies orbit at roughly the same speed. . . . These results suggest that either Newtonian gravity does not apply universally or that, conservatively, upwards of 50% of the mass of galaxies was contained in the relatively dark galactic halo."

But no dark matter is needed, just an alternative conclusion: Stars in a galaxy do not "orbit" the central bulge. Their motion is NOT comparable to planetary orbits in a solar system. This is a much different situation.

Picture two small galaxies approaching each other. The chances are good that the approach will be off-center (not co-linear). Two effects will become apparent immediately. The differential effects of gravitation will cause the galactic blobs to "string out" into a line of stars. The off-center approach will cause the system to rotate around its barycenter (forming a spiral). The barycenter core is initially formed from the stars on the leading edge of each galaxy which experience a stronger gravitational

pull and form a central nucleus of stars, usually accompanied by a visible "bar" of stars connecting the leading edges of the strung-out stars. Gravitation changes the ***direction*** of the stellar motion far more than the speed. The result is that, as quoted above, "most stars in spiral galaxies orbit at roughly the same speed". And they do so because their original ***speed*** of approach remains mostly unchanged.

It is not rotation or "centrifugal force" that keeps the stars separated. The separation is maintained by the same mechanism as with non-rotating star structures like globular clusters. There is a mass-dependent distance where gravitation and the outward expansion of space are at an equilibrium. Gravitation has an inverse square force distribution, but the expansion of space is centerless and uniform. There is necessarily an equilibrium position for these forces. For stars it is a few light years; for galaxies, it is a few million light years. Hence, the galactic stars will not coalesce with each other, but they are still stuck inside the galaxy's overall gravitation.

Globular clusters and star formation

A globular cluster is a roughly spherical blob of stars. It contains 10,000 to a million stars and can be up to a few hundred light years in diameter. (https://en.wikipedia.org/wiki/Globular_cluster)

There are several official mysteries connected to globular clusters. These apparently can be resolved by making two claims:

1. The age of any stellar system is directly related to its mass. Low mass systems are younger than high mass systems. Globular clusters are younger than galaxies. Super massive galaxies, like M87, are some of the oldest structures in the Universe. Double star systems are older than single stars. Low mass atoms will generally be younger than high mass atoms. And so forth.

2. Stars do NOT produce their power by the conversion of hydrogen to helium.

These claims lead to inferences that are definitely *very different from mainstream, institutional astronomy*. Yet they seem to be in accord with facts.

A bulleted summary of globular cluster characteristics is as follows:

- Globular clusters are formed in intergalactic space, are very plentiful, and are uniformly distributed throughout the Universe.

- Globular clusters must be young structures, contrary to the conventional view.

- The structures are stable and do not, in general, rotate like a spiral galaxy.

- Globular clusters are the key to star formation. The "construction materials" come from a cosmic ray process that is homogeneous and isotropic throughout space. The process produces gas, dust, and heavy elements (beyond iron) over a long period of time. The elements produced by this process can apparently include all elements of the Periodic table, even the ones that are radioactive here on earth. (See "Przybylski's Star" http://en.wikipedia.org/wiki/Przybylski's_star)

- The dust and gas will not condense due to the expansion of space until a certain size (30-300 light years) is reached.

- When the dust and gas become dense enough, stars will very gradually begin to condense, more or less simultaneously in numerous regions that are a few light years in diameter. This "wholesale" condensation results in proto-stars and stars that are about the same age, and very similar in composition.

- There is no process that can produce stars in isolation. Stars will not be found in small, stable clusters (say 500 stars) in intergalactic space. Stars sweep out a gravitational space that is a few light years in diameter and so another star cannot form in this space. Stars are outside each other's Gravipause and cannot approach each other, or collide. But they are inside the Gravipause of the cluster as a whole.

- The central region of the cluster is a region of low gravity due to the gravitational "force" of the stars in the outer regions balancing each other out at the center. The expansion of space predominates in this region and prevents the cluster from collapsing.

- Globular clusters can merge with nearby clusters to form larger elliptical (lenticular) clusters. If the approach is off center, the resulting structure will be a rudimentary spiral.

- Globular clusters and ellipticals will eventually fall into a large spiral galaxy. The trajectory is essentially a linear free-fall. Differential gravitational effects may distort the appearance of the structure during the merger. Clusters high above the plane will be the youngest and those near the plane, the oldest. Older stars will have a higher "metallicity" than the younger ones.

- The material in the cluster is not sourced from the spiral galaxy, contrary to the current doctrine.

- During the in-fall, the cluster does not participate in the galactic rotation, nor does it "orbit" the galaxy. Once in the galactic plane the cluster is gradually broken apart by the spiral's rotational effects and will form "open clusters" (like the Pleades).

- Globular clusters are plentiful, but they are not necessarily easy to find:

  "Half the universe's ordinary matter was missing — and may have been found" By Maria Temming (May 27, 2020) https://www.sciencenews.org/article/universe-missing-matter-found-fast-radio-bursts

"Astronomers have taken a new census of matter in the universe by examining how bright flashes of radio waves from other galaxies, called fast radio bursts, are distorted by particles on their way to Earth. This analysis shows that about half of the universe's ordinary matter, which has eluded detection for decades, is lurking in intergalactic space, researchers report online May 27 in *Nature*.

The mystery of the missing matter has vexed cosmologists for some 20 years. This elusive material isn't the invisible, unidentified dark matter that makes up most of the mass in the universe. It's ordinary matter, composed of garden-variety particles called baryons, such as protons and neutrons (SN: 10/11/17).

Scientists have long suspected the missing matter is hiding between galaxies, along filaments of gas strung between galaxy clusters in a vast cosmic web (SN: 1/20/14). "But we haven't been able to detect it very well, because it's really, really diffuse, and it's not shining brightly," says Jason Hessels, an astrophysicist at the University of Amsterdam not involved in the new work."

See also:
"Ultra diffuse galaxy" https://en.wikipedia.org/wiki/Ultra_diffuse_galaxy
"Dozens of new ultra-diffuse galaxies discovered in Abell 2744"
https://phys.org/news/2017-01-dozens-ultra-diffuse-galaxies-abell.html

Stellar power production

One "received truth" in professional astronomy is that stars, such as our sun, generate their power by converting hydrogen into helium. There are some blatant problems with this "fact" however:

1. **There is no hydrogen in the core of the sun.** The commonly accepted belief is that the sun generates most of its power by fusing hydrogen into helium in its hot central core. The sun does contain enormous amounts of hydrogen and helium but there is no reason to believe that these elements exist in the central core of the sun. Spectroscopic studies show that there are at least 67 atomic elements in the sun. This represents a range of atomic mass from 1 (hydrogen) to 238 (uranium). The sun is so hot that all the chemical/molecular compounds and atomic aggregates break up into single atoms and exist in the form of gas. Atoms with the highest atomic mass numbers will therefore gravitate towards the center of the sun. This will displace lighter elements like hydrogen and helium outward towards the surface. The central core of the sun will therefore contain elements that are heavier—indeed much heavier—than hydrogen and helium (helium itself is four times as massive as mono-atomic hydrogen)

   Critics will point out that hydrogen is 1,000 to 10,000 times more abundant than heavier elements such as carbon, nitrogen, oxygen, silicon, sulfur, neon, and iron. In fact all elements beyond the iron-cobalt-nickel group are very scarce, so only the first 28 elements in the Periodic Table of chemical elements would seem to have a significant bearing on the structure of the Sun. According to the critics, these elements would just be contaminants in an ocean of hydrogen and would not be enough to exclude hydrogen from the intensely hot central region of the sun.

   However, the elemental composition of the sun is derived from spectroscopic studies of its *atmosphere*. This does not tell us much about the composition of the interior:

   "Spectral lines reveal much about the chemical composition of the Sun's outer layers, but they do not hint at the internal chemical composition of the Sun, which is quite different from the outer layers." (*Understanding the Universe*, Philip Flower, 1990, p.426)

   Suppose a truckload of cork balls were to be mixed with the water in a swimming pool. The corks would eventually come to the surface where they can be seen. This may leave the impression that the pool is

filled with them, but in fact they are only in the upper couple of feet. Hydrogen is the lightest of all elements. It will come to the surface region of the sun just like the corks in the swimming pool.

The central region of the Sun is also the region of highest temperature. The outer layers of the sun may be 5,000-10,000 Kelvins but the central interior, 15 million Kelvins. Massive atoms like iron, therefore, not only gravitate to the center, they also get heated up the hottest. And the hotter the gas, the more volume it takes up. The iron would be 1000 times hotter than the hydrogen and atom for atom would take up 1000 times the volume of hydrogen at the cooler temperatures. This is also true of the other elements heavier than hydrogen. The fact that these elements are much more massive than hydrogen, and the fact that they gravitate to the hottest region and require more "elbow room," both conspire to push the hydrogen to the cooler outer regions.

In the Sun, power is apparently produced in bursts rather than continuously. The bursts occur in eleven year cycles. This behavior itself appears to be incompatible with the "hydrogen burning" hypothesis, which would seem to favor continuous burning.

See also the fifth objection.

2. The conversion of hydrogen into helium requires very improbable atomic transformations:

> "It happens that the proton-proton chain, very important in the sun, begins with a most improbable event: the collision of two protons resulting in the formation of . . . the heavy isotope of hydrogen called deuterium. Usually the formation of a compound nucleus of two protons simply breaks up into two protons again, rather than ejecting a positron and turning into a deuteron, and very many compound nuclei must form to produce appreciable amounts of deuterium. But even at the high temperatures of stellar interiors . . . it is extremely hard for two positively charged nuclei to come together to undergo any kind of reaction. . . . One might not expect nuclear reactions to occur at all in stars." (*Exploration of the Universe*, George Ogden Abell, D. Morrison, S.C. Wolff, 5th edition, 1987, p. 520.)

Reread that a few times. Do nuclear reactions of "any kind" that produce "appreciable amounts" of the right kind of atoms sound very likely at stellar temperatures? How would stars that are even cooler than the sun power themselves? (I respect this textbook, incidentally, as one of the more honest ones in the field of astronomy)

The overall equation here is that of a very stable isotope of hydrogen converting itself into a very stable isotope of helium by a very improbable route. Nature simply does not work this way.

Even if the deuterium could be produced by quantum tunneling, it must combine with ordinary hydrogen to produce helium-3. Natural helium has a composition of 99.99986% He^4 and 0.00014% He^3. If the reaction went this way, there should be much more He^3 around.

Furthermore, two atoms of rare He^3 would have to find each other in the vast volumes of hydrogen and He^4 and combine to produce one atom of He^4 and two atoms of ordinary hydrogen. I think it is clear that the only thing that can drive an equation like this is the need physicists feel to offer some kind of explanation for the origin of stellar power!

3. Stars can produce enormous bursts of energy extremely rapidly.

An entire star—which may be a couple million miles in diameter—can blow itself to pieces in a stupendous explosion called a "supernova."

"Briefly outshining its home galaxy, the explosion, known as a type 1a supernova, unleashes the equivalent of 10^{28} megatons of TNT—enough energy to destroy an entire solar system." (*Science News*, August 15, 2009, p. 22)

During a supernova explosion the material ejected can move outward at initial speeds as high as 10,000 to 20,000 km/sec (at least a couple thousand times faster than a detonation wave in a high explosive like TNT). This kind of energy production cannot be based on improbable meetings of widely separated rare isotopes which combine through improbable nuclear reactions. Rather, there is quick energy here in abundance! The commonly accepted power process and its relatives cannot account for it.

Another problem is that the explosion of a star is believed to occur when the conventional fuel is all used up:

"It is our present understanding that the supernova explosion happens at the end of the stellar evolution and therefore most of the nuclear energy has been used up already. There must be another energy source." (*Introduction to Stellar Astrophysics*, Volume 1, Erika Böhm-Vitense, 1989 (Cambridge), p. 179)

This other energy source, known as "gravitational collapse," turns out to be another myth of modern stellar astrophysics. For one, thing stars don't ever run out of fuel. For another, stars don't die quietly—they blow up. Moreover, there is no such thing as "atomic collapse": even materials near absolute zero can be compressed to 5 million atmospheres pressure without turning into neutrons or "collapsing". It is enough to realize that a power source that can blow up a star can also power it in the steady state for a long time.

"Dr. Tesla disclosed that he has lately perfected instruments which flatly disprove the present theory of the high physicists that the sun is destined to burn itself out until it is a cold cinder floating in space. Dr. Tesla stated that he is able to show that all the suns in the universe are constantly growing in mass and heat, so that the ultimate fate of each is explosion." http://www.electricitybook.com/tesla-death-ray/

It is worth noting that the production of steady state power is itself a problem. Blue supergiants—stars that have 50 to 100 times the mass of the sun—shine with luminosities a million times greater than the Sun. The commonly accepted power processes cannot account for the power output of blue super giants like Rigel (the brightest star in the constellation Orion).

Related: "Odd star explodes again and again Years-long supernova may be iPTF14hls' third outburst" , Lisa Grossman, *Science News* December 9, 2017, p.8 , https://en.wikipedia.org/wiki/IPTF14hls

4. The neutrino flux from the sun is much less than expected.

According to the Standard Solar Model there are several neutrino producing nuclear reactions in the Sun. The neutrino flux at the earth's surface should be about 66 billion/cm²/sec. A very small proportion of these should be detectable. The standard theories predict that a chlorine 37 type of detector should see a flux of 7.9 +/- 2.6 Solar Neutrino Units (SNU), but the actual results have been about 2.1 +/- 0.3 SNU. Overall, experiments of differing experimental design and more than 25 years of observation and refinements have detected *less* than one-third to one half the expected number of neutrinos. This has left astronomers in quite a quandary:

"Any modifications of the solar model . . . would have profound implications for astronomy. The only direct signal of the stellar nuclear reactions predicted by the standard model is the neutrino flux from the sun. The problem is, the prediction seems to be wrong." (*Scientific American*, May 1990, p.56; see also *Sky & Telescope*, "Closing in on the Solar-Neutrino Problem", Daniel Fischer, October, 1992, p. 378)

5. A supernova explosion reveals the interior composition to be high in elements heavier than hydrogen.

During a supernova explosion, the "outrushing gas has a higher abundance of such . . . elements as silicon, sulfur, argon, and calcium than does the sun. In Type I, but not in Type II, supernovae, the abundances of nickel, iron, and cobalt are also abnormally high". (Abell, *op. cit.*, p. 567)

I suspect two things here. One is that the elemental composition of the Sun, instead of being almost entirely hydrogen, is proportionally more like that of all the planets combined, with an extra abundance of hydrogen and helium, especially in the outer observable regions. Another is that when stars blow up, their composition is mainly that of all elements from hydrogen to the iron-cobalt-nickel group and relatively little else (in terms of percentages).

The idea that stellar power is *not* generated by any of the commonly accepted reaction chains has another consequence, namely that our beliefs about stellar ages will be wrong.

Stellar ages are inferred from our beliefs that stars derive their power from converting hydrogen into helium. If our beliefs about this process are erroneous, then stellar ages will have to be revised. Generally this will mean that what are currently believed to be old stars are actually young, and that the young stars are actually old. Because of the implications of this, our views on the evolution of the universe must also change drastically.

Mainstream scientists are now beginning to realize that stars may be older than galaxies. (*Science News* April 15, 1995, Vol 147, No. 15, p. 230 "Keck finding: Did stars predate galaxies?") They are also perplexed by evidence that the universe appears to be *younger* than the oldest stars in the universe. Again, these problems originate largely because of misunderstandings about the true mechanism of stellar power, as well as their belief in the "Big Bang" origin of the universe. (*Science News* 10/8, 10/22, 10/29 (1994) V146, Nos. 15,17,18, pp. 232-234, 265, 278; 9/9/95 V148. No. 11, p. 166).

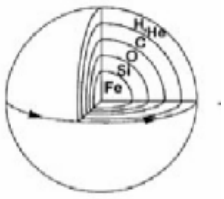
Some links:

"Sun's Iron Core May Be Cause Of Solar Flares", Dr. Oliver Manuel, (3 November 2003) http://www.scienceagogo.com/news/20031002191731data_trunc_sys.shtml

> Manuel claims that hydrogen fusion creates some of the sun's heat, as hydrogen – the lightest of all elements – moves to the sun's surface. But most of the heat comes from the core of an exploded supernova that continues to generate energy within the iron-rich interior of the sun,

"Why the Model of a Hydrogen-filled Sun is Obsolete", O. Manuel (2002) http://arxiv.org/ftp/astro-ph/papers/0410/0410569.pdf

> Hoyle[5] maintained, however, that the results of Payne[2] and Russell[3] were for the atmospheres, not for the deep interiors of stars. He, Eddington, and other astronomers continued to believe until the end of World War II that *"... the Sun was made mostly of iron ..."* (p. 153).



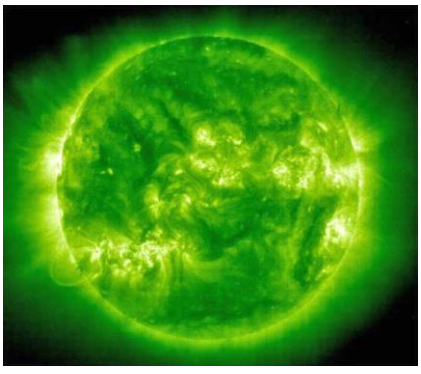
"Vast Solar Eruption Shocks NASA and Raises Doubts on Sun Theory", John O'Sullivan, Jan 3, 2011, http://www.sott.net/article/220912-Vast-Solar-Eruption-Shocks-NASA-and-Raises-Doubts-on-Sun-Theory

> *NASA reports an entire hemisphere of the sun has erupted. The U.S. space agency now admits the cataclysm puts existing solar theories in doubt.*
>
> We are forever being told that the sun is a vast gas ball of hydrogen and helium at the center of our solar system. But new evidence may help prove this isn't the case after all, according to solar experts who say the sun has an iron core. A stunned NASA admits, "Astronomers knew they had witnessed something big. It was so big, it may have shattered old ideas about solar activity."
>
> Controversy about our understanding of the sun has been fomenting for years. In 1980, solar science researcher, Ralph E. Juergens lamented, "The modern astrophysical concept that ascribes the sun's energy to thermonuclear reactions deep in the solar interior is contradicted by nearly every observable aspect of the sun."
>
> The astrophysics establishment has long shunned the idea of the sun having any such iron core.

"Abundances of Trans-Iron Elements in Solar Energetic Particle Events", Donald V. Reames, Aug, 2000, *Astrophysical Journal*, 540:L111–L114, 2000 September 10, http://iopscience.iop.org/article/10.1086/312886/pdf , http://epact2.gsfc.nasa.gov/don/00HiZ.pdf

> We report the first comprehensive observation of the abundances of heavy elements of atomic number Z in the range $34 \leq Z \leq 82$ in solar energetic particle (SEP) events as observed on the *Wind* spacecraft. In large gradual SEP events, abundances of the element groups $34 \leq Z \leq 40$, $50 \leq Z \leq 56$, and $70 \leq Z \leq 82$, relative to Fe, are similar to corresponding coronal abundances within a factor of ~2 and vary little with time during the events. However, in sharp contrast, abundances of these ions from impulsive flares increase dramatically with Z so that abundances of Fe, $34 \leq Z \leq 40$, and $50 \leq Z \leq 56$, relative to O, are seen at ~10, ~100, and ~1000 times their coronal values, respectively.

Image of the Sun shown in light of highly ionized iron (FeXII) Credit: SOHO-EIT Consortium, ESA, NASA http://www.bibliotecapleyades.net/imagenes_ciencia/sol01_01.jpg

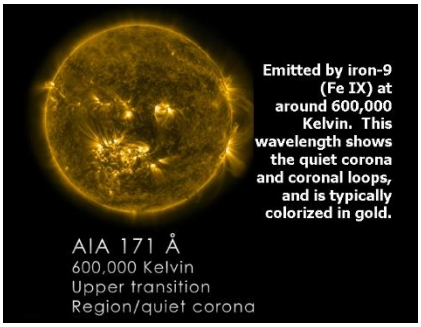


"An iron-rich Sun and its source of energy", O. Manuel and A. Katragada (2004) http://www.omatumr.com/abstracts2005/IronRichSun.pdf :

> Mass-fractionation enriches light elements and the lighter isotopes of each element at the solar surface, making a photosphere that is 91% H and 9% He. However, the solar interior consists mostly of seven, even-numbered elements of high nuclear stability - Fe, O, Ni, Si, S, Mg and Ca. These elements were made in the deep interior of the supernova that gave birth to the solar system 5 billion years ago. They comprise 99% of ordinary meteorites.

"Why the Model of a Hydrogen-filled Sun is Obsolete ", O. Manuel, Nuclear Chemistry, U. Missouri-Rolla: (2002) http://arxiv.org/ftp/astro-ph/papers/0410/0410569.pdf :

> When this empirical power law, defined by enrichments of light isotopes in the solar wind, was applied to solar atmospheric abundance, the most abundant elements in the Sun were found to be iron (Fe), nickel (Ni), oxygen (O), silicon (Si), sulfur (S), magnesium (Mg), and calcium (Ca) [p. 283]. These elements all have even atomic numbers, they are made in the interior of supernovae, and they are the same seven elements Harkins found in 1917 to comprise 99% of ordinary meteorites.



"Emitted by iron-9 (Fe IX) at around 600,000 kelvin" https://www.nasa.gov/content/goddard/sdo-aia-171-angstrom/

An Alternative Theory of Stellar Power

Stars obviously generate power. But how do they do it? Here is what the facts suggest to me:

1. Heavy elements gravitate to the center of a star.

2. The center is the hottest part of the star.

3. Heavy elements are probably less stable thermally than lighter elements.

4. If atomic power could be generated by simple, direct, purely thermal degradation of heavy elements, this would account for the extremely quick and energetic burst of power seen in supernova. It would also be a process abundant in steady state power because there are a lot of elements between iron (element number 26) and the end of the Periodic Table (position number 118). Heavy elements are actually rather scarce, but this is consistent with the idea that such elements are burned up in the stars. And such a thermal process would not directly produce neutrinos.

The picture that develops here is that heavy elements must be produced in the vast volumes of interstellar space and that the production process is low in kinetic energy. These elements are then gradually pulled into a star by gravitation. The thermal energy of the star causes them to decrease in atomic number and release a great deal of energy in the form of gamma rays. (I call this process

"thermal reversion.") The heavy elements lose mass and are swept upwards in the Periodic Table towards the iron-cobalt-nickel group. These three elements are especially stable, very abundant, and concentrate in the center of the star in very large quantities. If the thermal energy of the star ever gets great enough to revert this group—as it would in massive blue supergiants—the star will quickly generate far more power than its structure can handle and the entire star will instantly explode. It will be no surprise that supernovae spectra show abnormally high abundances of "nickel, iron, and cobalt" just as mentioned above.

The idea that heavy elements are *produced* in interstellar space will not receive an enthusiastic welcome by astronomers. But it would explain a couple of perplexing problems. First, there are "peculiar A stars" that show unusually strong spectral lines of yttrium, silicon, strontium, chromium, europium, and other "rare earth" metals:

> "Spectrum analysis indicates abundances which are increased by factors of up to 1000 for the rare earth elements. Astronomers found it hard to believe that the rare earth elements, especially, should be enhanced by such large factors in these stars. . . . There is also the peculiar observation that the enhancement of line strengths depends on the effective temperature of the stars. For the hotter stars, we see strong Si lines; the cooler stars have strong Eu, Sr, and Cr lines" (Böhm-Vitense, *op. cit.*, pp. 128, 135)

Here is another peculiar one: "Przybylski's Star" http://en.wikipedia.org/wiki/Przybylski's_star

> In 1961, the Polish-Australian astronomer Antoni Przybylski discovered that this star had a peculiar spectrum that would not fit into the standard framework for stellar classification.[12][13] Przybylski's observations indicated unusually low amounts of iron and nickel in the star's spectrum, but higher amounts of unusual elements like strontium, holmium, niobium, scandium, yttrium, caesium, neodymium, praseodymium, thorium, ytterbium, and uranium. In fact, at first Przybylski doubted that iron was present in the spectrum at all. Modern work shows that the iron-group elements are somewhat below normal in abundance, but it is clear that the lanthanides and other exotic elements are highly overabundant.[5]
>
> Przybylski's Star also contains many different short-lived actinide elements with actinium, protactinium, neptunium, plutonium, americium, curium, berkelium, californium, and einsteinium being detected. The longest-lived isotope of einsteinium has a half-life of only 472 days. Other radioactive elements discovered in this star include technetium and promethium.[14]
>
> (Related: "Chernobyl Exclusion Zone Radioactive Longer Than Expected"
> https://abcnews.go.com/Technology/chernobyl-exclusion-zone-radioactive-longer-expected/story?id=9374383
> http://www.wired.com/wiredscience/2009/12/chernobyl-soil/)

And another: "HD 87240 is a chemically peculiar star with an overabundance of heavy elements, study suggests" https://phys.org/news/2018-10-hd-chemically-peculiar-star-overabundance.html

> The astronomers found that this star is significantly overabundant in heavy elements, especially when it comes to platinum (Pt) and mercury (Hg) – about 10,000 times the solar abundances.
>
> Moreover, HD 87240 was found to be unusually rich in silicon (around 10 times the solar abundance) an in the so-called rare-earth elements like cerium (Ce), praseodymium (Pr) and neodymium (Nd) – at a level of at least five times the solar abundances.

The main problem here is that, according to current theory, high abundances of *heavy* elements are not expected to be found in the atmospheres of *cool* stars. The existence of barium-rich and mercury-rich stars present similar difficulties. These problems disappear however, if these heavy elements are

produced in interstellar space and are actually on their way *in* to the star instead of being boiled up from the stellar interior

This unexpected distribution also seems to show up in the Sun's corona:

> C. Three fold overabundance of detected metals
>
> One fact of particular interest is that most of the metals detected, particularly sodium, magnesium, aluminum, iron and nickel, seem to be about 3 times more abundant in the corona and solar winds than in the Sun's photosphere ([1], p. 31, Table 1.2)! This second fact, besides the 200 fold higher temperature of the corona with respect to the photosphere and chromosphere, strengthens yet more the possibility that some process internal to the corona could be at play, not directly involving the Sun itself.
>
> Current instruments sensitivity prevents being as affirmative for the other elements, so we do not have much data on the relative abundance of the most other elements with respect to the photosphere.
>
> "The Corona Effect", Andre Michaud, http://www.ijerd.com/paper/vol7-issue11/A07110109.pdf

The element technetium has been detected in S, M, and N type stars. In so far as we can determine, technetium does not occur naturally on earth. It is produced here artificially in atomic reactors and cyclotrons, hence its name. It is radioactive and has a half-life of "only" about 4.2 million years. If it is produced in the supposed "nuclear furnace" in the interior of a star, this half-life is too short for it to reach the star's atmosphere where it can be seen in stellar spectra. Again, this observation is consistent with the claim that heavy elements are produced in inter-galactic space by a cosmic ray process. (Apparently, in some regions of space, all elements in the Periodic Table can be produced and be stable against radioactivity. See "Przybylski's Star" http://en.wikipedia.org/wiki/Przybylski's_star)

Planet formation

The current doctrine in astronomy is that the planets formed from a disk of gas and dust that was left over from the formation of the Sun. Nothing is said about the origin of the gas and dust. And another problem is that the expansion of space would prevent the dust from coalescing. In small (1 light year) isolated locales, neither stars nor planets could form under these conditions.

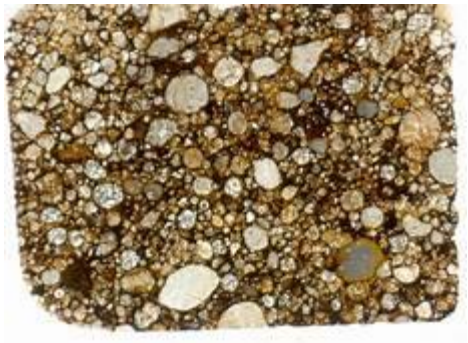
Even a superficial inspection of the solar system shows that there are huge chunks of matter—asteroids and Kuiper belt objects— in orbit around the Sun. Satellite flybys indicated these are more like piles of rocks than mounds of dust. Additionally, huge impact craters are visible on Mercury, Earth, Mars, and the Moon (etc.). These cannot be caused by an in-fall of dust bunnies.

Additionally, there is the problem of the composition of meteorites. These are generally classified as "irons" and "stones". How such "chemically differentiated" material originated is a mystery.

Below is a picture of an iron meteorite. It has been cut, polished and then etched with acid. The irons are made of mostly iron, some nickel, and a rarity of elements beyond iron. Note the crisscross Widmanstätten pattern. The large crystals are evidence of slow cooling from a molten state.

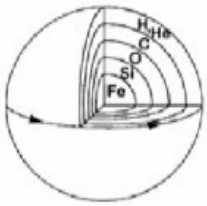
University of Minnesota
College of Science and Engineering
https://cse.umn.edu/sites/cse.umn.edu/files/styles/full/public/meteorites_fig2.jpg

Below is a picture of a stony meteorite. The stones are made of mostly light elements above iron in the Periodic Table. Elements beyond iron are rare but are more abundant in the stones than in the irons (as would be expected). The round chondrites are evidence of solidification from a molten state in a zero gravity environment.



Turnstone Geological Services Limited
Campbellford, Ontario, Canada
http://www.turnstone.ca/rom162ch.htm

These structures could be produced by a supernova explosion. This is based on the belief that the Sun is layered like an onion:



http://arxiv.org/ftp/astro-ph/papers/0410/0410569.pdf

Note that the elements are already differentiated by gravity. When a massive star explodes, the lighter elements eventually form what become the "stony" meteorites and the central iron portion forms the "irons".

The Sun we see now was not the original one. The current one started with a core of iron that was largely depleted of heavy elements.

Neither this nor what follows fits the conventional (institutional) supernova doctrine in astronomy. Consider it to be an appeal to common sense and observed facts.

The explosion products initially expand into interstellar space. The star, however, does not disappear completely. Usually a small central core is left over from the explosion. This provides a gravitational center that aids in re-coalesce of the system, which still takes a long time. If there is enough mass, the re-coalesce will eventually be observed as a binary star system consisting of a small, dense white dwarf and a huge, diffuse red supergiant. If there is not enough mass for a double star system, a planetary system will eventually form around the star from large chunks of material being drawn in and chaotically smashing into each other.

And that, in a nutshell is how planets probably form.

Some consequences of this picture:

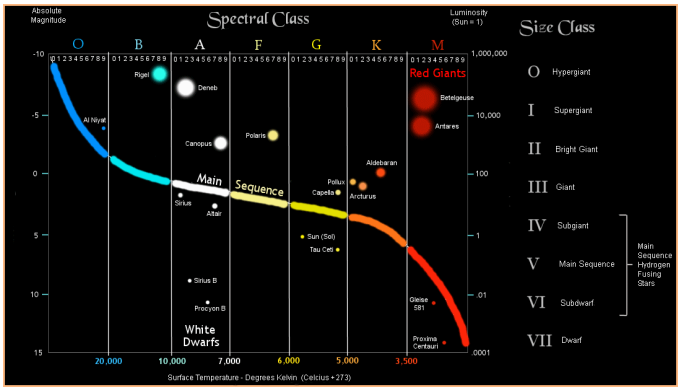
- the solar system and the Earth are very old.
- stars can form within light-hours of each other, or light-years from each other, but not within light-months.
- the system can be cyclic and form multiple stars over a very long period of time.
- planets will probably NOT be found in binary star systems. A search for intelligent life in these system will probably be unproductive.

Links:

"Sun's Iron Core May Be Cause Of Solar Flares", Dr. Oliver Manuel, (3 November 2003)
http://www.scienceagogo.com/news/20031002191731data_trunc_sys.shtml

> "We think that the solar system came from a single star, and the sun formed on a collapsed supernova core," Manuel explains. "The inner planets are made mostly of matter produced in the inner part of that star, and the outer planets of material that formed out of the outer layers of that star."
>
> Manuel offers another explanation, based on his assertion that the solar system was born catastrophically out of a supernova – a theory that goes against the widely-held belief among astrophysicists that the sun and planets were formed 4.5 billion years ago in a relatively ambiguous cloud of interstellar dust.

Note that the Sun is slightly below the Main Sequence in the Spectral Class diagram below.

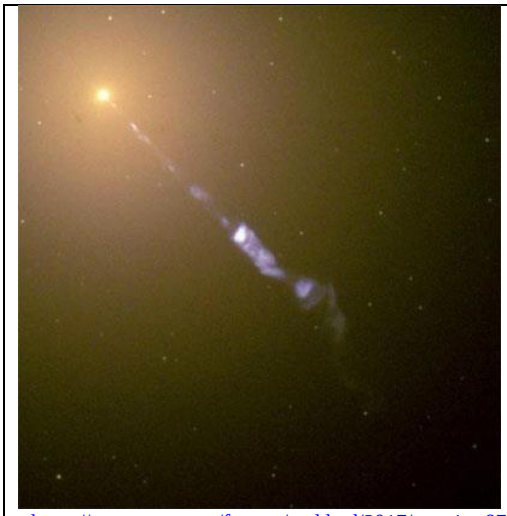


https://peoplesguidetothecosmos.com/solarsystem/sol.htm

This means it is still a bit "white dwarfish". It has not quite arrived at gravitational equilibrium with the spatial system. It, and planets associated with it, may still be gradually expanding, even though their masses are nominally constant. See The interatomic distance problem (above)

Cosmological destruction

Galaxies seem to have a size limit. When they become extremely large (spheroidal or a tightly wound spiral), they apparently undergo some kind of extremely energetic process. M87 and the Sombrero galaxies are possible examples:


https://www.nasa.gov/feature/goddard/2017/messier-87


https://www.odysseymagazine.com/sombrero-galaxy-facts/

Interestingly, there are statements in the Bible that may have a bearing on this:

You, LORD, in the beginning laid the foundation of the earth,
And the heavens are the work of Your hands.
They will perish, but You remain;
And they will all grow old like a garment;
Like a cloak You will fold them up,
And they will be changed.
But You are the same,
And Your years will not fail.

Hebrews 1:10-12, (*NKJV*):

Your years go on through all generations.
In the beginning you laid the foundations of the earth,
and the heavens are the work of your hands.
They will perish, but you remain;
they will all wear out like a garment.
Like clothing you will change them and they will be discarded.
But you remain the same, and your years will never end.
Ps 102:25-26 (*NIV*)

"Lift up your eyes to the heavens,
And look on the earth beneath.
For the heavens will vanish away like smoke,
The earth will grow old like a garment,
And those who dwell in it will die in like manner;
But My salvation will be forever,
And My righteousness will not be abolished."
Isaiah 51:6, (*NKJV*):

(See also Job 13:28, Isaiah 34:4)

Heaven and Earth, the very work of God's hands, will "all wear out like a garment". They will be "changed" and "discarded" and "will vanish away like smoke". Those are astonishing statements, comparing the Earth to a worn out garment, and saying the Heavens will vanish like smoke! Here are some inferences:

- Whatever these texts mean, it is *clearly something with* ***major*** *implications,* and affects the entire literal, physical heavens and the Earth. A prominent religious leader gave the same testimony almost a thousand years later: "Heaven and earth will pass away, but My words shall not pass away." (Matthew 5:18, 24:35; Mark 13:31; Luke 16:17, 21:33)

- The Universe is wearing out! So *time* must be real and physical. Time is not just a convenient illusion for humans, as some physicists tell us. There must be a Master Clock somewhere, some *physical process* that relates to age and wear-and-tear. Atoms of matter, stars and galaxies, must be somehow recording the passage of time.

- "Like clothing you will change them." Old clothes wear out and are discarded. But they are then replaced by new ones. How many of these cycles have taken place? One? Thousands? How many cycles has the 'closet' seen? Can we really tell how old the Universe is when its worn out parts are being replaced? If your car or clothing were undergoing a similar process, could you really tell how "old" they are?

- The claim that some matter in the Universe can be older than other matter is incompatible with the Big Bang theory. In that theory, all matter was created 15 billion years ago, and therefore is of the same age.

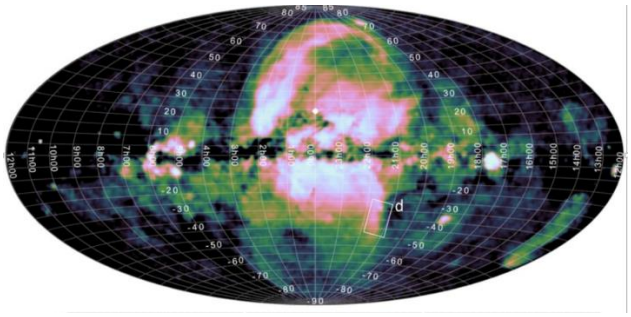
- God's everlasting righteousness and salvation are contrasted with the age of the Universe and its impermanence. If the Universe was created in 24 hours, as some religious groups believe, this would certainly be a weak, unimpressive comparison.

The exploding Milky Way (our galaxy!)

Our galaxy is one of moderate age. Is it "wearing out" somehow? Being "dispersed like smoke" somehow? The oldest matter would be in the central regions of the galaxy. Is anything unusual happening there? The answer is YES, and it is quite spectacular. Note this article about our very own exploding galaxy:

> "A decade ago, NASA's Fermi Gamma-ray Space Telescope detected two enormous plumes of highly energetic gas extending above and below the disk of the Milky Way galaxy. The combined plumes, dubbed Fermi bubbles, extend a total of some 50,000 light years.
>
> These "bubbles" remain largely mysterious, and continued research has turned up several surprises. According to Science News, recent findings from the eROSITA X-ray telescope has shown that the plumes produce a powerful flux of X-rays and energetic gamma rays.
>
> While much remains mysterious about the Fermi bubbles, one thing about them seems clear: They are the aftermath of a stupendous explosion, a few million years ago, in the heart of our galaxy."
> (https://now.northropgrumman.com/fermi-bubbles-reveal-an-exploding-galaxy-our-own/)

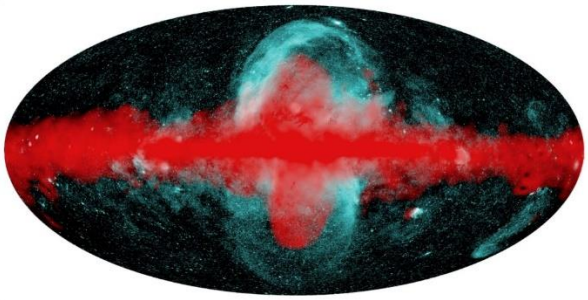
It has been possible to get pictures of these Fermi bubbles in X-ray and gamma ray spectrums:



Milky way

Figure 2. After subtracting the x-ray emission from known astrophysical sources, the eROSITA bubbles (pink and green structures) become clearer. The panels on the top and bottom display the measured surface-brightness profiles (red), which are compared to various models (other colors) seeking to explain the origins of these bubbles.

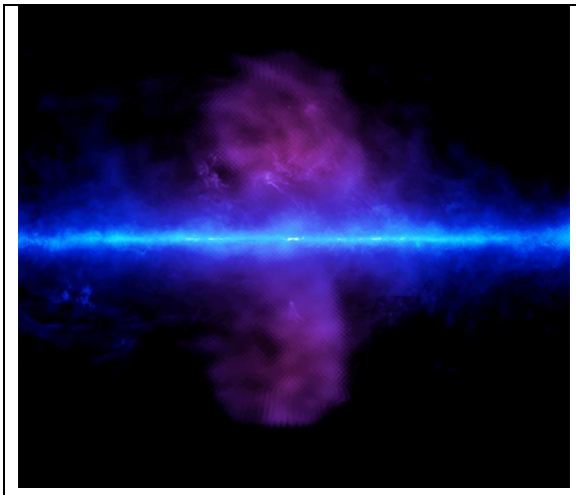
https://astrobites.org/2020/12/19/xray-fermi-bubbles/



Milky Way

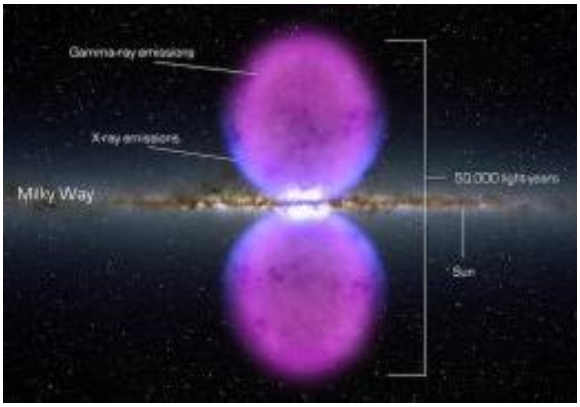
Figure 3. Comparison of the structure of the bubbles as seen in x-ray (green) and gamma-ray (red) wavelengths. The similar shapes of the structures hint at common origins, although the x-ray bubbles extend farther away from the Galactic Plane than their gamma-ray counterparts.

https://astrobites.org/2020/12/19/xray-fermi-bubbles



In 2010, gamma-ray observations by Fermi revealed previously unknown features in our galaxy that stretch halfway across the sky. Now called the Fermi Bubbles, these mysterious structures (magenta in the image above) emerge above and below the center of our galaxy, spanning a total length of about 50,000 light-years. The plane of our galaxy (shown in blue above) glows brightly in gamma rays, which result when high-energy particles called cosmic rays interact with gas and dust. The Fermi Bubbles emit higher-energy gamma rays than the rest of the galaxy's disk. Credit: NASA

https://scitechdaily.com/common-origin-of-colossal-fermi-bubbles-and-galactic-center-x-ray-outflows-revealed/



The Fermi Bubbles are two enormous orbs of gas and cosmic rays that tower over the Milky Way, covering a region roughly as large as the galaxy itself. These giant space bubbles may be fueled by a strong outflow of matter from the center of the Milky Way.(Image credit: NASA Goddard)

https://www.space.com/fermi-bubbles-milky-way-radiation-mystery.html

https://astronomy.com/magazine/weirdest-objects/2015/12/1-fermi-bubbles

"Things you can tell from Fermi bubbles"
https://cosmosmagazine.com/space/astronomy/the-things-you-can-tell-from-fermi-bubbles/

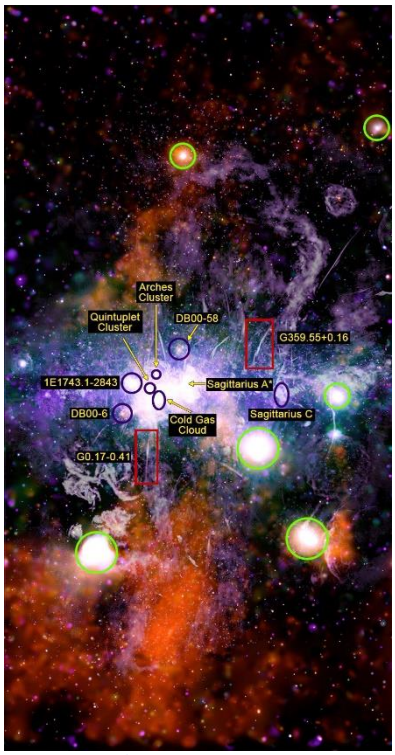
"Mysterious 'Fermi Bubbles' may be the result of black hole indigestion 6 million years ago", Brandon Specktor, Senior Writer (May 27, 2020):

> "These twin orbs of gas, dust and cosmic rays emerge from the galactic center like two wings of an enormous moth, one on either side of the galaxy's central black hole. From tip to tip, the bubbles stretch about 50,000 light-years across (that's about half the diameter of the Milky Way itself), yet are visible only in high-energy gamma-ray light." (https://www.livescience.com/fermi-bubbles-black-hole-shock-wave.html)

The center of our Milky Way looks like a random mess of exploding fireworks. (Please click on the links to see the full image.)

https://www.iflscience.com/space/incredible-image-shows-the-center-of-our-galaxy-like-we-have-never-seen-it-before/

https://cdn.iflscience.com/images/7e0245d5-eef0-5526-8e72-9a3d82bace62/content-1622200769-266070-web.jpg



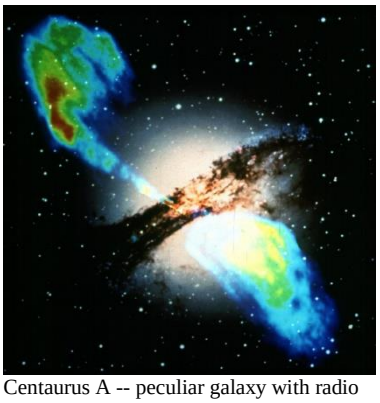
https://www.iflscience.com/space/incredible-image-shows-the-center-of-our-galaxy-like-we-have-never-seen-it-before/

Image Credit: X-ray: NASA/CXC/UMass/Q.D. Wang; Radio: NRF/SARAO/MeerKAT

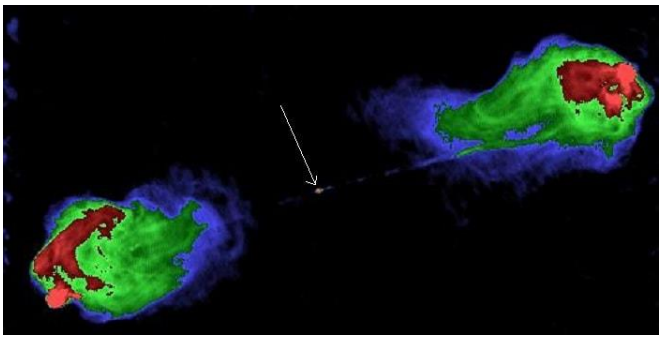
Other Exploding Galaxies

Exploding galaxies are not unusual and many examples can be found. Here are a couple more that are well known. Note: do not confuse these images with those of exploding stars (supernova).

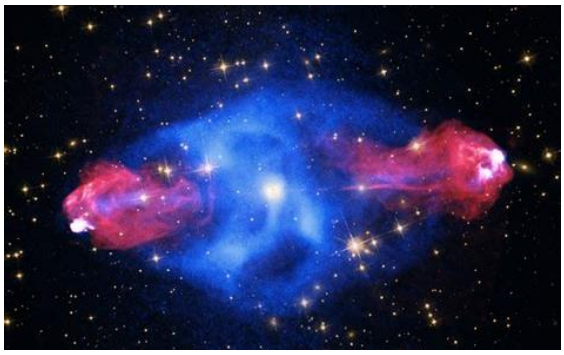
Centaurus A (visible light)



Centaurus A -- peculiar galaxy with radio lobes. From HST web site. https://web.njit.edu/~gary/728/Lecture1.html



5 GHz radio image of the Cygnus A radio galaxy (white arrow) surrounded by its two radio lobes. Credit: Mhardcastle / VLA
https://trustmyscience.com/wp-content/uploads/2018/10/cygnusa-image-radio.jpeg
https://trustmyscience.com/champ-magnetique-capture-matiere-pour-alimenter-trou-noir/



Light from Cygnus A
Image Credit: X-ray: NASA/CXC/SAO; Optical: NASA/STScI; Radio: NSF/NRAO/AUI/VLA

https://apod.nasa.gov/apod/ap150124.html

"Astronomy Picture of the Day" (2015 January 24)

> "Celebrating astronomy in this International Year of Light, the detailed image reveals spectacular active galaxy Cygnus A in light across the electromagnetic spectrum. Incorporating X-ray data (blue) from the orbiting Chandra Observatory, Cygnus A is seen to be a prodigious source of high energy x-rays. But it is actually more famous at the low energy end of the electromagnetic spectrum. One of the brightest celestial sources visible to radio telescopes, at 600 million light-years distant Cygnus A is the closest powerful radio galaxy. Radio emission (red) extends to either side along the same axis for nearly 300,000 light-years . . . Confined to yellow hues, optical wavelength data of the galaxy from Hubble and the surrounding field in the Digital Sky Survey complete a remarkable multi wavelength view". https://apod.nasa.gov/apod/ap150124.html

Where is the Clock?

For a galaxy to reach an age limit, it must have a Clock somewhere. Galaxies begin exploding from their central parts, where the oldest matter would be located. Therefore, the Clock likely applies to atomic matter, or stars, rather than to the overall galactic structure.

Something must power this Clock. That is, something makes it tick. The Clock must be capable of recording a very, very, long amount of time (accumulating a large number of the ticks, or recording widely spaced ticks). The ticks must be held or recorded in a stable container capable of lasting for billions of years. When the alarm activates, the associated matter undergoes an energy release which, apparently, is proportional to the amount of matter present. How does all this work?

Atoms have the required stability for such a Clock. Radioactivity is a possible source of energy release. There is evidence that radioactive half-lives can be influenced by neutrino flux (considered later) The universe is full of neutrinos much like it is full of starlight. Some locations in the Universe have neutrinos with extremely high energies (e.g., "high-energy astrophysical neutrinos" https://phys.org/news/2021-08-emission-blazar-txs.html) Like atoms, neutrinos are also stable and presumably possess enormous lifetimes. Further, they interact so extremely weakly with matter that most (but not all) of them will pass right through the Earth (and even stars) as though nothing were in their path. Additionally, the neutrino flux is much higher near a star than in interstellar space. It is evident that some sort of "atomic neutrino absorption" would have the characteristics required to drive a long-period atomic aging mechanism.

Neutrinos do not have a rotational structure sufficient to manifest as mass. Hence, they are massless, but possess momentum and energy. Still, they can have a mass effect if they merge with a time/space structure that has a full intrinsic atomic rotation system (i.e., an atom). This is probably the basis for "isotopes".

In this scheme a "primary mass unit" would be the same thing that is represented by Mosley's "atomic number" (equating to two a.m.u.). A secondary mass unit, suggested by the existence of isotopes, is also evident and is conventionally attributed to neutrons. The ratio of primary mass to secondary mass manifestly has a bearing on atomic stability. If the ratio is not within the "valley of stability", the atom will eject a positron + neutrino or an electron + neutrino as in beta decay. If the atom has a mass higher than the limit implied by the Periodic Table (2 x 118), it either splits ("fissions") or ejects mass as an alpha particle. These reactions involve energies in the keV to MeV energy range. Metastable atomic isotopes (much above the ground state) can eject gamma rays.

Apparently a high flux of neutrinos shifts the upper end of the "valley of stability" towards *lower* atomic mass in the Periodic Table. On Earth, the upper end of the stability zone is currently at uranium (atomic number 92, atomic weight 236). The shift towards less massive elements makes more atomic material less stable. This causes greater emission of neutrinos which would result in still more atomic decay (a positive feedback loop). The result would be a kind of slow motion explosion (NOT like a supernova or an atom bomb). The energy release would be enormous but more gradual than we would normally expect. There would be plenty of gamma rays and X-rays but the scene would not necessarily be spectacular, especially in its early stages.

The Clock then, is probably stored in atoms, and is powered long-term by occasional capture of neutrinos. A positive feedback effect activates the "alarm", and starts a process that can destroy an entire galaxy.

See also: Radioactive decay rates and neutrino environment below.

Non-local astronomy

Non-local astronomy is the study of non-local astronomical structures and their observable manifestations in a spatial (conventional) reference system. It is not currently a recognized field of study in astronomy.

Recall that there is no "speed of light barrier." The speed spectrum is continuous and has no "speed bumps" or barriers. What changes at the speed of light is the manner in which the reference system portrays the motion. The measure of motion in the spatial system is a change of position in 3D space with respect to progressive (scalar) time (i.e., "speed" or "velocity") . Speeds above that of light are temporal and have no inherent spatial direction and their measure is *energy* instead of *speed* (i.e., t/s instead of the usual s/t). This inversion happens because the "zero" for motion is not a numerical zero. The inversion does not flip from a positive value to a negative value. Instead, it flips to its numerical reciprocal if the calculation is done in units of "natural quantities". The pivot point is 1/1 which is regarded here as the speed of light in natural unit quantities of space and time.

Reference system inversion effects

Here, we want to answer the question of how the inversion effect affects our perception of electromagnetic radiation. Specifically, what *energy* of gamma rays will convert to what *frequency* of radio waves due to reference system inversion effects?

Astronomers use both frequency and energy units when describing astronomical objects. Gamma ray energies are usually presented in electron-volt energies (GeV to TeV). Radio wave energies are presented in frequency units (typically Megahertz to Gigahertz). Radio waves can be "genuine" radio waves or they can be gamma rays that have been inverted into the radio frequency spectrum by reference system effects.

Hence, we first have to convert ordinary energy units into ordinary frequency units.

Spectrum of Electromagnetic Radiation

Region	Wavelength (Angstroms)	Wavelength (centimeters)	Frequency (Hz)	Energy (eV)
Radio	$> 10^9$	> 10	$< 3 \times 10^9$	$< 10^{-5}$
Microwave	$10^9 - 10^6$	10 - 0.01	$3 \times 10^9 - 3 \times 10^{12}$	10^{-5} - 0.01
Infrared	10^6 - 7000	0.01 - 7×10^{-5}	$3 \times 10^{12} - 4.3 \times 10^{14}$	0.01 - 2
Visible	7000 - 4000	$7 \times 10^{-5} - 4 \times 10^{-5}$	$4.3 \times 10^{14} - 7.5 \times 10^{14}$	2 - 3
Ultraviolet	4000 - 10	$4 \times 10^{-5} - 10^{-7}$	$7.5 \times 10^{14} - 3 \times 10^{17}$	3 - 10^3
X-Rays	10 - 0.1	$10^{-7} - 10^{-9}$	$3 \times 10^{17} - 3 \times 10^{19}$	$10^3 - 10^5$
Gamma Rays	< 0.1	$< 10^{-9}$	$> 3 \times 10^{19}$	$> 10^5$

http://www.pas.rochester.edu/~blackman/ast104/spectrum.html
https://astronomy.swin.edu.au/cosmos/E/Electromagnetic+Spectrum
http://ircamera.as.arizona.edu/astr_250/Lectures/Lec04_sml.htm

Conventional conversion of energy units to frequency equivalents:
https://www.unitsconverters.com/en/Electron-Volt-To-Hertz/Unittounit-3462-3511 (1E+6 = 2.418E+20)

1 eV (10^0 eV) = 2.42×10^{14} Hertz (near visible optical)
(13.6 ev) = 3.288×10^{15} Hertz (Rydberg ultraviolet)
1 keV (10^3 eV) = 2.42×10^{17} Hertz (X-ray)
1 MeV(10^6 eV) = 2.42×10^{20} Hertz (gamma ray)
1 GeV (10^9 eV) = 2.42×10^{23} Hertz
1 TeV (10^{12} eV) = 2.42×10^{26} Hertz
1 PeV (10^{15} eV) = 2.42×10^{29} Hertz (ultrahigh energy gamma ray)

Common examples: An ordinary microwave oven operates at a frequency of 2.450 Gigahertz which is equivalent to 1.01×10^{-5} electron volts. Yellow light has a frequency of 5×10^{14} Hertz (500 THz) or 2.07 electron volts. The human eye responds to a band in the vicinity of 400–790 THz (1.65 – 3.28 eV). Solar power cells can have a somewhat broader response. Infrared is roughly 300 Gigahertz to 400 THz.

Next, we have to convert a given frequency to "natural quantity" frequency units by dividing by the Rydberg frequency (which is hereby assumed to be a "natural quantity" of frequency). Then we invert that number and multiply by the Rydberg frequency to get back to a frequency that a telescope in a spatial reference system can see. Hence:

Conversion of conventional energy units to *un*conventional inverse frequency units

The calculations here take the Rydberg frequency as 3.288 10^{15} Hertz

1 keV = 2.42 x 10^{17} Hertz (conventional, as above)
2.42 x 10^{17} Hertz / (3.288 x 10^{15} Hertz) = 73.54 (natural quantities of frequency)
1/ 73.54 = 0.0136 (inverse quantities of frequency)
0.0136 x 3.288 x 10^{15} Hertz (convert to spatial system)
= .0447 x 10^{15} Hertz
= **4.47 x 10^{13} Hertz** (frequency as seen from a spatial reference system)

It follows that:
1 eV (10^{0} eV) = 4.48 X 10^{16} Hertz (inverse (spatial) equivalent)
1 keV (10^{3} eV) = 4.48 X 10^{13} Hertz (inverse (spatial)equivalent)
1 MeV(10^{6} eV) = 4.48 X 10^{10} Hertz (inverse (spatial)equivalent)
1 GeV (10^{9} eV) = 4.48 X 10^{7} Hertz (inverse (spatial)equivalent)
1 TeV (10^{12} eV) = 4.48 X 10^{4} Hertz (inverse (spatial)equivalent)
1 PeV (10^{15} eV) = 4.48 X 10^{1} Hertz (inverse (spatial)equivalent)

Example: The fermi telescope can detect 300 GeV gamma rays. The radio frequency equivalent in the spatial system would be:

1 eV = 2.42 x 10^{14} Hertz (convert electron volts to Hertz)
300 x 10^{9} eV = 300 x 10^{9} x 2.42 x 10^{14} Hertz = 7.254 x 10^{25} Hertz
7.254 x 10^{25} Hertz / (3.288 10^{15} Hertz) = 2.206 x 10^{10} (natural quantities of frequency)
1/2.206 x 10^{10} natural quantities = 0.453 x 10^{-10} (inverse of natural quantities)
0.453 x 10^{-10} x (3.288 x 10^{15}) Hertz (conversion to spatial system)
= 1.5 x 10^{5} Hertz (150 kilohertz)

(In the United States the AM broadcast band extends from 535 kilohertz to 1.7 Megahertz)

Plainly, high energy gamma rays can "map into" low frequency radio waves IF such gamma rays originate in Transitional Space/Time. In such a circumstance, gamma rays, X-rays, and radio waves can be in "close" observational proximity with each other. Some gamma ray sources will be inverted to radio waves but those with ordinary spatial motion will not.

This has some surprising implications for non-local astronomy:

Cosmic Microwave Background (CMB)

From a spatial standpoint the central regions of a temporal star are just as visible as the outer regions. The problem, of course, is that the view is non-local. The "cosmic atoms" would be seen as a background of high energy particles with inverse masses whizzing past us at the speed of light. Low energy cosmic particles (e.g., atomic constituents of planets, asteroids) would have extremely high energies (10^{21} electron volts) from the standpoint of the spatial reference system. They are not

accelerated by some weird "cosmic accelerator" but are ordinary temporal particles whose energies are inverted by our reference system.

Photons are likewise common to both systems. Temporal ultraviolet photons at the Rydberg frequency would map into the spatial ultraviolet directly. Other frequencies would be inverted:

Example: Yellow light (**5×10^{14} Hertz**) from a temporal star would be seen as:
5×10^{14} Hertz / ($3.288\ 10^{15}$ Hertz) = 1.52×10^{-1} (natural quantities)
$1/1.52 \times 10^{-1}$ natural quantities = 0.658×10^{1} (natural inverse quantities)
0.658×10^{1} x (3.288×10^{15}) Hertz (conversion to spatial system frequency)
= 2.16×10^{16} Hertz

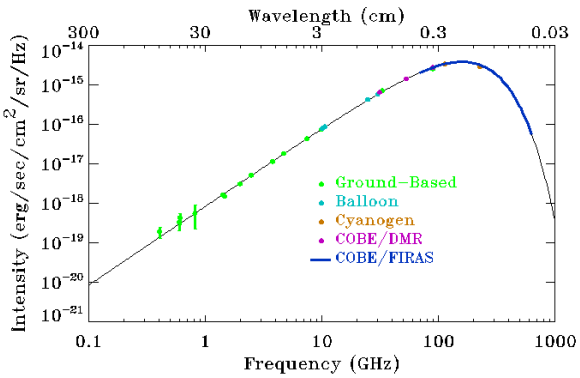
The photons would be seen as background radiation.

Photons inside the star would have higher and higher energies (X-ray and gamma) as the central region is approached, but with lesser and lesser abundance. At mid-radius, we would expect gamma rays, with a particular energy and abundance; at less than mid-radius, we would expect higher energy gamma rays, but with lesser abundance. These photons are in the temporal system (i.e., "cosmic" or "non-local" system) and so would appear as a steady uniform microwave background to a spatial observer. The higher energy, lesser abundant gamma rays would map in as lower energy microwaves with lowest abundance (intensity).

The spectral energy distribution in the actual CMB is observed to be "thermal" as the following excerpt shows:

CMB Measured Intensity vs Frequency

The plot below shows a set of precise measurements of the intensity of the cosmic microwave background (colored points) compared to a perfect blackbody curve (thin black line). Colors indicate the measurement techniques. The data are in excellent agreement with a blackbody curve over nearly 4 decades in frequency and more than 5 orders of magnitude in intensity.



The most precise measurements of the CMB spectrum at the millimeter wavelengths near its peak were made by the Far Infrared Absolute Spectrophotometer (FIRAS) instrument aboard the Cosmic Background Explorer (COBE) satellite. FIRAS determined the CMB temperature to be 2.725 +/- 0.001 K, with deviations from a perfect blackbody limited to less than 50 parts per million in intensity. ARCADE measures the CMB spectrum at centimeter wavelengths (a decade below FIRAS) to search for new signals that would be undetectably small at the shorter wavelengths measured by FIRAS

The expected energy distribution (spectrum) from temporal stars has the expected profile at least superficially. It is "thermal" instead of "inverse thermal" or "non-thermal". This conclusion, however, is still very speculative as a lot of details have yet to be worked out.

The microwave background was found to be uniform to 1 part in 100,000 to 1 part in 1,000,000. It does not vary with time of year or direction in space. This is an extraordinary uniformity in what we see as an otherwise lumpy universe. Conventional science has not yet devised a credible explanation for the *entire spectrum* of background radiation.

Cosmic ray (particle) background

Temporal stars are made of inverse atoms just like our spatial stars are made of normal atoms. This implies that there should be cosmic background *particles* just like there is cosmic background *radiation*. The omnipresent gravity of stars and galaxies tends to sweep our space free of particles. This makes our space transparent, and also puts most of the particles in a high energy environment inside stars. The counterpart of this should be happening in the temporal system. According to the speed spectrum diagram, the temporal zero speed, as seen from the spatial zero, is 2c distant (note that the diagram is considering only one dimension). The spatial reference system can only depict speed *as a change of position in space* up to 1c; speeds in excess of this will appear as energy. Low speed temporal particles, such as those in interstellar temporal gas or atoms in a temporal planet, will appear to us spatial observers as a diffuse background of particles moving through our reference system at the speed of light and possessing extremely high energies. Atoms in a temporal star will appear likewise, except that they will have lower energies, and be much more plentiful.

It should be pretty clear that these particles are what the scientific community has been calling "cosmic rays". They are in fact extremely isotropic and homogeneous just as we would expect if they have a temporal origin. As for their energies consider this:

> "We find that there is a flux of about 1 particle/cm^2 sec at 10 GeV. Above 10^{20} eV, we can expect to see only about 5 particles *per century* per square kilometer! . . . If we add up all the energy carried by all of the CR [Cosmic Ray] particles, we find that the rate of arrival of CR energy on the Earth amounts to about 100,000 kilowatts (10^5 kw) —about one billion times less than the energy arriving in sunlight, but comparable to the total energy that we receive in starlight." (*Cosmic Rays*, Michael W. Friedlander, 1989, p. 84, 86)

A particle with an energy of 10^{20} eV has roughly the energy of a golf ball or baseball in flight.(http://www.sciam.com/0197issue/0197swordy.html , http://www.sciencedaily.com/releases/1998/12/981216081217.htm) They are extremely rare, and do not deposit all their energy in one collision. You don't have to worry about getting hit by one. A natural process that could *accelerate* particles to 10^{20} eV and spray them uniformly all over the Universe is simply inconceivable. Even earthbound particle accelerators cannot produce particle energies that are even close to 10^{20} eV. It is much more reasonable to view these particles as originating in a temporal system with near zero speed; this will explain both the extremely high energy and the diffuse nature of these particles when seen from a spatial system.

Cosmic ray particles also seem to be within the required mass range. These inverse atoms with inverse masses must be members of an "Inverse Periodic Table." If we choose 1 a.m.u. as the likely natural unit of mass, then the mass range of the Table can be worked out. However, cosmic ray particle mass are usually stated in terms of electron masses. If we equate one amu with 1835 electron masses, then the mass range of the "Inverse Periodic table" extends from (2/1)(1835) to

(2/118)(1835) electron masses. This range, 3670 to 31 electron masses, apparently does encompass the range of cosmic ray particle masses. (note that the particles with the *highest* atomic number are actually the *least* massive particles)

Gamma ray background

See below

X-ray background

See above

Far Ultraviolet background

"The Mystery of the Cosmic Diffuse Ultraviolet Background Radiation", http://arxiv.org/abs/1404.5714 ;

> The diffuse cosmic background radiation in the GALEX far ultraviolet (FUV, 1300 Å - 1700 Å) is deduced to originate only partially in the dust-scattered radiation of FUV-emitting stars: the source of a substantial fraction of the FUV background radiation remains a mystery. The radiation is remarkably uniform at both far northern and far southern Galactic latitudes, and it increases toward lower Galactic latitudes at all Galactic longitudes.

Visible light (cosmic optical) background

"The universe's background starlight is twice as bright as expected", Liz Kruesi (March 2022**)**
https://www.sciencenews.org/article/universe-cosmic-background-light-bright-new-horizons

> Even when you remove the bright stars, the glowing dust and other nearby points of light from the inky, dark sky, a background glow remains. That glow comes from the cosmic sea of distant galaxies, the first stars that burned, faraway coalescing gas — and, it seems, something else in the mix that's evading researchers.
>
> Astronomers estimated the amount of visible light pervading the cosmos by training the New Horizons spacecraft, which flew past Pluto in 2015, on a spot on the sky mostly devoid of nearby stars and galaxies (*SN: 12/15/15*). That estimate should match measurements of the total amount of light coming from galaxies across the history of the universe. But it doesn't, researchers report in the March 1*Astrophysical Journal Letters*.
>
> "It turns out that the galaxies that we know about can account for about half of the level we see," says Tod Lauer, an astronomer at the National Science Foundation's NOIRLab in Tucson, Ariz.
>
> For decades, astronomers have measured the extragalactic background light in different wavelengths, from radio waves to gamma rays (*SN: 8/23/13; SN: 11/29/18*). This provides a census of the universe and gives researchers hints into the processes that emit those types of light.
>
> But the background visible light — dubbed the cosmic optical background, or COB — is challenging to measure from the inner solar system. (See also https://iopscience.iop.org/article/10.3847/2041-8213/ac573d)

Infrared background?

"NASA Rocket Experiment Finds the Universe Brighter Than We Thought" (2014)
https://www.nasa.gov/press/2014/november/nasa-rocket-experiment-finds-the-universe-brighter-than-we-thought

> A NASA sounding rocket experiment has detected a surprising surplus of infrared light in the dark space between galaxies, a diffuse cosmic glow as bright as all known galaxies combined. . . .
>
> During the CIBER flights, the cameras launch into space, then snap pictures for about seven minutes before transmitting the data back to Earth. Scientists masked out bright stars and galaxies from the pictures and carefully ruled out any light coming from more local sources, such as our own Milky Way galaxy. What's left is a map showing

fluctuations in the remaining infrared background light, with splotches that are much bigger than individual galaxies. The brightness of these fluctuations allows scientists to measure the total amount of background light.

To the surprise of the CIBER team, the maps revealed a dramatic excess of light beyond what comes from the galaxies. The data showed that this infrared background light has a blue spectrum, which means it increases in brightness at shorter wavelengths. This is evidence the light comes from a previously undetected population of stars between galaxies. Light from the first galaxies would give a spectrum of colors that is redder than what was seen.

Heating of the Sun's corona

"The Mystery of Coronal Heating" https://science.nasa.gov/news-articles/the-mystery-of-coronal-heating

> Imagine standing around a roaring campfire, roasting s'mores. You feel the warmth of the flames as the marshmallows crackle. Now back away. You get cooler, right?
>
> That's not how it works on the sun. The visible surface of the sun has a temperature of 10,000 F. Backing away from the inferno should cool things down, but it doesn't. Instead, the sun's upper atmosphere, or corona, sizzles at millions of degrees - a temperature 200 to 500 times higher than that of the roaring furnace below.
>
> For more than a half-century, astronomers have tried to figure out what causes the corona to be so hot. It is one of the most vexing problems in astrophysics.

"Heating the solar corona" https://phys.org/news/2019-09-solar-corona.html

> The hot outer layer of the sun, the corona, has a temperature of over a million degrees Kelvin, much more than the surface temperature of the Sun which is only about 5500 degrees Kelvin.

"Corona of the Sun" https://www.britannica.com/place/Sun/Corona

> [The solar corona has] highly ionized atoms such as iron X (iron with nine electrons missing), iron XIV, and calcium XV, which can exist only if the coronal temperature is about 1,000,000 K. These lines can only be emitted in a high vacuum. The strongest are from iron . . .
>
> While the corona is one million times fainter than the photosphere in visible light (about the same as the full Moon at its base and much fainter at greater heights), its high temperature makes it a powerful source of extreme ultraviolet and X-ray emission.
>
> The density at the base of the corona is about 4×10^8 atoms per cubic centimetre, 10^{13} times more tenuous than the atmosphere of Earth at its base.
>
> The conductivity of a hot ionized plasma is extremely high, and the coronal temperature decreases only as the $^2/_7$ power of the distance from the Sun. Thus, the temperature of the interplanetary medium is still more than 200,000 K near Earth.
>
> Low-density plasmas radiate so little that they can reach and maintain high temperatures. By detecting excess helium absorption or X-ray emission in stars like the Sun, researchers have found that coronas are quite common. Many stars have coronas far more extensive than that of the Sun.
>
> The key factor is the extremely low density, which hampers heat loss. The corona is a harder vacuum than anything produced on Earth.

Hence, the Sun's corona is hotter on the outside, cooler on the inside—just the opposite of what would be expected if the corona were heated by the Sun. This situation is described as ". . . one of the most vexing problems in astrophysics."

But it is doubtful that a thermodynamic concept called "temperature" can truly be applied to something that "is a harder vacuum than anything produced on Earth". We are likely looking at what could be called "spectral temperatures" caused by ionization due to X-ray and gamma ray background radiation. This would certainly account for the inside-out structure of the corona, the high "temperatures", and the low actual heat content.

But is there a gamma ray background? Yes, it has been observed for decades, although its source is still unknown to conventional astronomy.

"The Gamma-ray Background" Robert Naeye
https://www.nasa.gov/mission_pages/GLAST/science/gamma_ray_background.html

> From as far back as the late 1960s, orbiting observatories have found a diffuse background of gamma rays streaming from all directions. "If you had gamma-ray vision and looked at the sky, there would be no place that would be dark," says Large Area Telescope (LAT) team member David Thompson of NASA's Goddard.
>
> To this day, astronomers have not pinned down the source of this gamma-ray background.

"Background Radiation, Gamma ray" Carl E. Fitchel
https://ned.ipac.caltech.edu/level5/ESSAYS/Fitchel/fichtel.html

> "It is now known that the diffuse celestial radiation extends well into the gamma ray region, at least to approximately 200 MeV, and that it is isotropic at least on a coarse scale. The degree of isotropy that has already been shown to exist, taken together with the spectrum being different from that of the galactic diffuse radiation, strongly supports this diffuse radiation being extragalactic in origin. The intensity of the radiation is rather weak . . ."

Thus, the solar corona is apparently "heated" or "energized" by the background of gamma rays and X-rays. (An interesting implication is that any planet with an atmosphere should also have a (barely detectable) corona.)

Possibly relevant: 'Auroras may heat up Jupiter's skies", *Science News* September 11, 2021, p. 12-13.

Spatially random gamma ray bursts: Temporal supernova?

"What are Gamma Ray Bursts." http://www.outerspacecentral.com/gamma_ray_page.html

"Normally lasting anywhere from a few milliseconds to several hours, gamma ray bursts (GRBs) shine hundreds of times brighter than a typical supernova and about a million trillion times as bright as the sun. GRBs are for a brief time the brightest source of cosmic gamma ray photons in the universe. GRBs emit more energy in a few seconds than our whole galaxy does in a year. GRBs are observed roughly once per day from completely random directions of the sky. (It was their complete randomness that originally convinced astronomers that GRBs existed outside of our Milky Way.) Note that the label of a GRB indicates its date, i.e. year-month-day, for example, GRB 130427A means it occurred on April 27, 2013 and if there were more than one that day A means it was the first of the day.

We only see a GRB when earth lies along the path of one of the two narrow GRB jets, which means there are many more GRBs each day that we don't see. The nuclear blast emits a surge of gamma rays as well as x-rays, and they produce afterglows that can be observed both at optical and radio wavelengths. No two GRBs are alike, each one has its own individual light curve plotted over time.

Gamma ray bursts are separated into two classes: long duration bursts and short duration bursts. Long duration bursts last more than 2 seconds and short duration ones last less than 2 seconds. However, short duration bursts range from a few milliseconds to 2 seconds with an average duration time of only 0.3 seconds (300 milliseconds). The long duration bursts normally last anywhere from 2 seconds to a few hours with an average duration time of about 30 seconds.

Scientists believe that the two types of bursts have completely different sources. They are not small and large versions of the same phenomenon."

"Gamma-ray burst" (https://en.wikipedia.org/wiki/Gamma-ray_burst)

From 1991, the Compton Gamma Ray Observatory (CGRO) and its Burst and Transient Source Explorer (BATSE) instrument, an extremely sensitive gamma-ray detector, provided data that showed the distribution of GRBs is isotropic– not biased towards any particular direction in space

What these "cosmic flash bulbs" really are is unknown. One possibility offered here is that, because of their spatially random distribution, they could be temporal stars exploding as non-local supernova.

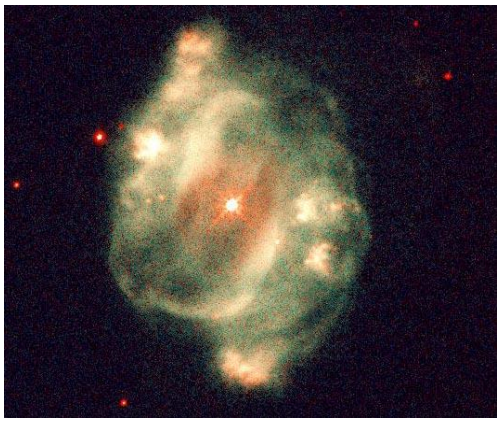
A normal supernova occurs in a small amount of time and spreads debris in a large amount of space. A temporal supernova is just the inverse (from our standpoint): it occurs in a small amount of space in a large amount of time. The spatial aspect would probably be concentrated enough to be seen in a spatial reference system, provided the time element, or part of it, coincides with the time of the progressive Ether that the local reference system happens to be using in that moment. Such a phenomena would be moving through our reference system at the speed of light, and so the appearance would be momentary. If the localization coincides with a large aggregate of ordinary matter, all that will be left from the extremely intense gamma ray flash will be an afterglow from what no longer exists.

Non-local astronomy is not yet a recognized field of study. Our observational system freely mixes local and non-local phenomena together. It is currently difficult to tell which is which, especially in the fog of institutional politics and fanciful theories. Is a gamma ray burst due to a sweep of 2D radiation across our observation point? Or could it be due to how a long temporal event maps into a spatial reference system? Do we have to deal with "double inversions" of energy, space, and time? There is currently just not enough information available for reasonable speculation. We need more observational data and a great deal more insights as to how phenomena in Transitional Space/Time map into a spatial reference system.

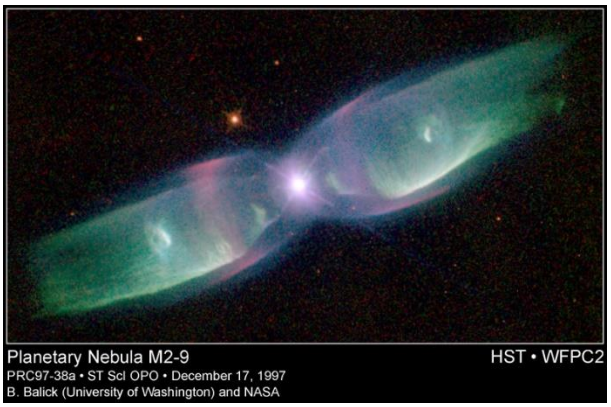
"Bipolar symmetry" (mirror imaging) due to temporal motion

"A **bipolar nebula** is a type of nebula characterized by two lobes either side of a central star. About 10-20% of planetary nebulae are bipolar." https://en.wikipedia.org/wiki/Bipolar_nebula

A strange effect noticed by astronomers is called "Bipolar symmetry". This is apparently a reference system effect caused by temporal motion. It arises because temporal motion is non-directional. That is, the motion of X towards Y cannot be distinguished from that of Y towards X when viewed from a telescope in the spatial system. Hence, an object with this kind of motion will show up with a mirror image. Note the astronomer's comment regarding NGC 5307 shown below in the first panel. Other examples are given as well.



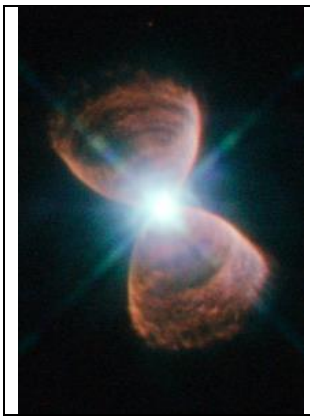
Explanation: Some stellar nebulae are strangely symmetric. For example, every major blob of gas visible on the upper left of NGC 5307 appears to have a counterpart on the lower right https://apod.nasa.gov/apod/ap971231.html



https://apod.nasa.gov/apod/image/0201/m2-9_hst_big.jpg (butterfly nebula)

https://www.space.com/dancing-ghosts-radio-galaxies

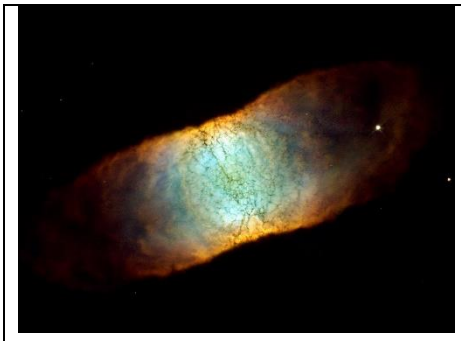
Butterfly Nebula (NGC 6302) https://www.constellation-guide.com/butterfly-nebula/



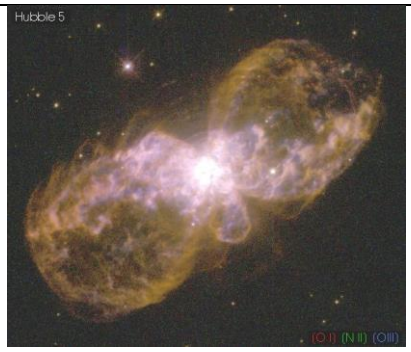
Bizarre alignment of planetary nebulae

"Astronomers have used the NASA/ESA Hubble Space Telescope and ESO's New Technology Telescope to explore more than 100 planetary nebulae in the central bulge of our galaxy. They have found that butterfly-shaped members of this cosmic family tend to be mysteriously aligned — a surprising result given their different histories and varied properties."
https://esahubble.org/news/heic1316/
https://astropix.ipac.caltech.edu/image/esahubble/heic1316a

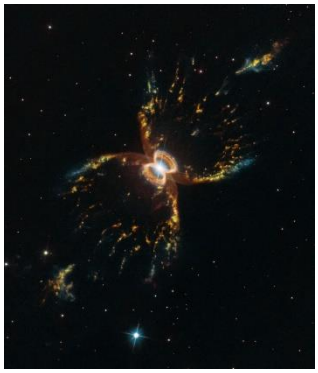
(Note the spaced-rings quantization effects apparent in this image.)



The **Retina nebula** (IC 440) is a planetary nebula in the southern constellation of Lupus.[3] The nebula possess an unusually rectangular structure with a white dwarf star at its centre.
https://www.conservapedia.com/Retina_nebula

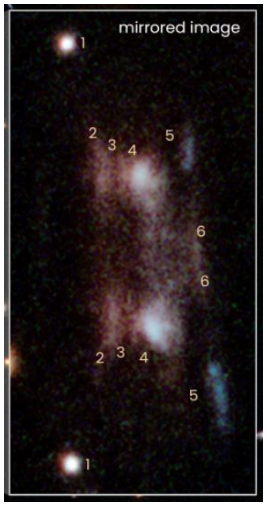


Hubble Double Bubble Planetary Nebula ("Hubble 5")
https://www.pinterest.com/pin/460633868117667259/

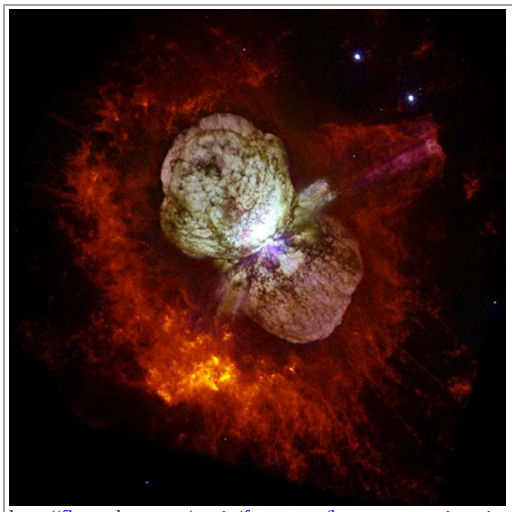


http://sci.esa.int/hubble/61308-hubble-celebrates-its-29th-birthday-with-unrivaled-view-of-the-southern-crab-nebula-heic1907/

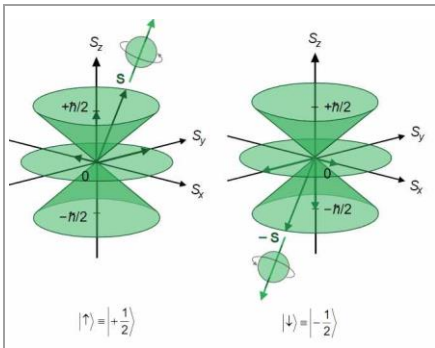
Credit:
http://www.universetoday.com/61103/what-is-a-nebula/#more-61103
(three of these appear to be the hourglass type seen "top down")



"Hamilton's Object"
https://stsci-opo.org/STScI-01FFJEPRH3E4GBDJS9BKY3R0MZ.png
https://phys.org/news/2021-10-galaxy-mystifies-hubble-astronomers.html



http://flatrock.org.nz/static/frontpage/large_eta_carinae.jpg



By Maschen - Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=17763199

See also: Quantum-like laws below

Astronomical temporal dimensional effects and quantum mechanical temporal dimensional effects may have something in common when related to ordinary space. Compare this image of Eta Carinae with the quantum mechanical heuristic of half-integer spin:

Conventional astronomy attributes mirror imaging to "gravitational lensing". But it is difficult to conceive how lensing could produce these near perfect mirror images. (*Seeing Red Redshifts, Cosmology and Academic Science*, Dr. Halton Arp, (1998) chapter 7, "Gravitational Lenses")

Quantization effects due to temporal motion

Stellar explosions can lead to quantization effects due to temporal motion. If the mass is insufficient to ultimately form a binary star system, the result can lead to planet formation.

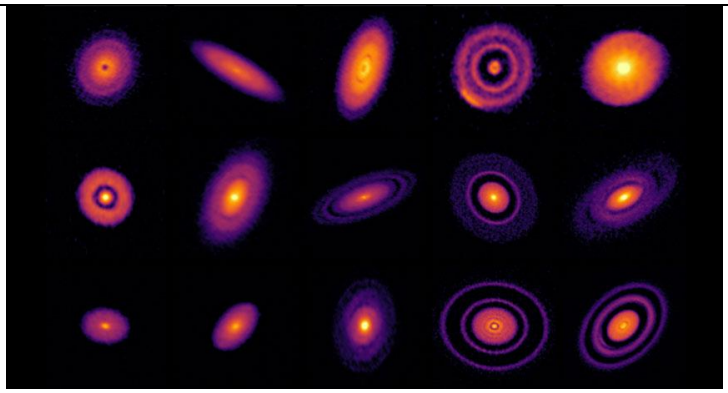
Energetic stellar explosions can conceivably lead to one of two outcomes: the formation of a linear jet or a set of circular rings. A jet requires very high energy that can produce two dimensions of temporal motion and one dimension of spatial motion. I doubt that a Type 1 supernova has this required energy available.

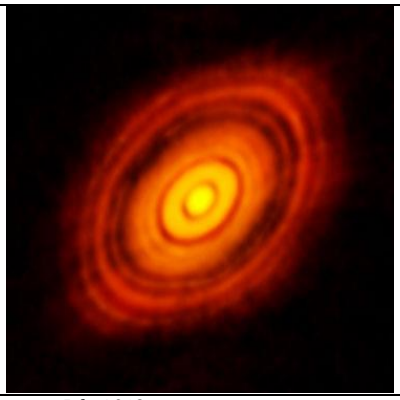
The other possibility, with a lesser energy requirement, is that of one dimension of temporal motion and two dimensions of spatial motion. This would produce a flat disk of debris; the quantization would segregate this into discrete rings like those visible in the photographs below. Ultimately the system becomes a series of asteroid belts surrounding a central star. The belts eventually coalesce into individual planets.

The quantization implies that planetary orbits are not random. When you look at the images below, think of Bode's Law and Kuiper belts and Oort clouds (or maybe "Oort rings"). Bode's law also implies there should be at least one planet in a habitable zone a long time after the initial stellar explosion. (https://en.wikipedia.org/wiki/Titius%E2%80%93Bode_law) (https://en.wikipedia.org/wiki/Kuiper_belt)..(https://en.wikipedia.org/wiki/Oort_cloud)

Hypothetically, if somewhat more energy is available, a cone shaped structure could be produced. (which will appear with its mirror image, forming an hourglass shape). This can be clearly seen in SN1987A (below) and in the two Hubble images above. Again, note the quantization rings. It is not clear that this could condense into a planetary system, but maybe a binary star system is possible.

> What is really weird is the formation of systems that appear rectangular or square such as those shown below. I think this could stem from 'quantum like laws' that deal with intrinsic spin orientation. Use of Geometric Algebra (a.k.a. Clifford algebra) might clarify a geometric relationship, as it "integrates different mathematical concepts highlighting geometrical meanings that are often hidden in the ordinary algebra." (p. 89) But for now, it is a mystery.





"Gaps in gas disks around stars may not always mark newborn planets", *Science News*, Lisa Grossman, July 2019
https://www.sciencenews.org/article/protoplanetary-gas-disks-stars-gaps-newborn-planets

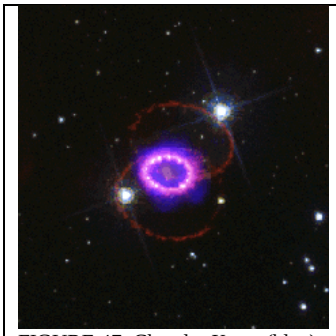


FIGURE 47: Chandra X-ray (blue) and Hubble optical (red) composite of Supernova 1987A
https://cxc.harvard.edu/newsletters/news_13/sn1987a.html

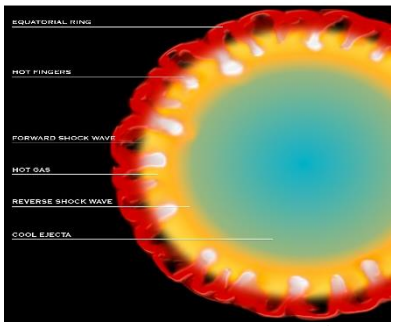
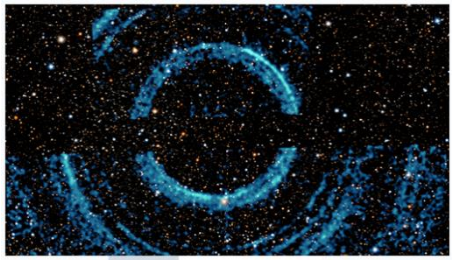


FIGURE 48: Schematic illustration of Supernova 1987A dynamics. (shockwave interpretation)
https://cxc.harvard.edu/newsletters/news_13/sn1987a.html



https://chandra.harvard.edu/photo/2021/v404cyg/

"Scientists find evidence the early solar system harbored a gap between its inner and outer regions", Jennifer Chu (October 15, 2021 https://phys.org/news/2021-10-scientists-evidence-early-solar-harbored.html (See also: https://phys.org/news/2019-12-meteorites-clues-solar.html)

> "It's pretty hard to cross this gap, and a planet would need a lot of external torque and momentum," says lead author and EAPS graduate student Cauê Borlina. "So, this provides evidence that the formation of our planets was restricted to specific regions in the early solar system."
>
> "Gaps are common in protoplanetary systems, and we now show that we had one in our own solar system," Borlina says. "This gives the answer to this weird dichotomy we see in meteorites, and provides evidence that gaps affect the composition of planets."

"Distribution of distances in the solar system" V. Perinova , A. Luks, P. Pintr (https://vixra.org/pdf/0805.0002v1.pdf , page 9)

> "In this paper we assume that there exists a law by which big objects – planets and moons of giant planets – do not originate anywhere, but at allowed distances from the central body. Unnegligible number of authors have issued from similar assumptions and derived empirical formulae for parameters of allowed orbits."

"Comprehensive Research on the Origin of the Solar System Structure by Quantum-Like Model" Qingxiang Nie, accepted May 27, 2011 https://file.scirp.org/pdf/IJAA20110200005_81422959.pdf

> "Numerical calculation shows that the radial distribution density of the particles has the character of wave curves with decreasing amplitudes and elongating wavelengths. By means of this model, many questions of the solar system, such as the planetary distance, mass, energy, angular momentum, the distribution of satellites, the structure of the planetary rings, and the asteroid belt and the Kuiper belt etc., can be explained in reason. In addition, the abnormal rotations of Venus and Mercury can be naturally explained by means of the quantum-like model."

Seeing Red *Redshifts, Cosmology and Academic Science,* Halton Arp (1998) p. 221:

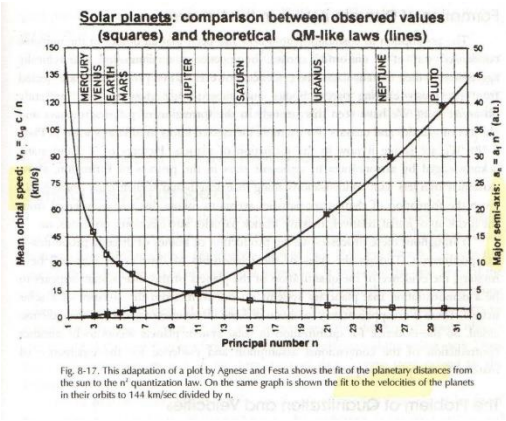


Fig. 8-17. This adaptation of a plot by Agnese and Festa shows the fit of the planetary distances from the sun to the n^2 quantization law. On the same graph is shown the fit to the velocities of the planets in their orbits to 144 km/sec divided by n.

The above graph shows a plot of mean orbital speeds and distances for all solar planets versus Principal Quantum number *n*. Note the close agreement with QM-like laws.

And this also from Arp (p. 222-223; note the reference to "non-local physics" and "time"):

> ". . . the evidence of the quantization of the planets of the solar system appears to be a demonstration that planetary systems do not form from the collapse of a solar nebula. There is no apparent way to obtain ordered discreteness from a formless. diffuse cloud. So the evidence . . . seems to be . . . for the emergence of material from a previous body."

> "In the phenomenon of quantization, we have a connection from the redshifts of the quasars, to the redshifts of the galaxies, to the properties of the solar system and finally to the properties of fundamental particles like the electrons. The quantization of physical parameters would seem to be governed by the laws of non-local physics, *i.e.* like quantum mechanics in which the fundamental parameter appears to be time –for example the repetition rate of a spinning electron. It is clear that we are not running out of problems to solve. In fact, contrary to some rumors that we are reaching an end to physics, the more we learn the more primitive our previous understanding appears, and the more challenging the problems become."

Quantization effects are also apparent in quasar redshifts (considered later; See also https://en.wikipedia.org/wiki/Redshift_quantization

The realization that *quantum-like laws* apply not only to the realm of the very small (like atoms) but also to astronomically sized objects, has absolutely astonishing but non-obvious implications. We have seen how there are two kinds of non-locality . The rules governing temporal motion can be extended far beyond the realm of Quantum Mechanics. They imply that we can travel to distant galaxies without traversing the intervening space (see non-local propulsion example above). They imply that something the size of an aircraft carrier can be made to act like a massless particle. The

technical means to do this has been *accessible* for at least a century. But this knowhow is ***not*** something that our not so “civil”-ization can currently use.

See also:

https://www.academia.edu/29945834/Research_needed_on_monopolar_pulsed_high_voltage_levitation
https://www.researchgate.net/publication/338293585_Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems
http://scripturalphysics.org/4v4a/CapacitorTests/CapacitorTests.html

Filamentary structures due to temporal motion

Why would a supernova explosion produce *filamentary* structures instead of a gigantic blob of expanding gas?

The filamentary structures are conventionally attributed to magnetic fields.

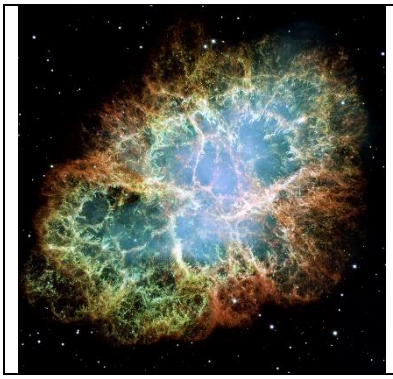
Here, a working space/time hypothesis is that these are products of Type 2 supernova and that there are two types of explosion products. One is a below-light- speed component that will appear as an expanding cloud of debris, as in a normal explosion. The other is an above-light- speed component, that, because of the temporal speed component, the resulting structure is a narrow jet. The Veil nebula and Pencil nebula are possible examples of jets that have been disrupted by environmental effects. Jets can also be widened by the fact the temporal motion has a random directional component in a spatial reference system. Jets should hypothetically become non-local and disappear observationally or become a combination of a jet remnant and an expanding sphere of explosion products (i.e., the same object but with different space and time displacements of its components).

Veil Nebula
https://upload.wikimedia.org/wikipedia/commons/thumb/6/6e/Veil_Nebula_-_NGC6960.jpg/1200px-Veil_Nebula_-_NGC6960.jpg

Pencil nebula
http://cdn.eso.org/videos/videoframe/eso1236b.jpg

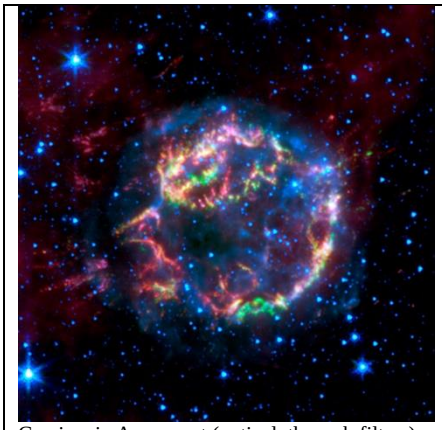
Vela Supernova remnant
https://astrodonimaging.com/gallery/vela-supernova-remnant-wide-view/
https://en.wikipedia.org/wiki/Vela_Supernova_Remnant

Simeis 147: Supernova Remnant
a.k.a. Sharpless 2-240 (catalog) and
the "Spaghetti Nebula" (popular).
https://science.nasa.gov/simeis-147-supernova-remnant
Remnant is about 150 light years across (well beyond the Gravipause)

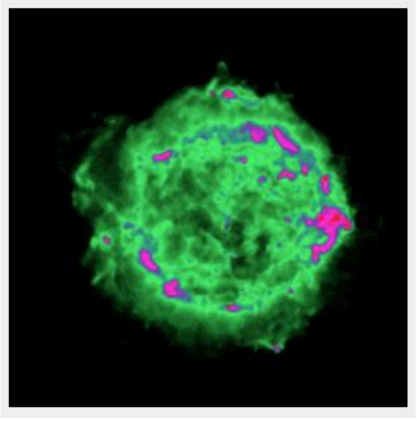


Crab nebula
Hubble Space Telescope mosaic image
At the center of the nebula lies the Crab Pulsar. . . . At X-ray and gamma ray energies above 30 keV, the Crab Nebula is generally the brightest persistent gamma-ray source in the sky, with measured flux extending to above 10 TeV. . . In 2019 the Crab Nebula was observed to emit gamma rays in excess of 100 TeV, making it the first identified source beyond 100 TeV.
https://en.wikipedia.org/wiki/Crab_Nebula

This a possible example of a high-mass supernova.



Cassiopeia A remnant (optical, through filters)
"Cassiopeia A is a supernova remnant at distance 11,000 light-years in our galaxy in the constellation Cassiopeia. The original star, about 15 to 20 times more massive than our sun, died in a cataclysmic "supernova" explosion relatively recently in our own Milky Way galaxy"
http://hyperphysics.phy-astr.gsu.edu/hbase/Starlog/cassa.html
http://hyperphysics.phy-astr.gsu.edu/hbase/Starlog/picsta/cassa.jpg



Cassiopeia A remnant (X-ray image)
Credit: Chandra

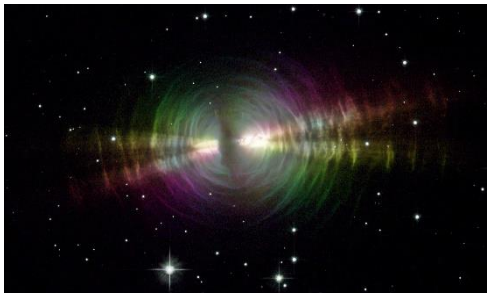
https://www.followthistrendingworld.com/post/cassiopeia-a

This a possible example of a low-mass supernova (compared to the Crab nebula).

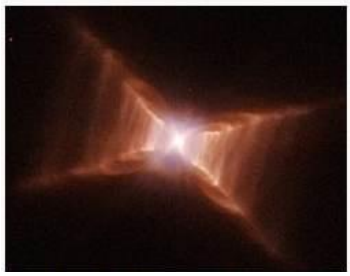
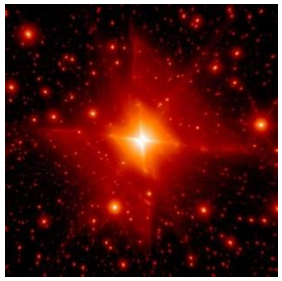
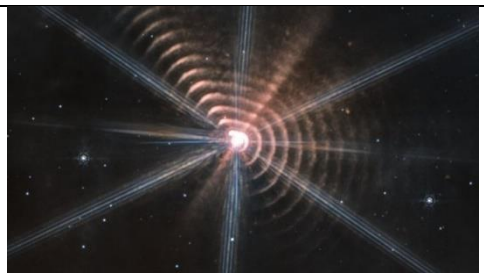
Eskimo Nebula (NGC 2392)

"The outer disk contains unusual light-year long orange filaments".
https://www.nasa.gov/multimedia/imagegallery/image_feature_762.html
https://www.constellation-guide.com/eskimo-nebula-ngc-2392/

NGC 6153, also known as ESO 331-6 or HD 148687, is located in the southern constellation of Scorpius, about 4,830 light-years away.
The nebula is elliptical in shape and has an extremely rich network of loops and filaments, shown clearly in this new image from Hubble.
http://www.sci-news.com/astronomy/science-ngc6153-planetary-nebula-02939.html



https://commons.wikimedia.org/w/index.php?curid=19200945 (egg nebula)
(note quantization effects)

		
http://en.wikipedia.org/wiki/Red_Rectangle_Nebula Some people think the Earth is flat. Others think it is round. Here is another possibility: maybe it is cube shaped. Or maybe brick shaped. ☺ Also note quantization effects.	http://en.wikipedia.org/wiki/Red_Square_Nebula http://www.newscientist.com/article/dn11577-red-square-nebula-displays-exquisite-symmetry/	https://cdn.mos.cms.futurecdn.net/p9krHxVwLDkbbJU9bb7XgK-970-80.jpg

Polarized radiation

"Thermal vs. Nonthermal Radiation"
http://www.grandunification.com/hypertext/NonthermalThermalRadiation.html

> "Synchrotron radiation is polarized. It has been argued that since the radiation from pulsars is polarized, this proves that pulsars use synchrotron radiation. (This is not a valid argument.) Some of the problems with these arguments are: we do not know everything; there might be some other process that generates the pulsar's energy, another process might also create polarized radiation."

"Evidence in Support of a Rotational Model for the Pulsar PSR 0833–45", V. Radhakrishnan, *et al*., *Nature*, volume 221 (Feb. 1, 1969) pages 443–446:

> "Measurements of the pulsar tentatively identified with the supernova remnant Vela X support the rotational model. This pulsar is remarkable for the very high degree of linear polarization in its signals."

Related: See "Pulsars" , *Annual Review of Astronomy and Astrophysics*, Volume 8, 1970
Hewish, pp 265-296 "beaming in two coordinates"
https://www.annualreviews.org/doi/10.1146/annurev.aa.08.090170.001405

Polarized radiation is the only type of radiation that can originate in "2D space". This might be the same thing as what could be called "magnetic space" (motion that is missing one spatial gravitational dimension). Pulsar radiation should be 100% polarized at its point of origin, with subsequent partial depolarization due to the interstellar medium.

The luminosity of the source will be proportional to $1/d$ instead of $1/d^2$.

Nonthermal Radiation

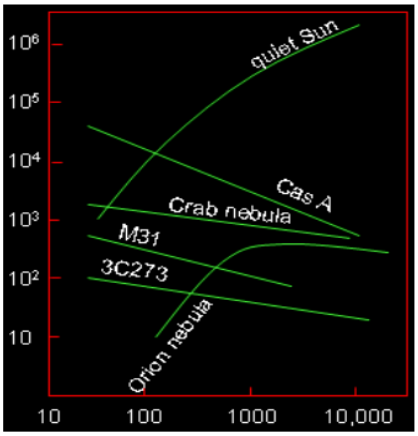
"Thermal vs. Nonthermal Radiation"
http://www.grandunification.com/hypertext/NonthermalThermalRadiation.html

> "Some of the more unusual objects in space such as supernovas, pulsars, radio galaxies, Seyfert galaxies, BL Lacertae objects, GRBs, and others, produce copious amounts of photons that can **not** be described as "blackbody radiation" or "thermal radiation.". . . . This process is **not** as well understood by scientists, and what is known may be incomplete."

> "Synchrotron Radiation from Pulsars?
> If pulsars create their radiation using the synchrotron method, then the pulsar would need a massive magnetic field, and a continuous supply -- lasting billions of years -- of very high energy electrons. It might be possible to create a situation in space where these unusual conditions are met. However, there appear to be pulsars spread throughout the universe and they appear to be fairly common. It is unlikely that such an unusual process would be the source of energy for an apparently common object."

> "Nonthermal Radiation from Radio Galaxies
> Radio galaxies such as 3C 449 produce tremendous amounts of nonthermal radiation. Current astrophysical theory can not explain this radiation with the synchrotron radiation explanation. The arms of huge radio galaxies like 3C449 can be 100 million light years long. But at best, synchrotron radiation could only work out to about 10 million light years. After that, the electrons would have decelerated to the point where they do not radiate any more. Furthermore, as many reports indicate, it is common at the ends of a radio galaxy's arms for the radiation to brighten!"

"HET608-M03A02: Mechanisms of Radio Emission: Thermal and Non-Thermal Radio Emission"
http://www.astronomy.swinburne.edu.au/sao/downloads/HET608-M03A02.pdf



"Here we compare the spectrum of two thermal sources (Orion Nebula and the quiet Sun) with synchrotron emission from the quasar 3C273, the galaxy M31, and the supernova remnants Crab nebula and Cassiopeia A. The shape of the two types of emission clearly differ." http://www.astronomy.swinburne.edu.au/sao/downloads/HET608-M03A02.pdf

See also:

https://phys.org/news/2021-09-unusual-giant-radio-galaxy-j01331302.html
"Extragalactic radio sources with sharply inverted spectrum at metre wavelengths":
https://ui.adsabs.harvard.edu/abs/2014MNRAS.443.2824G/abstract
https://www.researchgate.net/publication/264005199_Extragalactic_radio_sources_with_sharply_inverted_spectrum_at_metre_wavelengths
https://ui.adsabs.harvard.edu/abs/2014ASInC..13..157G/abstract

Radioactive decay rates and the neutrino environment

Astronomers are faced with the problem of astronomically large structures emitting enormous amounts of power (gamma rays, X-rays, radio waves) for long periods of time. What is the source of such power? Enormous amounts of material –spanning light years – becoming radioactive could be a

source of such power. The material could be reaching its age limit, or be ejected into a “foreign” space/time environment such as Transitional Space/Time. Or there could just be a change in radioactive decay rates due to some external influence such as neutrino flux. Such clouds of material would therefore be “self-powered” and emit radio waves, X-rays and gamma rays.

Sources of “high-energy astrophysical neutrinos” are known (https://phys.org/news/2021-08-emission-blazar-txs.html) and so this is worth investigating.

Natural radioactive decay rates might not be constant. In fact, we have studied radioactive decay on earth for only about 100 years, and still do not understand what actually causes radioactivity. Isotope geochronology (ages of rocks, planets, stars, etc.) is based on this limited knowledge and extrapolates it out to *billions* of years and applies it to things that are far outside of our experience. (Is this "junk science"? It certainly seems presumptuous.)

Researchers believe they have seen variations in the radioactive decay rates of silicon 32, chlorine 36, manganese 54, radium 226, and possibly plutonium 238. The variations are typically a few tenths of one percent and seem to correlate with the yearly variations in Earth-Sun distance.

The scattered quotes below are from "Half-Life (more or less)", by Davide Castelvecchi, *Science News*, Nov 22, 2008, p. 20-23 https://www.sciencenews.org/article/half-life-more-or-less :

> " . . . when researchers suggested in August that the sun causes variations in the decay rates of isotopes of silicon, chlorine, radium, and manganese, the physics community reacted with curiosity, but mostly with skepticism."
>
> "Both experiments had lasted several years, and both had seen seasonal variations of a few tenths of a percent in the decay rates of the respective isotopes."
>
> "In those experiments, the decay rate changes may have been related to Earth's orbit around the sun, the Purdue teams says. In the Northern Hemisphere, Earth is closer to the sun in the winter than in the summer. So the sun may have been affecting the rate of decay, possibly through some physical mechanism that had never before been observed."
>
> "The closer to the sun, the denser the shower of neutrinos."
>
> "If the results are confirmed, and nuclear decay is not immutable, perhaps physicists could find a way to speed it up to help get rid of waste from nuclear power plants."

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"About 7 percent fewer solar neutrinos hit detectors when Earth is furthest from the sun, compared with when it's closest, says Arthur B. McDonald, director of the Sudbury Neutrino Observatory in Ontario." *Science News*, Vol 160, No. 8, August 25, 2001, p. 115
https://www.sciencenews.org/article/18953

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"Evidence for Correlations Between Nuclear Decay Rates and Earth-Sun Distance", J. H. Jenkins, *et al*. Available online at http://arxiv.org/abs/0808.3283 ;

> The decay-rate aberrations that Jenkins noticed occurred during the middle of the night in Indiana – meaning that something produced by the sun had traveled all the way through the Earth to reach Jenkins' detectors. What could the flare send forth that could have such an effect?
>
> Jenkins and Fischbach guessed that the culprits in this bit of decay-rate mischief were probably solar neutrinos, the almost weightless particles famous for flying at almost the speed of light through the physical world – humans, rocks, oceans or planets – with virtually no interaction with anything.

> Then, in a series of papers published in *Astroparticle Physics*, *Nuclear Instruments and Methods in Physics Research* and *Space Science Reviews*, Jenkins, Fischbach and their colleagues showed that the observed variations in decay rates were highly unlikely to have come from environmental influences on the detection systems.
>
> Their findings strengthened the argument that the strange swings in decay rates were caused by neutrinos from the sun. The swings seemed to be in synch with the Earth's elliptical orbit, with the decay rates oscillating as the Earth came closer to the sun (where it would be exposed to more neutrinos) and then moving away.

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"The strange case of solar flares and radioactive elements", Stanford University, https://news.stanford.edu/news/2010/august/sun-082310.html

> All of the evidence points toward a conclusion that the sun is "communicating" with radioactive isotopes on Earth, said Fischbach.
>
> But there's one rather large question left unanswered. No one knows how neutrinos could interact with radioactive materials to change their rate of decay.
>
> "It doesn't make sense according to conventional ideas," Fischbach said. Jenkins whimsically added, "What we're suggesting is that something that doesn't really interact with anything is changing something that can't be changed.

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"Is the Sun emitting a mystery particle?", Ian O'Neill, 2010, http://news.discovery.com/space/is-the-sun-emitting-a-mystery-particle.html (https://www.seeker.com/is-the-sun-emitting-a-mystery-particle-1765094955.html):

> However, when they compared their measurements with other scientists' work, the values of the published decay rates were not the same. In fact, after further research they found that not only were they not constant, but they'd vary with the seasons. Decay rates would slightly decrease during the summer and increase during the winter.
>
> As the Earth is closer to the sun during the winter months in the Northern Hemisphere (our planet's orbit is slightly eccentric, or elongated), could the sun be influencing decay rates?
>
> In another moment of weirdness, Purdue nuclear engineer Jere Jenkins noticed an inexplicable drop in the decay rate of manganese-54 when he was testing it one night in 2006. It so happened that this drop occurred just over a day before a large flare erupted on the sun. . . .
>
> The sun link was made even stronger when Peter Sturrock, Stanford professor emeritus of applied physics, suggested that the Purdue scientists look for other recurring patterns in decay rates. As an expert of the inner workings of the sun, Sturrock had a hunch that solar neutrinos might hold the key to this mystery.
>
> Sure enough, the researchers noticed the decay rates vary repeatedly every 33 days -- a period of time that matches the rotational period of the core of the sun. The solar core is the source of solar neutrinos.
>
> It may all sound rather circumstantial, but these threads of evidence appear to lead to a common source of the radioactive decay rate variation. But there's a huge problem with speculation that solar neutrinos could impact decay rates on Earth: *neutrinos aren't supposed to work like that*.

“Shredded stars may rev up neutrinos”, Emily Conover *Science News*, June 20, 2020, p. 9

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If you studied radioactivity or evolution or isotope geochronology, you probably learned about the “decay constant” for radioactive materials. These courses leave the impression that radioactive materials decay at a “constant” rate over geologic time. And so the claim that decay rates can be affected by solar neutrinos may be hard to accept. But caution is still indicated here. Decay rates can

be altered by some very ordinary technical means. This proves that decay rates are not as immutable and "constant" as most of us have been led to believe. Some examples:

"Characterization of Uranium Co-deposited with Hydrogen on Nickel Cathodes", G. Goddard, J. Dash and S. Frantz, *Transactions of the American Nuclear Society*, 83, 376-378 (2000)).

> "Previously, it has been reported that nuclear transmutation reactions are accelerated when radioactive elements are subjected to low-level electric fields during electrolysis of aqueous electrolytes. . . . Our research investigated the co-deposition of U3O8 and H on Ni cathodes, using an acidic electrolyte and a Pt anode. Then, the radiation emitted by the electroplated U3O8 was compared with radiation emitted by un-electrolyzed U3O8 from the same batch. . . . The electroplated U3O8 initially produced ~2900 counts in 3 min (April 17, 2000). This rose sporadically in steps to 3700 counts in 3 min on May 11, 2000, and it remained relatively constant at this level until the . . . measurements ended on June 8, 2000. The unelectrolyzed U3O8 from the same batch emitted radiation at a much lower rate, ~1250 counts in 3 min, and this remained almost constant over the entire period of measurement." (G. Goddard, J. Dash and S. Frantz, "Characterization of Uranium Co-deposited with Hydrogen on Nickel Cathodes", *Transactions of the American Nuclear Society*, 83, 376-378 (2000)).

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"Radioactivity Deactivation at High Temperature in an Applied DC Voltage Field Demonstrated in 1964". Larry Geer & Cecil Baumgartner, http://www.gdr.org/nuclear_half.htm)

> "Radioactive isotope decay rate or half-life can be increased or decreased as needed to deactivate radioactivity or to increase shelf life of radioactive isotopes. Currently many investigators/experimenters have reported half-life anomalies and have demonstrated repeatability of the various processes. The deactivation/neutralization of radioactivity in isotopes by the several demonstrated processes clearly suggest the possibility of full scale processing of radioactive nuclear materials to deactivate radioactive nuclear materials. "

"High temperature suppresses radioactive decay", *Science Frontiers*, Mar-Apr- 1994, http://www.science-frontiers.com/sf092/sf092c14.htm

> "Thirty years ago, Otto Reifenschweiler was searching for a compound which could protect Geiger-Mueller tubes from damage when they are first ionised. He found the compound, which became a money-spinner for Philips, in a mixture of titanium and radioactive tritium. He also discovered that as the mixture was heated, its radioactivity declined sharply. No process known to physics could account for such a baffling phenomenon: radioactivity should be unaffected by heat. Nevertheless, as the temperature increased from 115°C to 160°C, the emission of beta particles fell by 28%." ("High temperature suppresses radioactive decay", *Science Frontiers*, Mar-Apr- 1994, http://www.science-frontiers.com/sf092/sf092c14.htm ; *Physics Letters A* ("Reduced radioactivity of tritium in small titanium particles," Vol. 184, pp. 149-153; see also "Radioactivity Reborn, Eugene F. Mallove http://www.infinite-energy.com/images/pdfs/MalloveIE54Radio.pdf; https://www.osti.gov/biblio/512913-about-possibility-decreased-radioactivity-heavy-nuclei)
>
> "The 'Reifenschweiler effect' is the observation that the beta-decay of tritium half-life 12.5 years is delayed reversibly by about 25-30% when the isotope is absorbed in 15 nm titanium-clusters in a temperature window in between 160-275 C. Remarkably at 360 C the original radioactivity reappears. The effect is absent in bulk metal. Discovered around 1960/1962 at Philips Research Eindhoven, The Netherlands Reifenschweiler extensively discussed his observation with o.a Casimir (the director of research at the time), Kistemaker (ultracentrifuge expert), and although no satisfactory explanation was found, R. was allowed to publish it. At the time a unique example as to how an electronic environment might affect nuclear phenomena." (http://pages.csam.montclair.edu/~kowalski/cf/311alberts.html ; https://scienceblog.com/35810/evidence-for-relativistic-interpretation-of-casimir-effect-2/)

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"The History Of The Discovery Of Transmutation At Texas A&M University", J.O'M. Bockris, Molecular Green Technology, College Station, Texas 77845, Revised Version, 6th of August, 2003 http://www.lenr-canr.org/acrobat/BockrisJthehistory.pdf

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"Cool solution to waste disposal" (2006; Claus Rolfs, Ruhr University)
http://phys.org/news73578268.html
http://www.theengineer.co.uk/news/waste-solution/295563.article

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"Half-life heresy: Accelerating radioactive decay", Aussiegirl (2006)
http://aussiethule.blogspot.com/2006/10/half-life-heresy-accelerating_23.html
https://www.newscientist.com/article/mg19225741-100-half-life-heresy-accelerating-radioactive-decay/

> "His dramatic – and controversial – claim is that by encasing certain radioisotopes in metal and chilling them close to absolute zero, it ought to be possible to slash their half-lives from millennia to just a few years. He says it's time to rewrite defeatist textbooks that insist we cannot alter the pace of radioactivity. "When I was studying physics, my teachers said nuclear properties are independent of the environment – you can put nuclei in the oven or the freezer, or any chemical environment, and the nuclear properties will stay the same," says Rolfs. "That is not true any more." "

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"Serial statistics: Is radioactive decay random?", Anderson, J. L. and G.W. Spangler, 1973, *Phys. Chem. J.*, 77 (26) : pp. 3114 - 3121. https://pubs.acs.org/doi/abs/10.1021/j100644a019

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"Nuclide transmutation device and nuclide transmutation method"
https://www.freepatentsonline.com/EP1202290B1.pdf

> "The present invention relates to a nuclide transmutation device and a nuclide transmutation method associated, for example, with disposal processes in which long-lived radioactive waste is transmuted into short-lived radioactive nuclides or stable nuclides, and technologies that generate rare earth elements from abundant elements found in the natural world."

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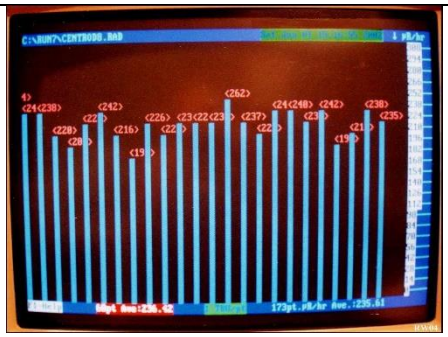
"Chernobyl Exclusion Zone Radioactive Longer Than Expected"
https://abcnews.go.com/Technology/chernobyl-exclusion-zone-radioactive-longer-expected/story?id=9374383
http://www.wired.com/wiredscience/2009/12/chernobyl-soil

> Cesium 137's half-life — the time it takes for half of a given amount of material to decay — is 30 years, but the amount of cesium in soil near Chernobyl isn't decreasing nearly that fast. And scientists don't know why.
>
> . . .scientists have calculated that what they call cesium's "ecological half-life" — the time for half the cesium to disappear from the local environment — is between 180 and 320 years.
>
> Scientists expected the ecological half-lives of radioactive isotopes to be shorter than their physical half-life as natural dispersion helped reduce the amount of material in any given soil sample. For strontium, that idea has held up. But for cesium the the opposite appears to be true.

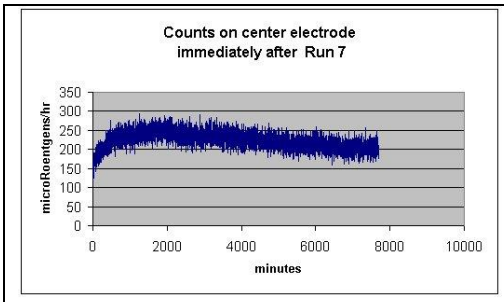
———

Even amateur investigators have reached the same conclusions. The four slides below are from "Brian Fraser's Adventures in Energy Destruction" (2011) http://scripturalphysics.org/qm/adven.html

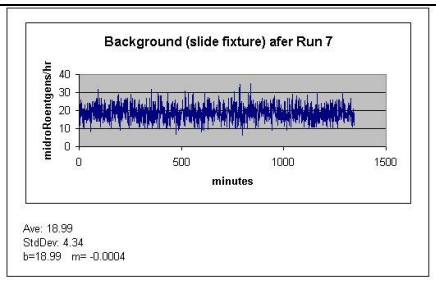
These are the basic materials and tools required for these experiments. The yellow crystals in the plastic bag are uranium nitrate hexahydrate. The RM-60 counter connects with a computer through the serial cable.



This is what the computer monitor looks like during counting (a dry electrode in this case). At the far right side of the screen, the blue bar shows that 235 counts have been received in one Time Base Unit (one minute in this case). The display scrolls leftward as counting continues (usually for days). Electrolyzed radioactive materials often show periodic variations ("saw-toothing" and "stair-casing") in the bar graph display, as well as in the data plots.



"The counting on the dry electrode began 8 minutes after the electrolysis was shut off. The emission rate starts out at about 150 counts/min and then steeply ***increases*** instead of decreases. It goes up to about 270 and then very slowly tapers off, again in somewhat of a saw-tooth fashion. The counting was terminated after about 130 hours."



"The count level, 19 microRoentgens/hr, from the empty fixture is essentially the same as that for the room in general. This shows that neither the RM-60 nor the counting fixture has been contaminated with stray radioactive dust. Note also that the curve is flat (albeit noisy); the background is essentially constant with the passage of time. . . ."

And so now consider a couple of astrophysical implications of the neutrino/atomic decay hypothesis. As dust particles in outer space are pulled into the Sun by its gravitation, the nuclides comprising them are subject to an ever more intense flux of neutrinos. This will cause some previously stable elements to become radioactive, and some already unstable nuclides to become even more radioactive. Once they are actually inside the Sun and have mixed with the solar material for a long time, they will presumably reach a new neutrino/atomic decay equilibrium. After a very long time, the star will finally enter the supernova stage and blow itself to bits. This drastically changes the density of its matter, and the previously existing neutrino flux drops drastically in intensity too. This *again* upsets the neutrino/atomic decay equilibrium and may cause the previously stable equilibrium to move to a new and more active decay range. Supernova products like nickel 56 and cobalt 56, which have half-lives of 6.1 days and 77 days, respectively, may be the result of such a processes.

External neutrino flux density can affect atomic decay rates. But there is yet another even more important mechanism: the violent ejection of ordinary atomic material into a Transitional Space/Time environment.

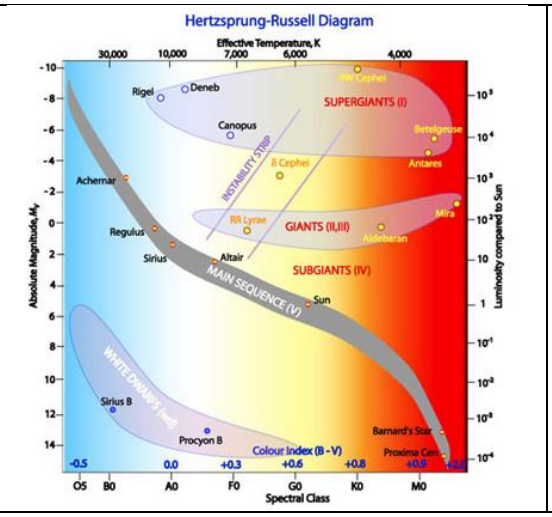
As shown above in the early pages of this essay, matter is a net temporal structure (t^3/s^3). The neutrinos that are entrained in it, have a spin structure that behaves like rotational space (somewhat like the electron, but with an additional spin dimension). The "elbow room" that these entrained neutrinos experience is essentially fixed (discounting an external flux of neutrinos, which could change their density over a very long period of time). But a violently explosive process like Type 2 supernova could change all this. Such a process, if energetic enough, will add a dimension (or two) of temporal motion. This an expansion in *time* (instead of space), and will result in a spatially ultra dense object like a white dwarf star. This adds more *time* to the environment seen by the neutrinos, and because they are essentially rotational units of space, they can diffuse ("move", which requires a space-to-time relation, not a space-to-space relation) into this expanded temporal environment. The lowered neutrino density upsets the previous equilibrium that affects radioactive decay rates, and the matter becomes radioactive. This happens suddenly. Type 2 supernova suddenly transfers an enormous amount of matter from one space/time environment to one of a different type. The result will be intense radio emissions accompanied by X-ray and gamma ray emissions.

This effect becomes even more spectacular with exploding star *clusters.* Stars in the central regions of galaxies will reach their age limit at approximately the same time. What happens when hundreds of thousands of these stars begin exploding all at once? We will soon find out in the section below on Quasars.

But first we need a quick review of the *Beyond Einstein* version of the two types of supernova.

Supernova

Type 1 supernova



"The Hertzsprung-Russell diagram the various stages of stellar evolution. By far the most prominent feature is the main sequence (grey), which runs from the upper left (hot, luminous stars) to the bottom right (cool, faint stars) of the diagram. The giant branch and supergiant stars lie above the main sequence, and **white dwarfs** are found below it." **Credit**: R. Hollow, CSIRO. https://astronomy.swin.edu.au/cosmos/h/hertzsprung-russell+diagram

Type 1 (or "Type I" if you love Roman numerals) supernova occurs when a star reaches a mass/thermal limit; It is essentially a structural limit found at the upper end of the H-R diagram (see above) where hot massive stars are located. The star power process suddenly produces far more power than its structure can stably dissipate. This results in a spectacular explosion.

These stars, and their explosions, have very similar properties, and are used as a "standard candle" for distance determinations in astronomy.

The explosion produces products of two types. One type is in conventional space, and is seen as a rapidly expanding cloud of debris. Eventually much of the debris will re-coalesce due to gravitation and form either a planetary system or a binary star system, depending on the amount of mass available.

The other type is an expanding cloud of debris in Transitional Space/Time. Here, speeds greater than that of light predominate. Due to reference system inversion effects, this "cloud" will be observed as a very compact object—a white dwarf star (which may or may not be visible). Its gravitation becomes inverted in the new space/time setting. Strangely, this implies that atoms of low atomic mass tend to *sink* to the center of the star, and the heavier elements tend to *rise* towards the surface. The star will therefore be seen as "metal rich". Stars with this inverted structure are inherently unstable. They will eventually "burp" ("nova") at various (long) intervals as the excess time displacement dissipates, and the gravitation effects slowly return to normal. The star will also *expand* and approach the main sequence diagonal of the H-R diagram from below.

The idea that stars could have inverted gravitation is definitely a weird claim. Yet hints of this possibility occasionally show up in the literature:

> White dwarfs . . . are the last place astronomers expected to find a nearly pure oxygen atmosphere. Yet that's exactly what recently turned up . . . .
>
> But a newly discovered white dwarf, about 1,200 light-years away in the constellation Draco, has no hydrogen or helium at its surface. Its atmosphere is dominated by oxygen . . . .
>
> While oxygen dominates this white dwarf's atmosphere, neon and magnesium come in second and third.
> ("Odd white dwarf offers peek at core", Christopher Crockett, *Science News* April 30, 2016, p. 12)

Another weird claim here is that an explosion in the time dimension could produce a highly compact star. But astronomers have been playing around with similar ideas:

> "The largest black holes are formed through imploding massive stars, instead of exploding massive stars ("supernova"). Formed through an implosion, these massive black holes stay put in the same place where their predecessor (the massive star) was born, the plane of the Milky Way galaxy." https://phys.org/news/2021-11-lack-massive-black-holes-telescope.html

Note that this is called an ***im***plosion in the spatial domain instead of an ***ex***plosion in the time domain. Also, motion in time cannot be directly represented in a spatial reference system. It is in a sense "motionless motion"◊. Hence, such objects "stay put in the same place where their predecessor (the massive star) was born".

The Type 1 supernova explosion is likely preceded by the Wolf-Rayet stage of a star. These are extremely hot, very massive stars which are surrounded by a nebulosity or a turbulent atmosphere.

> "Theories about how WR stars form, develop, and die have been slow to form. . . . They are rare, distant, and often obscured, and even into the 21st century many aspects of their lives are unclear."
> (https://en.wikipedia.org/wiki/Wolf%e2%80%93Rayet_star)

The power process in these stars is evidently nearing the critical iron-cobalt-nickel group. The partial table of elemental abundances below gives a hint at what might happen as this group is approached.

At. no.	Element	Solar photosphere
26	Fe	7.45
27	Co	4.92
28	Ni	6.25
29	Cu	4.21
30	Zn	4.60

https://www.sciencedirect.com/topics/physics-and-astronomy/elemental-abundance
https://en.wikipedia.org/wiki/Abundance_of_the_chemical_elements

The heavier elements are slightly less stable than the lighter elements. At very high temperatures their rotational structures partially revert to linear and release energy that is equivalent to 2 a.m.u. per atom. This is the heavy element "burning" process. In the partial sequence above, Zn is burned first, then Cu. The star's structure can accommodate the successive power increments from these two elements. But the burning of nickel might cause a problem. Nickel is more abundant than what has preceded it, and the power output is going to be higher. This will likely cause part of the star's surface to be blown outward momentarily. Gravitation will eventually bring it back to the star, and the cycle will repeat until most of the nickel is burned.

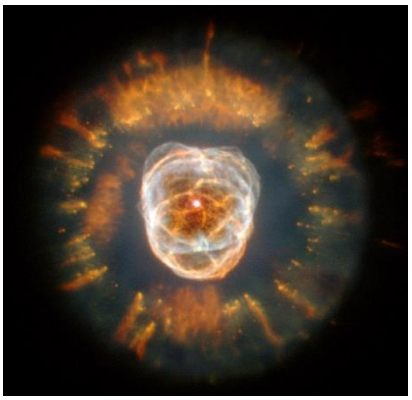
The outward bound matter is cooling and will eventually radiate visible light. But this might not be true of the inbound matter. The inbound matter is approaching a very energetic star, and its internal atomic energy levels are increasing, suppressing the tendency to radiate to what would usually be lower and more stable levels. Hence, the diffuse outbound matter becomes visible, but the diffuse inbound matter does not.

The result of all this —apparently— is a so-called "planetary nebula" (which has nothing to do with planets).

https://hdwallpaperim.com/space-stars-helix-nebula/

https://www.pinterest.com/pin/480407485244685698/

NGC 7293 seen through several visible filters by Hubble Space Telescope
https://en.wikipedia.org/wiki/Helix_Nebula#/media/File:NGC7293_(2004).jpg



Eskimo Nebula (NGC 2392)
"The outer disk contains unusual light-year long orange filaments".
https://www.nasa.gov/multimedia/imagegallery/image_feature_762.html

Eventually, the burning process moves on to the iron-cobalt group. The star's structure is completely inadequate to handle the power generated by the massive amounts of iron present in the core. The result will be a Type 1 supernova.

Refs:

https://en.wikipedia.org/wiki/Wolf%e2%80%93Rayet_star
https://www.sciencedirect.com/topics/physics-and-astronomy/elemental-abundance
https://en.wikipedia.org/wiki/Planetary_nebula
Superluminal speeds and high redshifts associated with O and B stars. (below)

Type 2 supernova

The occurrence of Type 2 supernova depends on an age limit. The size or mass of the star is not directly important. There is essentially no structural effect; only age is the relevant factor. Type 2 supernovae have different light curves, different peak intensities, etc., compared to Type 1 because they can have a broad range of masses. They have so many differences they are not used as "standard candles". These stars will be found *mostly* in older structures, like large galaxies rather than younger structures like the Magellanic Clouds (inbound to our galaxy), and globular clusters (which are actually *young* structures). They will be particularly prevalent in the central portions of galaxies where they will be largely unobservable.

For stars of comparable mass, the total explosive energy is more than that for Type 1, but is spread over a longer period of time. Hypothetically, the entire mass of the star will be affected. The energies are so extreme that the matter is ultimately propelled beyond the Transitional Space/Time region and into 3D time. The matter then becomes completely non-local. Its atoms will be scattered randomly throughout the entire (spatial) Universe.

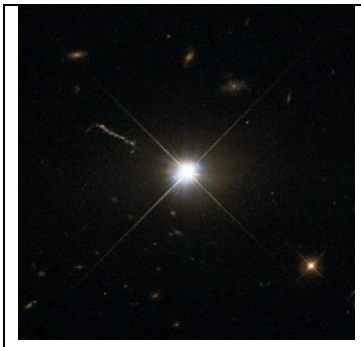
Stars of lower mass, however, may not release enough energy to make the transition, despite having a more efficient energy conversion process.

After the explosion but before the transition, we will see weird structures due to the temporal component in Transitional Space/Time. Some of these have been shown above:

Bipolar Symmetry (mirror images)
Quantization effects
Filamentary structures (filaments, jets, rings)
Non-thermal radiation
Polarized radiation

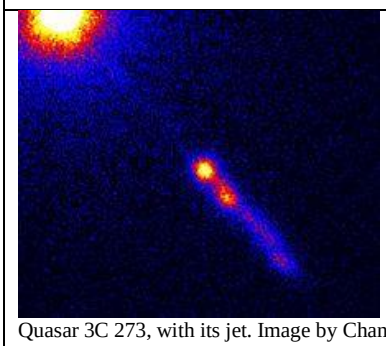
Quasars

A quasar is a blue star-like, high-redshift object associated with an irregular galaxy that appears to be disturbed by a highly energetic process. The galaxy has a significantly lower redshift than the quasar, and is associated with intense radio frequency emission. Examples

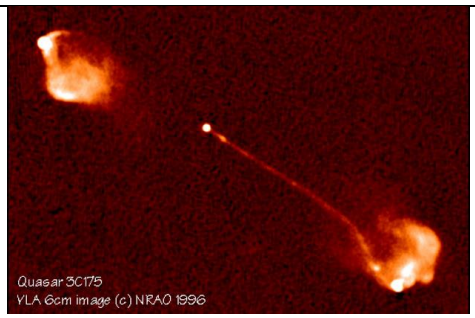


"This image from Hubble's Wide Field and Planetary Camera 2 (WFPC2) is likely the best of ancient and brilliant quasar 3C 273, which resides in a giant elliptical galaxy in the constellation of Virgo (The Virgin)

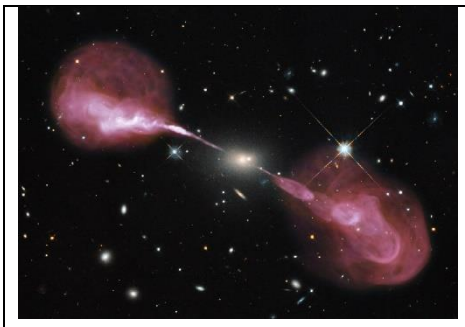
The term quasar is an abbreviation of the phrase "quasi-stellar radio source," as they appear to be star-like on the sky."
https://www.nasa.gov/content/goddard/nasas-hubble-gets-the-best-image-of-bright-quasar-3c-273/



Quasar 3C 273, with its jet. Image by Chandra X-ray Observatory
"3C 273 is visible in May in both the northern and southern hemispheres. Situated in the Virgo constellation, it is bright enough to be observed with larger amateur telescopes."
https://en.wikipedia.org/wiki/3C_273



Quasar 3C 175
https://apod.nasa.gov/apod/image/0109/3c175_vla.jpg



A Radio-Optical View of the Galaxy Hercules A
https://www.nrao.edu/pr/2012/herca/

"Some two billion light-years away, the yellowish elliptical galaxy in the center of the image appears quite ordinary as seen by Hubble in visible wavelengths of light. . . . But the innocuous-looking galaxy, also known as 3C 348, has long been known as the brightest radio-emitting object in the constellation Hercules. Emitting nearly a billion times more power in radio wavelengths than our Sun, the galaxy is one of the brightest extragalactic radio sources in the entire sky.

The VLA radio data reveal enormous, optically invisible jets that, at one-and-a-half million light-years long, dwarf the visible galaxy from which they emerge. The jets are very-high-energy plasma beams, subatomic particles and magnetic fields shot at nearly the speed of light from the vicinity of the black hole. The outer portions of both jets show unusual ring-like structures suggesting a history of multiple outbursts from the supermassive black hole at the center of the galaxy.

The innermost parts of the jets are not visible because of the extreme velocity of the material; relativistic effects confine all the light to a narrow cone aligned with the jets, so that light is not seen by us."

Here is a summary of the high points of the *Beyond Einstein* view of quasars:

- Quasars are the products of an exploding galaxy. Over a long time, a large galaxy may eject several quasars.

- Galactic explosions are caused by matter in stars reaching an age limit. Tens of thousands of such stars in the central portion of a large galaxy begin exploding at about the same (astronomical) time. This produces a pressure which nudges large clumps of stars beyond the Gravipause, and they begin to move away from the galaxy. They accelerate as gravitation is gradually being reduced and more and more of the explosion speed component begins to dominate.

- For a galaxy that is being viewed face-on (as a disk) quasars may be ejected in front or behind the galactic disk. Ones that are in front of the galaxy may outshine the galaxy, especially if the galaxy is very distant (billions of light years). Hence, the quasar may be seen as an isolated object. Quasars that are behind the galactic disk may illuminate the central region of the galaxy causing it to be unusually bright (a so called "N galaxy").

- The explosions are generated by Type 2 supernova and are extremely energetic. In a galactic setting the ejection products are *mainly* high speed *stars.* Entrained material may be swept along with the ejected stars.

- Entrained material in the explosion products can be moving at various speeds. Some will be at sub-light speeds and show the usual thermal line spectrum. Some will be at extreme speeds (temperatures) that are the temporal equivalent of solids and give a continuous, mostly featureless non-thermal spectrum, polarized by the motion in Transitional Space/time where one spatial dimension becomes inactive. (see https://en.wikipedia.org/wiki/BL_Lacertae_object). BL Lacertae objects are likely prequasar objects. As the temperatures decrease, the quasar line spectrum will appear.

- The speeds are high enough to involve one or two dimensions of temporal motion. The motion into Transitional Space/Time shrinks the spatial appearance, resulting in a high density, star-like object (quasar) that could be composed of a billion stars (equivalent to a lenticular or small spiral galaxy!) The quasar is the galactic version of a white dwarf star (both are ultra-compact, but one is a galaxy and one is a star).

- Quasar lifetimes are expected to be very long—billions of years. They should have the life expectancy of a small galaxy. But this is NOT a conclusion shared by institutional astronomy. In that school of thought, quasars are at very extreme cosmological distances, are burning through their power supply at a furious rate, and are basically short-lived "freak phenomena". But in this presentation, quasars are spatially associated with large galaxies at "ordinary" distances (like M87 and 3C273). The power process is based on the very energetic Type 2 supernova. And the radiation from the quasar is distributed two dimensionally (like a disk instead of a sphere). These factors greatly reduce the power requirement that is otherwise so problematic to conventional astronomy. ("The radiant energy of quasars is enormous; the most powerful quasars have luminosities thousands of times greater than a galaxy such as the Milky Way." https://en.wikipedia.org/wiki/Quasar)

- Speeds greater than light can take place in only two spatial dimensions. Quasar radiation will be partially polarized because the quasar itself is moving at a superluminal speed, but the atoms of matter inside the constituent stars may be moving at speeds less than that of light (if not, light emitted from *that* matter would also be polarized).

Related: light from pulsars can be expected to be 100% polarized (initially) "Evidence in Support of a Rotational Model for the Pulsar PSR 0833–45", V. Radhakrishnan, *et al*., *Nature*, volume 221 (Feb. 1, 1969) pages 443–446:

> "Measurements of the pulsar tentatively identified with the supernova remnant Vela X support the rotational model. This pulsar is remarkable for the very high degree of linear polarization in its signals."

- Luminosity of an object emitting in only two spatial dimensions will be proportional to 1/d instead of $1/d^2$. This may make the object much brighter than expected, and greatly reduce expected power requirements.

- Gravitation decreases in proportion to the inverse square of the distance. An object ejected from a galaxy would therefore be expected to accelerate and speed up as the distance increases. But this may not be true of quasars. Temporal motion is "motionless motion" (as previously mentioned at 1, 2, and 3). As the quasar distance increases, the spatial motion decreases until eventually the quasar remains in the same location observationally.

- Many of the stars within the blob are themselves experiencing an age limit and are exploding (Type 2 supernova). The small appearance and energetic explosions result in variations of brightness over "short" periods of time.

- Type 2 supernovae eventually divide their radiation between the spatial system and the temporal system, resulting in "pulsar" behavior. But in a galactic setting, the pulsations overlap and the signals become smeared together. (Related: "Strange radio waves emerge from the direction of the galactic center", https://phys.org/news/2021-10-strange-radio-emerge-galactic-centre.html)

- A galaxy must have a certain size and a certain minimal mass overlay of the central region for the pressure to build up high enough to eject a quasar. The ejection of a quasar leaves a "hole" in the galactic center, which minimizes the ability for pressure to build up again. Such a galaxy may then eject material (stars, dust, gas, etc.) in the form of a jet. After a long time, the hole will "heal" and the quasar production process can repeat.

- The jet's narrow appearance is caused by temporal motion. These superluminal speeds are apparently also common in the cores of large massive galaxies. They cannot be observed directly because of the overlying material. Their presence is inferred from high spatial density star counts in the core, and from radio frequency and infrared emission from the core (caused by gamma rays which are inverted into radio and infrared emission from our standpoint).

- By this criteria, our Milky Way galaxy is close to a pre-quasar producing stage. (See also "Mini-jet found near Milky Way's supermassive black hole" https://phys.org/news/2021-12-mini-jet-milky-supermassive-black-hole.html)

- It is likely that our Milky Way galaxy was actually a jet ejection product from M87—a super gigantic spheroidal galaxy in the Virgo constellation. The superluminal blob of a billion stars could not maintain its speed and fell back into the sub-light speed range. Over a long period of time, the temporal motion dissipates and the blob expands out into the spatially extended form of the Milky Way that we see today. Of course, it then acts like a normal galaxy and can accrete more material and star clusters by normal gravitation. Included in this mix will be some very old stars that will eventually become Type 2 supernova with pulsar characteristics.

- The jet in M87 is just the current one. It probably had some predecessors, and will be followed by several more until the entire galaxy is disrupted. (This implies, incidentally, that galaxies have a size limit. It may also explain how a galaxy may become "diffuse".)

- Quasars may become non-local due to superluminal speeds; they will enter the realm of 3D time and disappear from the spatial system as a recognizable object.

- Once you realize what is going on in M87, it is no longer just a fuzzy blob on a photographic plate. It becomes a stupendous, astonishing, almost incomprehensible object.

Resources:

"A Catalog of Quasar Properties from SDSS DR7"
https://users.obs.carnegiescience.edu/yshen/BH_mass/paper/old/sample_rv1.pdf

Seeing Red *Redshifts, Cosmology and Academic Science,* Halton Arp (1998)

Ultrahigh density star counts in galactic cores.

Stars cannot initially form within about a few light years of each other. After the initial star fully develops and finally undergoes a Type 1 supernova explosion, a binary or even multiple star system may form. This kind of star system will be approximately the size of our solar system, and well within the Gravipause of a few light years. Stars are generally either within light hours of their neighbors, or are separated by many light years, with nothing in between. Yet there are examples of stars in the cores of large galaxies being separated by mere *light weeks*. How is this possible? First, let's get the overall picture of star population density in general.

"Stellar density" https://en.wikipedia.org/wiki/Stellar_density

The true stellar density near the Sun is estimated as 0.004 stars per cubic light year, or 0.14 stars pc^{-3}. . . . The locations within the Milky Way that have the highest stellar density are the central core and the interior of globular clusters. A typical mass density for a globular cluster is 70 M_{Sun} pc^{-3}, which is 500 times the mass density near the Sun.

The stellar density near the Sun https://www.britannica.com/place/Milky-Way-Galaxy/Star-populations-and-movement

" . . . the RECONS (Research Consortium on Nearby Stars) has sought all stars within 10 parsecs of the Sun and found a density in the solar neighbourhood of about 0.003 star per cubic light-year."

"Binary stars" https://www.atnf.csiro.au/outreach/education/senior/astrophysics/binary_intro.html

. . . multiple star systems of main-sequence stars are far more common than single main-sequence stars in the galactic disk. The binary main-sequence star systems slightly outnumber single main-sequence stars. The ratios of binary systems to triplet and quadruplet systems is 46:9:2.[1] This means that only 34% of the main sequence stars in the Galactic disk have no companion stars.

"Are most stars binary?" https://askinglot.com/are-most-stars-binary

Actually most stars are in binary systems. Perhaps up to 85% of stars are in binary systems with some in triple or even higher-multiple systems.

"Binary Stars" https://astrophysicsspectator.org/topics/stars/BinaryStars.html

The size of a binary star system is more like the size of the Solar System than the separation between stars in the stellar neighborhood. The orbital periods of the majority of binary stars are between 1/3 and 300,000 years, with the median at 14 years.[2] Only a tiny fraction of binary stars have periods shorter than 1 day or longer than 1 million years. For a binary system with a total mass of 1 solar mass, the median orbital period of 14 years corresponds to a semimajor axis of only 6 AU, which is slightly more than Jupiter's distance from the Sun.

"Globular clusters" https://en.wikipedia.org/wiki/Globular_cluster

Globular clusters can contain a high density of stars; on average about 0.4 stars per cubic parsec, increasing to 100 or 1000 stars/pc^3 in the core of the cluster.[46] In comparison, the stellar density around the sun is roughly 0.1 stars/pc^3.[47]The typical distance between stars in a globular cluster is about 1 light year,[48] but at its core the separation between stars averages about a third of a light year—13 times closer than Proxima Centauri, the closest star to the Sun.[49]

"Bulge and nucleus of the Milky Way" https://pages.uoregon.edu/imamura/323/lecture-2/event.html

The central region of the Galactic Bulge (the nucleus) is interesting because it shows activity similar to Galactic Nuclei, AGNs (although at a considerably lower level).

- The core harbors ~ 1,600 stars per cubic light year. This is several 100,000 times as dense as the average stellar density of our Galaxy! Further, when one approaches the center of the Galaxy, one finds a dense cluster containing roughly 1 million stars with a stellar density around 10 million times as high as in the Solar neighborhood.

- Near the center of the Milky Way lies the bright radio source Sagittarius A. There is structure on scales ranging from 600 light years (the filamaents) to what appears to be a ring of material on scales of 10-15 light years to structure on scales of 10 Astronomical Units (~80 light minutes ~ 1.5 billion km)—an Astronomical Unit is the average distance of the Earth from the Sun.

"The Center of our Galaxy" http://www.astronomy.ohio-state.edu/~ryden/ast162_7/notes31.html (Astronomy 162: Professor Barbara Ryden)

Key Concepts

- Stars near the center of our galaxy are packed close together.

- The center of our galaxy harbors highly energetic phenomena.

- Within a parsec of the galactic center, the estimated number density of stars is about 10 million stars per cubic parsec. By contrast, the number density of stars in the Sun's neighborhood is a puny 0.2 star per cubic parsec. Because stars are so closely packed together near the galactic center, the night sky for inhabitants there would be spectacular. Near the galactic center, the average distance between neighboring stars would be only 1000 AU (about a light-week). If the Sun were located within a parsec of the galactic center, there would be a million stars in our sky with apparent brightness greater than Sirius. The total starlight in the night sky would be about 200 times greater than the light of the full moon; you could easily read the newspaper at midnight, relying on starlight alone.

"Compact Core of Galaxy M87" https://hubblesite.org/contents/news-releases/1992/news-1992-01.html

. . . to explore the central structure of M87 much closer into its nucleus than is possible from the ground. The images show clearly that the stars in M87 become densely concentrated towards the center, forming a bright "cusp" of light at the heart of the galaxy.

The central density of stars in M87 is at least 300 times greater than expected for a normal giant elliptical galaxy, and over a thousand times denser than the distribution of stars in the neighborhood of our own Sun. In fact, the

ultimate central density of stars in M87 may be even higher, but its measurement is beyond the resolving power of even HST."

It can be seen that the star population density near the Sun is very low. This is in line with expectations. The population density in globular clusters is about a light year, or somewhat less. This also is still as expected because the average will include binary or multiple star systems, which form within the Gravipause, and which will lower the average distance.

But near the galactic centers, star population density becomes extremely high. The stars, on average are separated by "about a light week". This is far denser than what would normally be expected. What is going on here?

We get a clue from statements like the above that say "The center of our galaxy harbors highly energetic phenomena". This implies superluminal speeds, or temporal motion. These stars are in Transitional Space/Time. This space, or its equivalent, is therefore "shrunk" in this region, resulting in much higher star population density.

Superluminal speeds and high redshifts associated with O and B stars.

Type O and B stars are massive, very luminous, very hot, blue stars at the upper end of the Main Sequence. Institutional astronomy views them as *young* stars that still have a robust power supply to burn through. The *Beyond Einstein* view is that these stars are very old, as age generally correlates directly with mass. They are powered by atoms of high atomic weight, which are created in interstellar space by a cosmic ray process. This fuel supply never runs out, and the stars continue to grow until they reach the Type 1 supernova limit. (See "The Classification of Stellar Spectra", http://www.star.ucl.ac.uk/~pac/spectral_classification.html)

Strangely, O and B stars may have high intrinsic redshifts. (*Seeing Red Redshifts, Cosmology and Academic Science* Halton Arp, (1998) ; Chapter 4: "Intrinsic Redshifts in Stars!" A very brief mention of this topic is presented next.

"Redshifts of Unknown Origin, G. Burbidge" (1996) https://www.cambridge.org/core/services/aop-cambridge-core/content/view/329A77C1389C8340AF96ECE6813B0F1E/S0074180900110265a.pdf/redshifts_of_unknown_origin.pdf

"Probably the biggest problem in cosmology is one that many people don't even think about or want to think about. It has to do with the nature of the redshifts of astronomical bodies.

. . . there is abundant observational evidence that not all of the redshifts of astronomical objects can be explained by expansion, by Doppler effects, or by gravitation.

Where is the K term found and how large is it? The K term originally named by Campbell in 1911, is an excess redshift always seen in the spectra of high luminosity (0 and B) stars. It amounts to about 10 km sec^{-1} or $z_u = 0.00003$. While it is very small, the value is well determined, and it is highly significant at the 10 σ level (cf Trümpler 1956). . . . Thus we have a small but measurable redshift term which is real but unexplained. In a recent study Arp (1992) . . . has been able to detect the same effect in the most luminous stars in the Magellanic Clouds and in other nearby galaxies. . . .

As we shall show, the pattern of investigation common in astronomy is to ignore a result when it cannot be understood theoretically . . . . At least in this case many reputable scientists remained aware that there was a problem. In contrast nowadays when a phenomenon cannot be understood, there is not only an attempt made to ignore it, but also to suppress studies of it, and treat very harshly those who persist in working in the field. . . .

> We have shown that there is very good observational evidence for the existence in nature of a redshift component of unknown origin in stars, galaxies and QSOs. . . .
>
> The repercussions on cosmology of this general result may be very considerable"

Burbidge laments that "when a phenomenon cannot be understood, there is not only an attempt made to ignore it, but also to suppress studies of it . . . ." This makes articles like *Beyond Einstein* very hard to research and write. Facts that are needed simply cannot be found, because there is strong prejudice against publishing such inconvenient facts that have the audacity to not behave as they should. This results in necessarily vague and speculative statements in cutting edge research. Additionally, most of the raw, descriptive data is not available to the public, only its official interpretation (e.g.: "high redshift object" becomes "background object")

"Redshifts of high-luminosity stars - the K effect, the Trumpler effect and mass-loss corrections." Halton Arp (1992) https://ui.adsabs.harvard.edu/abs/1992MNRAS.258..800A/abstract (K effect)

> Many independent tests over the last 80 years have shown that the K effect is an excess redshift which O and B stars exhibit relative to other stars in the Galaxy. Trumpler reported that the most luminous O and B stars in young galactic clusters showed this excess redshift at a 10 σ level of significance. The same effect is demonstrated here in B and A supergiants in h+ χ Persei, as well as in other associations of young, luminous stars. It is also now possible to demonstrate the K-Trumpler effect in O, B and A supergiants in the Magellanic Clouds, as well as in nearby galaxies such as NCC 1569 and 2777and in blue, irregular variables in M31 and M33. In addition, mass outflow in luminous stars is shown to require an average correction of about 20 km s^{-1} and increases the excess redshifts of the stars in the Magellanic Clouds to a significance level of 6σ. Completely empirical and independent measurements show that mass-loss corrections of this size are required on average for supergiants in both the Small and Large Magellanic Clouds and also in the Milky Way. After this correction, the K-Trumpler, intrinsic redshift is more than doubled. Recent measures by some investigators confirm that measuring lines deeper in the atmospheres of these stars, where the mass outflow is less, in fact makes the measured redshifts more positive. The supergiant, irregular variables in M31 and M33 appear to represent more extreme cases of both mass loss and the K-Trumpler effect.

It should be obvious that the redshifts of these stars are *intrinsic*, and are not caused by the cosmological expansion of space.

Non-Cosmological quasar redshifts

It is well known that quasars also show high redshift. This is normally interpreted to mean that they are at very far cosmological distances. But two facts argue against this: the fact that quasar redshifts show a pattern of regular quantization, and the fact that quasars are often associated with a galaxy with a normal redshift:

"Possible Discretization of Quasar Redshifts" K. G. Karlsson (1971)
https://www.researchgate.net/publication/234515946_Possible_Discretization_of_Quasar_Redshifts

> "A number of new peaks in the distribution of redshifts of quasi-stellar objects has been found. These, together with the well known peaks at z = 1.956 and z=0.061, form a geometrical series"

"Confirmed: physical association between parent galaxies and quasar families", John Hartnett (December 2018) (https://creation.com/quasars-associated-with-galaxies)

> "Karlsson proposed that quasars have an intrinsic non-cosmological redshift component which comes in discrete values (z_K= 0.060, 0.302, 0.598, 0.963, 1.410, …). However, to properly detect any physical association, the candidate quasar redshift must be transformed into the rest frame of its putative parent galaxy's redshift. . . . In this manner it is possible to detect a physical association, even in the case where parent galaxies have high redshift values. If this

process is neglected, no association may be found. Such was done in several papers, applied to large galaxy/quasar surveys, claiming to debunk the Arp hypothesis."

"Confirmed: Physical association between parent galaxies and quasar families", John Gideon Hartnett (July 23, 2018) https://biblescienceforum.com/2018/07/23/confirmed-physical-association-between-parent-galaxies-and-quasar-families/

> In a paper,1 just published, that looked for an association between putative parent galaxies and pairs of quasars, the authors found many such quasar families, suggesting that the association is real, and not just coincidental. They used the Sloan Digital Sky Survey (SDSS) data release 7 and the 2MASS (Two Micron All Sky Survey) Redshift Survey (2MRS) Ks ≤ 11.75 mag data release to ***test for the physical association of candidate companion quasars with putative parent galaxies*** by virtue of Karlsson periodicity in quasar redshifts."

There is an unspoken implication here that quasar redshifts are mathematically related to galactic recession redshifts due to temporal motion. This should be a simple relation, and is in addition to the quantization aspect.

See also:

https://creation.com/images/pdfs/tj/j18_2/j18_2_105-113.pdf
http://redshift.vif.com/JournalFiles/V13NO1PDF/V13N1HAN.pdf
https://arijmaki.wordpress.com/2010/04/10/ngc-7603-the-discordant-redshift-system/

Jets, filaments, and clouds of ejections products are self-powered

"Quasar jets are particle accelerators thousands of light-years long", https://phys.org/news/2020-06-quasar-jets-particle-thousands-light-years.html

> "An international collaboration bringing together over 200 scientists from 13 countries has shown that the very high-energy gamma-ray emissions from quasars, galaxies with a highly energetic nucleus, are not concentrated in the region close to their central black hole, but in fact, extend over several thousand light-years along jets of plasma. This discovery shakes up current scenarios for the behavior of such plasma jets."

These jets are ***not*** powered by some kind of "cosmic accelerator." Material that enters Transitional Space/Time becomes radioactively unstable, and will emit gamma rays, X-rays, and the inverted versions thereof (radio waves). Thus, the emissions from these jets originate from the material in the jet itself and not from some external source or process.

Non-local Chemistry?

At this point we have seen examples of non-local physics, non-local astronomy, and hints of non-local propulsion. Could there be such a thing as non-local chemistry—the chemistry of inverse atoms that have been stabilized into the spatial system? A presentation of this topic will have to wait a few decades. The scientific community, and its institutions in particular, are not at all ready for this one.

Neutrino current and "cold electricity"

Here are some properties of neutrino current as understood by people in the dark corners of the shadow physics community:

1. According to standard institutional physics, there is no such thing as electric “neutrino currents” In other words, there is only *one* kind of electric current and it is due to electrons.

2. Neutrino currents act like , and are superficially indistinguishable from, electron currents.

3. Static neutrinos are confined to a narrow zone in the center of a conductor. They do not normally appear on the surface.

4. Neutrino currents do not produce heat, unlike electron current. Hence, the term “cold electricity”.

5. Electron currents are based on a particle that has *one* rotational dimension. Neutrino currents are based on a particle that has *two* rotational dimensions. The former can be termed “electric” and the latter as “magnetic” or “etheric” (neutrinos were unknown in Tesla’s day)

6. It is apparently possible to separate or “fractionate” neutrino currents from electron currents, but the technology is not widely used or understood.

7. Tesla’s experiments and patents are best understood from the standpoint of neutrino currents—something that institutional physicists will not undertake.

Says *Basic Properties of Matter*, Dewey B. Larson, Vol. 2 (1988):

"In this uncharged condition, the neutrino has a net displacement of zero. Thus it is able to move freely in either space or time. Furthermore, it is not affected by gravitation or by electrical or magnetic forces, since it has neither mass nor charge. . .Although the neutrino as a whole is neutral, from the space-time standpoint, because the displacements of its separate motions add up to zero, it actually has effective displacements in both the electric and magnetic dimensions. It is therefore capable of taking either a magnetic or an electric charge. Probability considerations favor the primary two-dimensional motion, and the charge acquired by a neutrino is therefore magnetic. . . . This charged neutrino is thus, in effect, a rotating unit of space, similar in this respect to the uncharged electron, and, as matters now stand, indistinguishable from it." *Basic Properties of Matter*, Dewey B. Larson, Vol. 2 (1988)

Did Tesla encounter this odd type of electricity? Here is some food for thought from *The Free Energy Secrets of Cold Electricity*, Peter A. Lindemann, D.Sc (2000) http://www.teslasociety.ch/info/NTV_2011/free.pdf p. 43 ;:

"To summarize, Tesla accidentally discovered an electrostatic "super-charging" effect while trying to verify Hertz' discovery of electro-magnetic waves. After hundreds of experiments, he learned how to control and maximize this phenomenon. This led him to the discovery that electricity is made up of different components, that can be separated from each other, and that a pure, gaseous etheric energy can be fractionated away from the flow of electrons in a circuit designed to produce short duration, unidirectional impulses. . . .

Tesla's thoughts on this are summarized in Lindemann's book in a chapter written by Gerry Vassilatos (from *Secrets of Cold War Technology*, http://www.scribd.com/doc/15125148/Secrets-of-Cold-War-Technology)

"The extraordinary efficiency of the magnetic arc disrupter in developing aetheric currents derived from several principles. Tesla saw that electrical current was really a complex combination of aether and electrons. When electricity was applied to the disrupter, a primary fractioning process took place. Electrons were forcibly expelled from the gap by the strong magnetic influence. The aether streams, neutral in charge, remained flowing through the circuit however. The magnetic disrupter was his primary means for fractionating the electrons from the aether particles.

Aether particles were extremely mobile, virtually massless when compared with electrons, and could therefore pass through matter with very little effort. Electrons could not “keep up” with either the velocity or the permeability of aetheric particles. According to this view, aether particles were infinitesimals, very much smaller than electrons themselves. The aetheric carriers contained momentum. Their extreme velocity matched their nearly massless nature, the product of both becoming a sizable quantity. They moved with superluminal velocity, a result of their incompressible and massless nature. Whenever a directed radiant matter impulse begins from some point in space, an incompressible movement occurs instantly through space to all points along that path. Such movement occurs as a

solid ray, an action defying modern considerations of signal retardations in space. Incompressible raylines can move through any distance instantly. Should the path be 300,000 kilometers long, the impulse at the source end will reach that point as quickly as at all other points. This is superluminal velocity. (Lindemann, paper page 28)

Note the two relevant effects in the magnetic arc disrupter:

1. The charged electrons were expelled by the transverse magnetic field, but the etheric component, being uncharged, was not.
2. Electric arcs may have a narrower conduction cross section than conventional conductors.

Back in those days a magnetic arc disrupter would have used electromagnets instead of the more convenient permanent magnets available nowadays. Apparently, the field was run continuously and not switched on and off. But keep in mind the little fact:

"There is another difference between the two kinds of electric fields: *electric fields produced by charges can be represented by a potential, but potential has no meaning for electric fields produced by a changing magnetic flux*. . . . The induced electric filed due to a changing magnetic field is nonconservative and cannot be represented by a potential. (The magnetic field due to a current is also nonconservative. The lines of magnetic field form closed loops, and the magnetic field also cannot be described by a potential.)" — *Physics*, Halliday, Resnick and Krane, 5th ed.(2002) p. 785

(See also https://en.wikipedia.org/wiki/Electropermanent_magnet (off topic but interesting)

Tesla was unable to account for the enormous voltage multiplication effect:

"He had already observed how the very air near these transformers could be rendered strangely self-luminous. This was a light like no high frequency coil ever could produce, a corona of white brilliance, which expanded to ever enlarging diameters. The light from Tesla Transformers continually expands. . . . Unlike common high frequency alternations, Tesla radiant energy effects grow with time. Tesla recognized the reason for this temporal growth process. There were no reversals in the source discharges, therefore the radiant energy would never remove the work performed on any space or material so exposed. As with the unidirectional impulse discharges, the radiant electric effects were additive and accumulative. In this respect, Tesla observed energy magnifications, which seemed totally anomalous to ordinary engineering convention." (Lindemann, paper page 27)

Many of Tesla's experimental claims and inventions do not make much sense to the institutional physics establishment. But they could be better understood from the standpoint of neutrino currents instead of conventional electron currents.

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All this might help explain a strange phenomenon that occurred when DC voltage was initially applied to long transmission lines:

"This hazardous condition only occurred with the sudden application of high voltage DC. This crown of deadly static charge stood straight out of highly electrified conductors, often seeking ground paths which included workmen and switchboard operators. In long cables, this instantaneous charge effect produced a hedge of bluish needles, pointing straight away from the line into the surrounding space. The hazardous condition appeared briefly at the very instant of switch closure. The bluish sparking crown vanished a few milliseconds later, along with the life of any unfortunate who happened to have been so "struck". After the brief effect passed, systems behaved as designed. Such phenomena vanished as charges slowly saturated the lines and systems. After this brief surge, currents flowed smoothly and evenly as designed.

The effect was a nuisance in small systems. But in large regional power systems where voltages were excessive, it proved deadly. Men were killed by the effect, which spread its deadly electrostatic crown of sparks throughout component systems. Though generators were rated at a few thousand volts, such mysterious surges represented hundreds of thousands, even millions of volts.

Tesla knew that the strange supercharging effect was only observed at the very instant in which DC dynamos were applied to wire lines, just as in his explosive capacitor discharges. Though the two instances were completely different, they both produced the very same effects. The instantaneous surge supplied by dynamos briefly appeared superconcentrated in long Lines. Tesla calculated that this electrostatic concentration was several orders in magnitude greater than any voltage that the dynamo could supply. The actual supply was somehow being amplified or transformed. " (Lindemann, paper page 16)

The oddities to be noted here are:

1. The sparks occurred on switch closure, not switch opening. It is well-known that sudden opening of a DC circuit that is already conducting high currents will cause a huge (and dangerous) voltage spike as the magnetic field energy collapses back into the wire. But this phenomenon occurred on switch closure, when the wire had no current, no magnetic field, no stored energy.

2. The sparks leapt *perpendicular* to the wire into the surrounding space (this has also been seen in UFO encounters). In the normal well-known case (above), the sparks would leap *parallel* to the wire and only at the open contacts at the switch location.

3. There was an enormous voltage multiplication effect. This occurred only on initial application of voltage.

Behavior of a conventional circuit is quite different. But note the 'what if . . .' (http://en.wikipedia.org/wiki/RL_circuit) :

"The delay in the rise/fall time of the circuit is in this case caused by the back-EMF from the inductor which, as the current flowing through it tries to change, prevents the current (and hence the voltage across the resistor) from rising or falling much faster than the time-constant of the circuit. Since all wires have some self-inductance and resistance, all circuits have a time constant. As a result, when the power supply is switched on, the current does not instantaneously reach its steady-state value. The rise instead takes several time-constants to complete. If this were not the case, and the current were to reach steady-state immediately, extremely strong inductive electric fields would be generated by the sharp change in the magnetic field — this would lead to breakdown of the air in the circuit and electric arcing, probably damaging components (and users)."

Note that last sentence: "this would lead to breakdown of the air in the circuit and electric arcing, probably damaging components (and users)." This raises a question: Do neutrino or Weyl fermion currents generate a back-EMF? If there are two kinds of current carriers (neutrinos and electrons) and the neutrinos move much, much faster than the electrons, wouldn't the back EMF be far stronger for the neutrino? Do the effects on a long straight wire change if the same length of wire is coiled? If neutrinos move to the center of mass of the wire (instead of the surface), then is there still an effect proportional to the cross-sectional area and overall mass of the wire? This distribution changes at high frequencies (or sudden impulses). The center of the wire has the most flux linkages at high frequencies; it therefore has the most resistance to electron flow at high frequencies and this forces the electrons to flow more readily near the surface of the wire, a phenomenon known as the Skin Effect. But what happens to neutrino currents, which normally prefer the center of the wire?

A working hypothesis is that there may indeed be two kinds of electricity. One is "magnetic electricity" (based on the neutrino) and the other is "electrical electricity" (based on the electron). Does "magnetic electricity" need a magnetic field for conduction? The "electrical electricity" needs only a wire, and the magnetic field is only a side-effect of conduction. Look at the illustration of gravitational modification caused by moving electrons through a wire and ask yourself what would happen with a *neutrino* instead of an *electron*. Instead of producing a radial *magnetic* field, perhaps it could produce a radial *electric* field. And, is there some kind of "inverse inductance" (based on rate of change of voltage, instead of rate of change of current)?

Various perspectives on neutrinos:

"About 65 billion neutrinos . . . pass through every square centimetre of area on Earth, every second . . . without doing anything." http://phys.org/news/2015-10-neutrino-great-cosmic-mysteries-nobel.html#jCp

Compare: one Coulomb of charge is about 6.24 x 10^{18} electrons, and one ampere is 1 coulomb per second.) Flux of bright sunlight is about 10^{14} photons/cm^2-sec and twilight is about 10^{10}. Neutrino flux at Earth is comparable to photon flux at twilight, but neutrinos are generally a thousand to a billion times more energetic than visible photons.

In our solar system the neutrino flux is strongest near the Sun.

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The planetary neutrino flux would be an ideal energy source. It is very energetic, abundant and completely ignorable when not needed (unlike light, X-rays, gamma rays). When needed, it could, with the right technology, supply reliable, robust energy at the flick of a switch. It would be available *anywhere* —outer space, under the ocean, or deep within the Earth.

Advanced neutrino science and technology could make use of neutrinos for communication (the Earth and oceans are virtually transparent to neutrinos). Neutrinos could conceivably be used for "X-raying" the Earth to locate mineral deposits, oil deposits, geological formations, and caverns. Neutrino technology could also be used for remote surveying of nuclear weapons production facilities, and remote examination of actual nuclear weapons (amount and type of fissile material). There are indications that this technology could even be used to remotely convert fissile material into non-fissile material (turn a nuclear bomb into a dud while the missile is still in flight).

See "An Invisible Particle Could Be The Building Block For Some Incredible New Technology", at http://www.businessinsider.com/why-you-should-care-about-neutrinos-2013-12

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Neutrinos (in some form) may be Weyl fermions. These have unusual properties (*Science News*, July 8, 2017, Emily Conover, p.14 http://phys.org/news/2015-07-year-massless-particle-next-generation-electronics.html):

> "Unlike electrons, Weyl fermions are massless and possess a high degree of mobility; the particle's spin is both in the same direction as its motion—which is known as being right-handed—and in the opposite direction in which it moves, or left-handed. "The physics of the Weyl fermion are so strange, there could be many things that arise from this particle that we're just not capable of imagining now,""
>
> "Weyl fermions cause unusual behavior. Put a normal material in a magnetic field, and its resistance to the flow of electricity grows, but in a solid with Weyl fermions, a magnetic field makes current flow more easily. . . . In a material with these quasiparticles, a magnetic field in one direction can increase conductivity, while in another direction it can decrease conductivity. "This type of thing can have interesting applications," Hasan says. "In a single material, just by changing the direction of the field, now we can get different behaviors," flipping between insulating and conducting, for example."

"Elusive particle appears in 'semimetal' Weyl fermions detected in tantalum arsenide" , .(*Science News*; August 22, 2015. Andrew Grant, p. 11; https://www.thefreelibrary.com)

> The newly discovered particle, known as a Weyl fermion, resembles a massless electron that darts around and through the material in unusual and exciting ways, physicists report online July 16 in Science.

"It's definitely a big deal," says Leon Balents, a condensed matter theorist at the University of California, Santa Barbara.

The behavior of Weyl fermions makes tantalum arsenide a metal-like compound that shares desirable features with graphene and topological insulators, materials that have attracted a torrent of research attention over the last decade or so. "There are a lot of reasons to be interested in these materials," Balents says.

Materials like tantalum arsenide could enable future electronic devices to feature fast-moving current that easily circumvents bumps and valleys in its path. Physicists will be able to study the properties of the material-bound particles to explore the possibility that free-floating varieties of Weyl fermions exist.

Electrons, neutrinos and a host of other subatomic particles belong to a family called fermions. All the known fermions behave according to an equation devised in 1928 by English theoretical physicist Paul Dirac. But at least in theory, there are two other kinds of fermions, both proposed soon afterward: Majorana fermions and Weyl fermions. Unlike Dirac and Majorana fermions, members of the Weyl class--named after German mathematician and physicist Hermann Weyl--are massless.

"After 85-year search, massless particle with promise for next-generation electronics found", https://www.sciencedaily.com/releases/2015/07/150716160325.htm

An international team led by Princeton University scientists has discovered Weyl fermions, an elusive massless particle theorized 85 years ago. The particle could give rise to faster and more efficient electronics because of its unusual ability to behave as matter and antimatter inside a crystal, according to new research.

The researchers report in the journal *Science* July 16 the first observation of Weyl fermions, which, if applied to next-generation electronics, could allow for a nearly free and efficient flow of electricity in electronics, and thus greater power, especially for computers, the researchers suggest.

. . . Their basic nature means that Weyl fermions could provide a much more stable and efficient transport of particles than electrons, which are the principle particle behind modern electronics. Unlike electrons, Weyl fermions are massless and possess a high degree of mobility; the particle's spin is both in the same direction as its motion -- which is known as being right-handed -- and in the opposite direction in which it moves, or left-handed

. . . The researchers also found that Weyl fermions can be used to create massless electrons that move very quickly with no backscattering, wherein electrons are lost when they collide with an obstruction. In electronics, backscattering hinders efficiency and generates heat. Weyl electrons simply move through and around roadblocks, Hasan said.

Related links:

"What's a Topological Insulator? https://scienceblogs.com/principles/2010/07/20/whats-a-topological-insulator

"The swing doctors: Physicist cracks code on material that works as both conductor, insulator" Morgan Sherburne (August 31, 2018) https://phys.org/news/2018-08-doctors-physicist-code-material-conductor.html

"Research could lead to more efficient electronics", Todd B. Bates (June 4, 2018) https://phys.org/news/2018-06-efficient-electronics.html#nRlv

"Topological Material Shows Unusual Behavior" Oct. 23, 2018, https://www.machinedesign.com/materials/topological-material-shows-unusual-behavior

"The New Phase of Electric Force" *Scientific American* 25 December 1875 33:401)

"Innovation as a social process Elihu Thomson and the rise of General Electric 1870-1900 ", W. Bernard Carlson (1991)

http://books.google.com.au/books?id=KUB5KFjTHhwC&printsec=frontcover#v=snippet&q=Ruhmkorff&f=false
(scroll back to about p. 57+ ; non-electric sparks from telegraph; Edison's etheric energy ; Elihu Thomson - Wikipedia)

"Edison, Science and Artefacts", Ian Wills (2006)
http://philsci-archive.pitt.edu/3541/1/Wills-EdisonScienceAndArtefacts.pdf
(Edison's discovery of "etheric force")

"Electricity at high pressures", Elihu Thomson 1853-1937 (2007) http://archive.org/details/electricityathig00thomrich
(million volt machines in the 1890s; 29 pages)

UFO Physics ?

Lately, there has been quite a bit of official interest in UFOs, UAPs, etc. The so-called "certified UFOs" are apparently nuts-and-bolts machines (physical devices made and flown by humans) that are powered by unusual configurations of electrical and magnetic devices (there is more to this story, however, but cannot be covered here). These machines make very effective application of non-local physics. Although the topic of UFO propulsion physics is outside the scope of *Beyond Einstein*, readers might be interested in some references (a few of many) that they can peruse at their own leisure. Hence:

"National Investigations Committee on Aerial Phenomena" http://www.nicap.org/index.htm
(there is a huge amount of useful, detailed information at this site)

UFOLOGY A Major Breakthrough in the Scientific Understanding of Unidentified Flying Objects, James M. McCampbell
http://www.nicap.org/ufology/preface.htm Preface
http://www.nicap.org/ufology/ufochap1.htm Certified UFOs
http://www.nicap.org/ufology/ufochap2.htm The Vehicles (See also Poynting Vector Insights ; http://www.cufos.org/rullan.pdf)
http://www.nicap.org/ufology/ufochap3.htm Composition & Luminosity
http://www.nicap.org/ufology/ufochap4.htm Sounds
http://www.nicap.org/ufology/ufochap5.htm Electrical Interference
http://www.nicap.org/ufology/ufochap6.htm Physiological Effects
http://www.nicap.org/ufology/ufochap7.htm Flight & Propulsion
http://www.nicap.org/ufology/ufochap8.htm Pilots & Passengers
http://www.nicap.org/ufology/ufochap9.htm Activities On Earth
http://www.nicap.org/ufology/ufochap10.htm Some Concluding Remarks

Advanced aerial devices reported during the Korean war, Richard F. Haines (1990) detailed UFO sightings during the Korean War
http://www.nicap.org/books/aadkw/aadkw-chapters.htm

Report on the UFO wave of 1947, Ted Bloecher (1967)
http://nicap.org/waves/Wave47Rpt/ReportUFOWave1947_Cover.htm

PROJECT 1947 Holloman AFB UFO Sightings http://www.project1947.com/holloman/index.htm
(this site is well written and has lots of authentic information)

The UFO Evidence A thirty Year Report, Richard H. Hall (2001) :

> "An equally extraordinary, and puzzling, performance feature is the frequently reported ability of UFOs to disappear abruptly from one point and suddenly reappear at another (here termed instant relocation). Perhaps they move too fast for the human eye to follow, or this feature may indicate a relativistic effect. The hummingbird-like motions may be a comparatively slower version of instant relocation that remains perceptible to our vision and brain. . . . The apparent ability to move instantaneously (or extraordinarily rapidly) from one point to another suggests a propulsion system that, if we consider potential applications of relativity physics, may not be all that far beyond our current conceptual understanding. . . . Here, as in many other instances of extraordinary UFO data, careful scientific study of UFOs could lead to important scientific breakthroughs." (p. 425; See instant relocation, above and http://www.ufoskeptic.org/light.html)

UFO Evidence http://www.ufoevidence.org/topics/topicshome.asp

"Evidence of Very Strong Low Frequency Magnetic Fields", A. Meessen (August 2012) http://www.cobeps.org/pdf/meessen_evidence.pdf (technical; compass rotation effects)

http://www.nicap.org/detection/compass/Herr_Incidents_Update.pdf (Table with links)

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It is well known that a changing magnetic field can produce a changing electric field. The reverse is also true, but the effect is very weak. Page 863 of *Physics*, Halliday, Resnick and Krane, 5th ed.(2002) poses an example problem: "A parallel-plate capacitor with circular plates is being charged . . . . Derive an expression for the induced magnetic field . . . in the region between the plates." The rate of rise time of the E field is given as $dE/dt = 10^{12}$ Volts/(meter-sec). The answer turns out to be 280 nanoTesla (2.8 milligauss) and this comment follows:

> "This shows that the induced magnetic fields in this example are so small that they can scarcely be measured with simple apparatus, in sharp contrast to induced *electric* fields (Faraday's law), which can be demonstrated easily. This experimental difference is in part due to the fact that induced emfs can easily be multiplied by using a coil of many turns. No technique of comparable simplicity exists for magnetic fields. In experiments involving oscillations at very high frequencies, *dE/dt* can be very large, resulting in significantly larger values of the induced magnetic field."

Along that line of thought, suppose 100 million volts was switched across a 1 centimeter spark gap in 100 nanoseconds. That is $10^8/(10^{-2} \times 10^{-7})$ or 10^{17} volts/(meter-sec). With those numbers, the above example would be 280×10^{-4} Tesla or 280 Gauss. The magnetic field of the Earth is roughly 0.5 Gauss and is easily detected by a hand-held compass. Even one-hundredth of that—2.8 Gauss — could easily swing an aircraft compass needle, especially if in "close" proximity to the UFO.

UFOs are known to make use of microwaves in some capacity, and these high frequencies (Gigahertz) could result in very high *dE/dt* . In turn this would result in significant *magnetic* field pulses with fast rise times. But how these would be used is unclear.

Space/time dimensions for some electromagnetic quantities

Derivation

We saw previously that energy is t/s, that mass and inductance are both t^3/s^3, and that electrical current is s/t. It is possible to use these dimensions to derive other dimensions for electrical quantities. Power (energy per time), for instance, is 1/s.

The less obvious dimensions can be derived from common electrical formulas. The voltage across and inductor, discussed above, is V = L(dI/dt) and we can use it to find the dimensions of voltage

("electric potential"). Hence, V [=] t^3/s^3 (s/t)(1/t) or t/s^2. We can also readily see that the formula is analogous to F = ma, where a = dv/dt. Voltage even has the same space/time dimensions as mechanical force.

Electric field intensity (E) is measured in volts per meter and therefore is t/s^3. This can also be derived from formulas found in college level textbooks on electromagnetic science:

$$power = I\int_C E \bullet dl$$

$$\left(\frac{1}{s}\right)[=]\left(\frac{s}{t}\right)E\left(\frac{s}{1}\right)$$

$$\left(\frac{t}{s^3}\right)[=]\ E$$

In a similar way we can find the space/time dimensions for a magnetic field:

$$\oint_C E \bullet dl = -\int_s \dot{B} \bullet ds$$

$$\left(\frac{t}{s^3}\right)\left(\frac{s}{1}\right)[=]\ B\left(\frac{1}{t}\right)\left(\frac{s^2}{1}\right)$$

$$\left(\frac{t^2}{s^4}\right)[=]\ B$$

Does $\boldsymbol{E} = c\boldsymbol{B}$ agree with these dimensions? We can readily see that it does.

Does it work for the Hertzian wave equation?:

$$\nabla^2\mathbf{B} - \frac{1}{c^2}\frac{d^2\mathbf{B}}{dt^2} = 0$$

$$\nabla^2\mathbf{E} - \frac{1}{c^2}\frac{d^2\mathbf{E}}{dt^2} = 0$$

Dimensions of terms that are added or subtracted must be the same. Hence, for the first equation (**B**):

$$\frac{\frac{t^2}{s^4}}{s^2} = \frac{t^2}{s^2}\frac{\frac{t^2}{s^4}}{t^2}$$

which comes out to t^2/s^6 for both terms; and for the second one (**E**):

$$\frac{\frac{t}{s^3}}{s^2} = \frac{t^2}{s^2}\frac{\frac{t}{s^3}}{t^2}$$

which reduces to t/s^5 for both terms.

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The magnetic vector potential (denoted as ***A***) is also very important in electrodynamics. It has the dimensions of momentum per charge. That comes out as (t^2/s^2) (1/s) or t^2/s^3. The ***B*** field is supposed to be the curl (mathematically a spatial derivative) of the ***A*** field. That comes out as $(t^2/s^3)(1/s) = t^2/s^4$ and is as shown above.

Magnetic vector potential

Incidentally, the magnetic vector potential is another one of those historical oddities:

> "This subject has an interesting history. The theory we have described was known from the beginning of quantum mechanics in 1926. The fact that the vector potential appears in the wave equation of quantum mechanics . . . was obvious from the day it was written. That it cannot be replaced by the magnetic field in any easy way was observed by one man after the other who tried to do so . . . . It seems strange in retrospect that no one thought of discussing this experiment until 1956, when Bohm and Aharanov first suggested it and made the whole question crystal clear. The implication was there all the time, but no one paid attention to it. Thus many people were rather shocked when the matter was brought up. . . . It is interesting that something like this can be around for thirty years but, because of certain prejudices of what is and is not significant, continues to be ignored." *(The Feynman Lectures on Physics*, Vol. 2, page 15-12)

Because the vector potential ***A*** is regarded as more fundamental in quantum electrodynamics "***E*** and ***B*** are slowly disappearing from the modern expression of physical laws; they are being replaced by ***A*** and ϕ ." (*ibid*., page 15-14)

See also:

> "Thoughts on the Magnetic Vector Potential", John R. Taylor, 1996. http://www.scribd.com/doc/24546297/Thoughts-on-the-Magnetic-Vector-Potential-by-John-R-Taylor
>
> "What the electromagnetic vector potential describes", E. J. Konopinski, 1977, https://www.semanticscholar.org/paper/What-the-electromagnetic-vector-potential-describes-Konopinski/51aeb80ed1f81587bf86d82a20afebb8de69cfd9
>
> "Apparatus for Generating Motional Electric Field", William J. Hooper, 1972. http://www.rexresearch.com/hooper/3610971.htm

"The Connection Between Inertial Forces and the Vector Potential", Alexandre A. Martins, Mario J. Pinheiro http://arxiv.org/ftp/physics/papers/0611/0611167.pdf ;

"Communication method and apparatus with signals comprising scalar and vector potentials without electromagnetic fields", Harold E Puthoff (12/01/1998) http://www.freepatentsonline.com/5845220.pdf ;

> One advantage of the present invention, alluded to before, is that the vector and scalar potentials penetrate electromagnetic shields. This is because electromagnetic shields work on the principle that incident (E, B) fields induce counter-effects that cancel said incident fields in the shielding materials. Such shielding effects do not occur for signals based solely on vector and scalar potential concepts, frequently referred to hereafter as (A, φ) signals. Devices based on the (A, φ) concepts are frequently referred to herein as pure-potential devices (PPD's).
>
> A further advantage of the present invention is that prior art electromagnetic receivers do not detect pure-potential signals. The prior art electromagnetic receivers are based on detecting electric and/or magnetic fields, neither of which is present in devices, systems and methods in accordance with the present invention. Hence, the present invention provides an overlapping, parallel use spectrum that exists side by side with the ordinary electromagnetic spectrum. The pure-potential transmission does not interfere with the prior art electromagnetic transmission and vice versa.
>
> It is, accordingly, an object of the present invention to provide a new communication method and apparatus.

See also:

"A magnetic vector potential base communication system"
http://www.freepatentsonline.com/EP0920141A2.pdf

"Apparatus . . . utilizing a curl-free magnetic vector potential field"
http://www.freepatentsonline.com/4447779.pdf

"Electromagnetic transmission utilizing a curl-free magnetic vector potential field"
http://www.freepatentsonline.com/EP0050523A2.pdf

"Josephson junction interferometer device for detection of curl-free magnetic vector potential fields"
http://www.freepatentsonline.com/4491795.pdf

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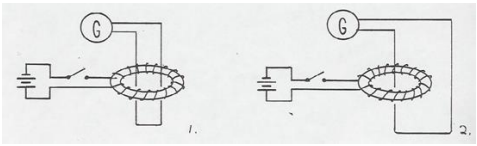
Simple demonstration of vector potential reality:

"If a wire is threaded through the hole of the toroid and returned through the hole, case 1, no galvanometer deflection is seen as B is switched on and off. But if the wire is threaded through the hole and returned around the coil, case 2, a galvanometer deflection will be seen from = -d/dt. "



See this link for details:

http://www.physics.ucla.edu/demoweb/demomanual/electricity_and_magnetism/electrodynamics/vector_potential.html

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But there are some problems

But there are some troubling inconsistencies in electromagnetic space/time dimensions. The Poynting vector is usually interpreted as power per area which comes out to $1/s^3$. The literature also expresses it as:

$$\boldsymbol{S} = \boldsymbol{g}c^2$$

where g is the momentum density (momentum per volume) and which has the dimensions of t^2/s^5. According to this formula then, $\boldsymbol{S}$ works out to be $1/s^3$, exactly as expected. But we are not so fortunate when expressing $\boldsymbol{S}$ in terms of $\boldsymbol{E}$ and $\boldsymbol{B}$ as in this formula:

$$\boldsymbol{S} = \varepsilon_0 c^2 \boldsymbol{E} \times \boldsymbol{B}$$

The permittivity, ε_0, is expressed in coulombs per volt per meter. Charge is the one-dimensional analog of mass, and so permittivity is probably $(t/s)(1/(t/s^2))(1/s)$, which appears to be dimensionless. The dimensions for the remaining items have been given previously, and with those, S works out to be $(s^2/t^2)(t/s^3)(t^2/s^4)$ or t/s^5. That is obviously NOT the same as $1/s^3$ which is what we were expecting. Did we mess up something when we used the vector cross product? Does S have some alternative interpretation which would account for the discrepancy? Has a term inadvertently been left out of the formula? Is a profound insight lurking here somewhere?

Perhaps the guess on the dimensions for permittivity were wrong. Simple inspection shows that they would have to be (s^2/t) for the Poynting formula to work out correctly. Permittivity is used in formulas for capacitance, so maybe we can look at some capacitance formulas, explore the dimensions, and see if our new guess for the ε_0 dimensions is reasonable. Here is a good formula (*Electrical Engineering Circuits*, H.H. Skilling, 2nd ed., p. 18) to start with. It has obvious space/time dimensions and little else:

$$C = \varepsilon_0 \frac{A}{s}$$

C is the capacitance, ε_0 is the permittivity of free space (vacuum), *A* is the area of the plates, and *s* is the separation between plates. Plugging everything in, we find that the dimensions for capacitance (*C*) are $(s^2/t)(s^2)(1/s)$ which is just (s^3/t) .

We now must find out if these dimensions for capacitance make sense. If they do, then the new choice for the permittivity dimensions is probably correct as well. Let's try the formula for current through a capacitor (note that *v* is voltage here, not velocity):

$$current = C\frac{dv}{dt}$$

$$\left(\frac{s}{t}\right)[=]\ C\left(\frac{t}{s^2}\right)\left(\frac{1}{t}\right)$$

$$\left(\frac{s^3}{t}\right)[=]\ C$$

This is perfect. We were hoping that the space time dimensions of capacitance would work out to be (s^3/t) and that is exactly what we got. We can now confidently check other capacitance formulas and see if they to give the same dimensions for capacitance. Here is one that relates the charge on the capacitor plates to capacitance and voltage:

$$charge = CV$$

$$\left(\frac{t}{s}\right)[=]\ C\left(\frac{t}{s^2}\right)$$

$$\left(\frac{s}{1}\right)[=]\ C$$

And we find . . . *that it doesn't work*. Instead of getting (s^3/t), we get just (s).

Let's go back to the original capacitor formula: $C = \varepsilon_0 (A/s)$. If permittivity were dimensionless as originally supposed, the formula above, *charge = CV*, would be dimensionally correct. In other words, capacitance is just a space unit.(s). If we take that value and plug it into the formula for current, we find that current is (s/t) instead of (t/s). This seems to be trying to tell us something.

Rather than have two kinds of capacitance, it is more reasonable to believe that there are two kinds of electric current. One type of electricity, the so-called "static electricity", is based on coulombic charge which has the dimensions of (t/s). Ordinary electric current, however, is just space per time (s/t), like a velocity, as discussed above. Maybe "storing current" in a capacitor is equivalent to stuffing it with space units. Or maybe is it equivalent to stuffing it with coulombic charge units. Which is it? The formula for force exerted on a charge by an electric field between the plates of a capacitor is F = QE . Force is (t/s^2) and electric field is (t/s^3). It is obvious that the kind of Q (charge) we are looking at here must have the dimensions of (s) and not (t/s). In contrast to the inductor, what the capacitor stores is a "stopped" version of (s/t) or, in other words, just (s). And unlike the inductor, the electricity does not "squirt back out" when the battery is disconnected; a capacitor acts more like a storage tank than a pressurized accumulator (especially when the dielectric is a vacuum).

The conceptual problems here can be illustrated by thinking about a capacitor storing electrons as though it were a jar that stores marbles. Note that the marbles are stored throughout the jar's volume, not just on the jar's surface, and that the jar has limited capacity. If we want to store more marbles, we need to have a jar with more space. However, the marbles (electrons) represent space units (rotational space). Putting space units into the jar, and then asserting that the jar is running out of

space does not make any sense. We need a jar that has ***temporal*** volume instead of ***spatial*** volume. That way, adding more electrons creates a space/time (or time/space) ratio. This ratio also implies a limited capacity. But how do we put more temporal volume into a capacitor? As explained previously, matter itself is a temporal structure (t^3/s^3). Putting a slab of matter between the two plates, creates more temporal volume, more "capacity". Some materials work better than others for this purpose, and this in turn leads to concepts like "capacitivity"—something that is today called "permittivity".

Permittivity is thus an actual physical characteristic, and therefore should NOT be a dimensionless quantity. The second guess on the dimensions for permittivity (s^2/t) is probably correct.

Electromagnetic theory is still incomplete. Maxwell's equations do not include the Lorentz force, nor anything about the relation of gravity to electromagnetism. Additionally, there are still some very messy, difficult issues. Says Feynman:

> "In bringing together relativity and Maxwell's equations, we have finished our main work on the theory of electromagnetism. . . . this tremendous edifice, which is such a beautiful success in explaining so many phenomena, ultimately falls on its face. . . . Now we want to discuss a serious trouble—the failure of the classical electromagnetic theory. . . . the classical theory of electromagnetism is an unsatisfactory theory all by itself. . . . when electromagnetism is joined to quantum mechanics, the difficulties remain. " (*The Feynman Lectures on Physics*, Feynman, *et al.* (1964) Vol 2, p. 28-1)

Anyway, the point here is that space/time dimensions for electromagnetic and mechanical quantities can be worked out, despite some obvious difficulties and long standing misconceptions. **Ultimately, ***everything*** in physics can be expressed in terms of space/time ratios of some sort. This can lead to new insights about the true nature of these entities and their relationships with other entities.**

Introduction to Quantum Mechanics

Near the beginning of the twentieth century, scientists were confronted with many factual mysteries pertaining to microphysical phenomena. The classical, or Newtonian, mechanics was completely inadequate to deal with these mysteries, and so a new type of mechanics was invented: quantum mechanics. If you love good mysteries, you will find these to be among the best that the physical universe has to offer. I rate them as best in cleverness and best in ultimate importance. Despite their superficial simplicity, they have not been solved, not even by the most brilliant minds using the best equipment available to science. Quantum mechanics gives us "recipes" to get useful numerical answers, but despite 100 years of research, there is STILL no generally accepted explanation for the mysteries described below. The human mind will not rest until they are solved. Can *you* solve them?

Physicist P. C. W. Davies notes that "Quantum mechanics is one of those subjects that usually comes right in the end, even though it can seem horribly obscure when only half-learned." Indeed, your first encounter with a book on quantum mechanics will probably leave you with the impression that it is an arcane, abstract, almost impenetrable topic. This particular science is filled with mathematical "maps of hell" written in strange notation seemingly incomprehensible to all but sorcerers or geniuses. The concepts you will encounter are also disorienting, namely things like matter waves, probability amplitudes, non-locality, negative energy, tunneling, various paradoxes, clumsy, inelegant fudge factors, inexplicable constants, "principles" of indeterminacy and uncertainty, intrinsic spin, ridiculous models of the atom, quantum jumping, and so forth. And, as though all these problems were not enough, they raise "fundamental philosophical questions about the nature of reality."

Instead of quantum mechanics becoming clear "in the end" as Davies notes, it would be very desirable to make it clear "from the beginning." I hope that this goal can be achieved by giving a synopsis of the perplexing factual issues, some suggestions about crucially important intuitive concepts, and in finding an introductory "middle ground" for the mathematics. I hope this will make early encounters with this topic a bit less abrasive for everyone interested in this topic.

What is Quantum Mechanics?

Quantum mechanics is "The modern theory of matter, of electromagnetic radiation, and of the interaction between matter and radiation; it differs from classical physics, which it generalizes and supersedes, mainly in the realm of atomic and subatomic phenomena." (*McGraw-Hill Dictionary of Scientific and Technical Terms*, 5th ed.)

""Quantum mechanics" is the description of the behavior of matter and light in all its details and, in particular, of the happenings on an atomic scale. Things on a very small scale behave like nothing that you have any direct experience about. They do not behave like waves, they do not behave like particles, they do not behave like clouds, or billiard balls, or weights on springs, or like anything that you have ever seen. . . . Because atomic behavior is so unlike ordinary experience, it is very difficult to get used to, and it appears peculiar and mysterious to everyone—both to the novice and to the experienced physicist. Even the experts do not understand it the way they would like to. . . . We know how large objects will act, but things on a small scale just do not act that way. So we have to learn about them in a sort of abstract or imaginative fashion and not by connection with our direct experience." (*The Feynman Lectures on Physics*, R. P. Feynman, R. B. Leighton, M. Sands, 1965 (Addison-Wesley), Vol 3, p. 1-1 under "Atomic Mechanics")
https://www.academia.edu/28997196/The_Feynman_Lectures_on_Physics_VOL3

"In the short period of 1925 to 1928, Heisenberg, Schrodinger, Born, Dirac and many others laid the foundations of what is one of the greatest theories of all time, the theory of quantum mechanics. In generality and in range of application, it is unsurpassed. It has been so successful that one cannot discuss atomic and nuclear matters without some understanding of this basic theory.

"Because the predictions of quantum mechanics agree with so many different types of accurate, careful, repeated experiments,—the last court of appeal for all theories—this theory is almost certain to become a permanent part of man's equipment for understanding and analyzing a large and very important part of nature. However its conceptual foundations or philosophy may change in the future, it has already, in a thousand ways proved its utility and power." (*Introduction to Quantum Mechanics*, Chalmers W. Sherwin, 1959, (Holt, Rinehart and Winston), pages 6,7)

"Why is it so hard to learn? Students find quantum mechanics tough going for two reasons, one conceptual, the other technical. Familiar concepts like speed, size, acceleration, momentum and energy take on weird features, or even become meaningless. Intuition gained from daily experience is of no help, or can even be misleading. The student must learn to think about mechanical concepts in a completely different way. Some of the conceptual issues are still a matter of dispute among physicists and have raised fundamental philosophical questions about the nature of reality and the role of the observer in the physical universe. . . . On the technical side, the mathematical description of quantum processes is rather abstract, and not very obviously related to the subject of its description. Physical

quantities are represented by mathematical objects with unusual properties. Some of the mathematics is also often new to the student and learning it can be an additional burden" (*Quantum Mechanics*, P. C. W. Davies, 1984, (Chapman and Hall), pages ix, x)

"Quantum mechanics provides a good example of the new ideas. It requires the states of a dynamical system and the dynamical variables to be interconnected in quite strange ways that are unintelligible from the classical standpoint. . . . The justification for the whole scheme depends, apart from internal consistency, on the agreement of the final result with experiment. (*The Principles of Quantum Mechanics*, P.A.M. Dirac, 4th ed., (1958), p. 15)

"Like all humans, scientists have a deep-rooted need for descriptive explanations; mathematical formalism, alone, even if seemingly correct, is somehow insufficient. However, quantum mechanics furnishes predictions, not explanations. Perhaps there will come a time when the mysterious wavelike processes inherent in the structure of quantum theory will be unraveled in a causally explicit way—although I rather doubt it. But neither do I find that doubt disturbing. If not purpose, then surely there is a least great satisfaction in a theory of such broad predictive power that opens up for exploration a world beyond the senses where even the imagination can scarcely follow." *(A Universe of Atoms, An Atom in the Universe*, Mark P. Silverman (2002) p. 123)

Newtonian mechanics, also known as *classical mechanics*, is the mechanics used to describe the behavior of familiar, ordinary objects like cars, levers, gears, the forces on ships in the sea, the stresses in bridges and buildings, the trajectories of cannon balls, etc. Quantum mechanics describes the behavior of extremely tiny discrete objects like atoms and photons (light). Quantum electrodynamics is the modern extension of quantum mechanics to include the realms of electricity, magnetism, and light. In quantum mechanics, the discrete or "quantized" nature of matter and energy is prominent. In continuum mechanics (classical field theory) this discrete nature is unimportant.

Because a particle has two types of position (one in three-dimensional space and another in three dimensional time), there are also two types of "mechanics" to describe its motion. As noted above, spatial motion (s/t) is described by Newtonian mechanics in terms of paths, trajectories, and forces. A particle's temporal motion component, however, has no path or trajectory as seen from a spatial reference system. A path in three-dimensional time simply cannot be described directly with spatial terminology. Instead, its description requires "non-path" mathematical tools like the expression for total energy and potentials as found in the Hamiltonian and Lagrangian. *Changes* in location, rather than the locations themselves, can also be described, and this leads to differential equations like Schrödinger's wave equation. Temporal locations are "non-local" in the spatial system (the temporal origin is anywhere/everywhere because it is a "when" description, not a "where" description. It just "doesn't care" about spatial locations.) This requires mathematical tools that have "infinite reach" like Schrödinger's wave equation, Heisenberg's infinite matrices, and Feynman's method of "sum over all possible paths". These characteristics also lead naturally into the concepts of superposition of multiple states, probability amplitudes, and of "reality" being intertwined with the measurement system, rather than existing in an independent way. The type of mechanics that addresses these temporal aspects is called "Quantum Mechanics".

https://en.wikipedia.org/wiki/Hamiltonian_(quantum_mechanics)
https://en.wikipedia.org/wiki/Lagrangian_mechanics
https://en.wikipedia.org/wiki/Path_integral_formulation

Quantization is actually a fairly ordinary concept. The real heart of quantum mechanics is revealed by a phenomenon called "interference". It is, in physicist Feynman's words "the only mystery". It is "impossible, *absolutely* impossible, to explain in any classical way."

It also points to one of the most fascinating things you will learn in the study of quantum mechanics: the Universe seems strangely "overbuilt." It uses fantastic, seemingly unimaginable machinery, to create *ordinary* appearances (this, incidentally, is especially true of living, biological systems).

Hopes for intuitive concepts in Quantum Mechanics

Quantum Mechanics is weird, bizarre, and non-intuitive. But it works. Physicists themselves hope for a theory that is simpler than the mess we have today, and even believe such a thing is possible:

> "We have come to the conclusion that what are usually called the advanced parts of quantum mechanics are, in fact, quite simple. The mathematics that is involved is particularly simple, involving simple algebraic operations and no differential equations or at most only very simple ones. The only problem is that we must jump the gap of no longer being able to describe the behavior *in detail* of particles in space." —*The Feynman Lectures on Physics*, Feynman, Leighton, Sands, (1965) Vol. 3, p. 3-1 https://www.academia.edu/28997196/The_Feynman_Lectures_on_Physics_VOL3
>
> "All physical theories . . . ought to lend themselves to so simple a description that even a child could understand them." —Albert Einstein
>
> "However, if we do discover a complete theory, it should in time be understandable in broad principle by everyone, not just a few scientists. Then we shall all, philosophers, scientists, and just ordinary people, be able to take part in the discussion of the question of why it is that we and the universe exist." —*A Brief History of Time*, Steven Hawking, 10th ed. (1998) p. 191
>
> "The beauty of physics lies in the extent to which seemingly complex and unrelated phenomena can be explained and correlated through a high level of abstraction by a set of laws which are usually amazing in their simplicity. In the history of this abstraction, no triumph has been more spectacular than electromagnetic theory." —*Principles of Electrodynamics*, Melvin Schwartz, 1987, p. 105
>
> "Richard Feynman was able, in his PhD thesis, to reformulate quantum mechanics into a single, complete system of mechanics that includes all of classical mechanics as well. Feynman's mechanics, based on the Lagrangian, is all you need to explain all of mechanics, from the motions of the stars to the motions of electrons. For obvious reasons, this is often known as the path integral formalism of quantum theory. . . . It is actually much easier, in terms of the mathematics, to work with the Lagrangian than with the alternative Hamiltonian approach (which, through a historical accident, is the way most people are introduced to mechanics); John Wheeler, who was Feynman's PhD supervisor, says that his thesis, presented in 1942, marked the moment 'when quantum theory became simpler than classical theory'. If only teachers of physics in schools had the sense to teach mechanics from the beginning using the Lagrangian formalism, students could learn both classical and quantum mechanics at once, using equations that are easier to manipulate.

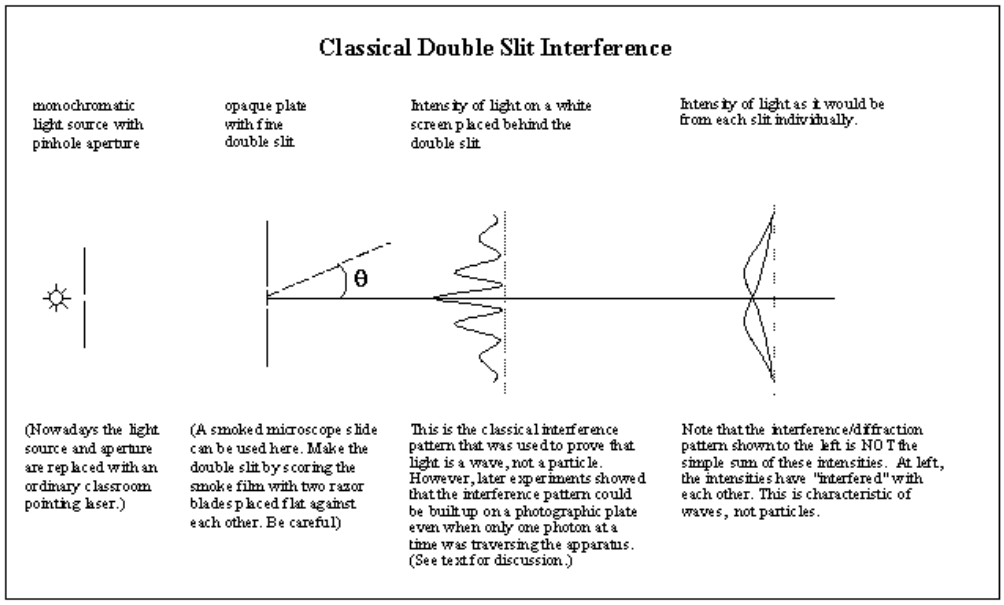
One of the main reasons why quantum mechanics often seems difficult when students do encounter it is that they have to unlearn all the old stuff first." (*Q is for Quantum: An Encyclopedia of particle physics*, John R. Gribbin, 1998, p.202-203) See also http://www.eftaylor.com/pub/CallToAction.pdf , http://www.eftaylor.com/software/ActionApplets/LeastAction.html , http://www.eftaylor.com/pub/ForceEnergyPredictMotion.pdf , http://www.eftaylor.com/leastaction.html , http://www.courses.fas.harvard.edu/~phys16/Textbook/ch5.pdf , http://www.people.fas.harvard.edu/~djmorin/chap6.pdf

In spite of this wish, things have only gotten worse. The public can now watch the development of String Theory, with its multiple universes and eleven dimensions, on public television. This is certainly another theory that is headed off into the weeds. At the other extreme we have the "Saturday evening theoreticians" who come up with their own theories that have obvious flaws. Ask any university professor and he will tell you that there are thousands of them (and that he gets emails from all of them).

What is hoped for here is a fresh start, one that begins with a sound premise, uses sound methodology, and produces clear "ideas" that will lead into the development of a complete theory.

The mystery of "interference"

Thomas Young's classical double slit experiment of 1801 provided unambiguous and convincing evidence that light has a wave nature. He used an apparatus like the one represented in the diagram below:



If light consisted of particles traveling in straight lines, one would *not* expect the *maximum* light intensity to appear directly behind the "shadow" of the central blockage between the two slits. And if light were particles, there would be no periodic waviness of the intensity of the pattern on the screen. If light were particles, another slit should mean more light. And where more light is expected, there should be more *light*, not darkness. However, all these problems are resolved if light is behaving as a wave.

This was one of those historical experiments that every student of physics is practically required to perform. In college physics we would smoke up a microscope slide and create two slits in the smoke film by placing two razor blades together and lightly scoring a double line in the smoke film. Then we

would hold the slide up to our eye and look through it at a bare-filament bulb (or even a distant street lamp) . The (multicolored) diffraction/interference pattern could easily be seen. A more modern version of this experiment uses an ordinary classroom pointing laser. The laser is shined on the double slit and the light projects onto a white card or paper behind it. The diffraction/interference pattern can be clearly seen on the paper (do not look at the laser beam directly).

The math was simple too. We could calculate the interference pattern intensity with little more than simple trigonometric relations.

So what is the big mystery? It is simply this: The light source can be dimmed down to the point where there is, on the average, only *one* photon traversing the apparatus at a time. Yet the diffraction/interference pattern *still* appears. In fact, in 1909, G. I. Taylor performed a similar experiment by photographing a diffraction pattern of a needle (instead of a double slit). He used an extremely feeble light source. A 2000 hour time exposure allowed the diffraction pattern to manifest itself on a photographic plate. The pattern was every bit as distinct as that obtained from a short exposure with a bright light source.

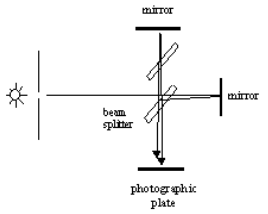
Similar experiments have been repeated many times. Short exposures with feeble sources result in photographs that have a very grainy, seemingly random pattern of exposed spots. Somewhat longer exposures are also very grainy, but also reveal that a pattern is beginning to emerge. Much longer exposures with the same dim source finally show a full, distinct diffraction pattern. Light is acting like a particle (definite position and energy) when it hits the photographic plate, yet acts like a wave (spread out in space) when passing through both slits and creating the diffraction pattern. It acts like a particle when sent one-at-a-time through the apparatus, but the pattern on the photographic plate shows a pattern characteristic of a wave.

To further confuse matters, similar experiments were performed with electrons and neutrons. We commonly regard these as *particles* (possessing a definite position, trajectory, momentum, etc.). Yet they too produced an interference pattern. Such patterns are characteristic of *waves*, not particles. How can waves act like particles, and particles act like waves? And like the experiments with light, the interference pattern will appear even if only one electron or neutron at a time is traversing the apparatus.

Clever experimenters have tried to determine which slit the photon or electron goes through. Suppose electrons are sent into a similar apparatus and we have a little light secretly waiting behind one of the two slits (like a traffic cop with a radar gun). As the electron flies by, a little flash of light will be reflected, and we will know which of the two slits the electron actually went through. When we actually try to do this (not exactly in this way), nature seems to get very devious. The interference pattern simply disappears and goes back to the single slit pattern (it knows the traffic cop is watching!). All sorts of clever schemes have been tried, and all end up with the same result. If the detector can somehow distinguish between the particle paths, even in principle, then there is no interference pattern!

These results are so counterintuitive no one would believe this actually happens unless the experimental evidence were as overwhelming as it is.

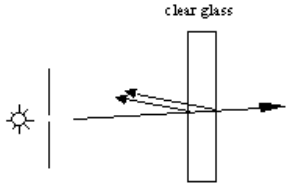
This diffraction/interference from one-at-a-time photons is commonplace and occurs in all sorts of optical systems, from complex to the simplest, whether we notice it or not. Consider the following illustrations:



Beam Splitter Interference

A similar type of interference pattern can be produced in a Michelson interferometer. This instrument separates the light beams by a considerable distance compared to the wavelength of light. The pattern still appears when one photon at a time is sent into the apparatus.

Furthermore, a clever experiment by John Clauser in 1974, showed that the beam-splitting mirror does not split the photon itself. A given photon will end up in one beam or the other, never both simultaneously --proof again that photons interfere with themselves one at a time.

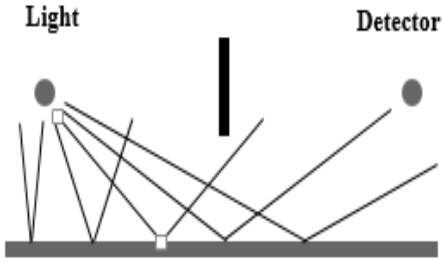


Partial Reflection Interference

The amount of light reflected perpendicularly from a pane of clear glass may vary from 0% to 16%. The reflectivity depends both on the thickness of the glass and on the wavelength of the light. The effect is known as "constructive and destructive interference."

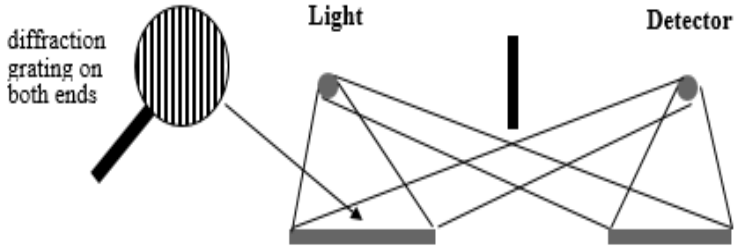
If the glass is made progressively thicker, the reflectivity cycles repeatedly from 0% to 16% to 0% without any apparent limit.

The same statistics can be produced with single photons from extremely weak light sources. The reflectivity is thus a measure of the *probability* of a whole photon being reflected or transmitted. But how does a single photon "make up its mind" about whether it will be reflected or not in any particular encounter? How does it seem to know what overall proportion should be reflected? ?



A light illuminates all points on a front-surface mirror and a photodetector views all points on the mirror. Direct paths between the light and the detector are blocked.

If the outer thirds of the mirror are blocked off, the intensity of the detected light remains about the same. If the middle third is blocked off, the detected intensity drops drastically. This suggests that most of the light is being reflected from the middle, and that the ends reflect relatively little light into the detector.



Here the middle third of the mirror is cut out. The outer thirds have extremely narrow strips of the reflective coating etched away so as to form a diffraction grating. We now find that a substantial amount of light is reflected into the detector!

Odd, isn't it? Scrape away the part of the mirror where no reflection is expected and it starts reflecting! An unexpected property becomes manifest. Would you have expected that the laws of physics allow you to do this? Was your thinking limited by "proven" notions, or by fundamental laws of physics?

The modern explanation of this paradox—the wave/particle duality—is that both light and particles have BOTH a wave nature and a particle nature. The wave amplitude, and specifically the square of the wave amplitude, represents the *probability density* that a photon (or electron) will appear in some position on the photographic plate. It is as though the photons are being directed by an abstract mathematical wave as they fly through the apparatus. The wave is like an invisible traffic cop who splits oncoming traffic, car by car, into a bunch of different directions, according to a definite pattern.

The cars do not interact among themselves and no particular car knows where the other cars are going.

Physicist Dirac has a discussion of the interferometer problem in his book *The Principles of Quantum Mechanics*:

> "Suppose we have a beam of light which is passed through some kind of interferometer, that it gets split up into two components and the two components are subsequently made to interfere. We may . . . take an incident beam consisting of only a single photon and inquire what will happen to it as it goes through the apparatus. This will present to us the difficulty of the conflict between the wave and corpuscular theories of light in an acute form."

He then describes the difficulties, presents some aspects of the theory of superposition of wave functions and emphasizes how the photon situation differs from that in classical mechanics. Then he notes the necessity of applying the probability principle to *one* photon at a time:

> "Sometime before the discovery of quantum mechanics people realized that the connexion between light waves and photons must be of a statistical character. What they did not clearly realize, however, was that the wave function gives information about the probability of *one* photon being in a particular place and not the probable number of photons in that place. The importance of that distinction can be made clear in the following way. Suppose we have a beam of light consisting of a large number of photons split up into two components of equal intensity [think of the interferometer illustration here]. On the assumption that the intensity of a beam is connected with the probable number of photons in it, we should have half the total number of photons going into each component. If the two components are now made to interfere, we should require a photon in one component to be able to interfere with one in the other. Sometimes these two photons would have to annihilate one another and other times they would have to produce four photons. This would contradict the conservation of energy. The new theory, which connects the wave function with probabilities for one photon, gets over the difficulty by making each photon go partly into each of the two components. Each photon then interferes only with itself. Interference between two different photons never occurs." (*The Principles of Quantum Mechanics*, P.A.M.Dirac, 4th ed., 1958, pages 7-9)

In other words, this type of interference is not an *en masse* phenomena, like the interference of water waves that can be observed in a ripple tank. The photon in the interferometer ends up in one optical leg or the other, and is somehow directed to the photographic plate in just such a special way that will contribute to the build-up of a precise interference pattern, *even though it may be the only photon in the apparatus during that instant of time.*

Understanding Dirac's concern about the conservation of energy is also crucial. Two ordinary waves, like water waves, can "cancel" each other if they are 180 degrees out of phase. In a ripple tank you can see two sets of waves approaching each other and you can note the spot where they would have the 180 degree phase difference. At that precise spot, the valley of one wave is filled in by the peak of the other wave, and the water surface ends up at normal height. The phenomena is well known and is called "destructive interference." It finds practical application in the electronic devices that emit "antinoise" to make work areas quieter and in antireflection coatings on camera lenses.

Likewise, two photon waves can "cancel" if they are 180 degrees out of phase. But people who think about this, soon find a problem with the concept. Each photon has a discrete amount of energy. If two photons were to interfere destructively, what happens to their energy? It cannot just disappear. Mathematically they cancel, but what happens physically? The Conservation of Energy principle is inviolate. The energy still has to go someplace. Like two bullets, the two photons cannot just vanish, not even for an instant. So in quantum mechanics the wave is interpreted to denote the *probability* that a single photon will appear in a certain place. In quantum technobabble it is called "the expectation value of an observable." This "gets over the difficulty", to use Dirac's own words, of the Conservation of Energy problems that would otherwise be created by both constructive and destructive interference.

This interpretation has a lot of factual support and has been used very successfully to predict the outcome of all sorts of extremely varied phenomena. But while it is a good description of *what* nature does, it leaves us utterly mystified about the *how*. How would a single photon, or electron, know where to hit the photographic plate or detector? Surely it does not compute its own wave function. Surely it does not say "Let's see, I am going towards a photographic plate in an interferometer, and 60% of us are supposed to end up here, 35% there, and the other 5% next to that." Surely it does not know how many photons have already arrived in any particular spot. If you were the Designer and Maker, how could you build something that automatically, and by its very nature, acted this way so easily and reliably? (Job 38:19-24)

The mystery gets even deeper when one discovers that the quantum type of interference is also possible temporally, not just spatially. Note what physicist Mark P. Silverman has to say on this topic:

> "The potential for quantum interference exists whenever a particle can propagate from its source to the detector by alternative spatial pathways under experimental conditions such that the exact pathway taken cannot be known. The archetypal example is the Young's two-slit experiment in which the particle, when probed, passes through one slit or the other. Unprobed, the resulting particle distribution is explicable only in terms of probability amplitudes that seemingly propagate through both slits. There is a direct temporal analogue to the two-slit experiment in which the linearly superposed amplitudes represent—not alternative spatial pathways—but rather the evolution of alternative indistinguishable events in time. . . .
>
> The phenomenon of quantum beats . . . is intrinsic to each atom and not a cooperative interaction between atoms. In other words, the spontaneous emission from single atoms is not modulated, but registers at the detector as one quantum of light at a time; the pattern of beats (measured at one location in real time or, equivalently, at different spatial locations along an accelerated atomic beam) can nevertheless be built up by the decay of many such single atoms. This is again the old "mystery" of quantum interference translated to the time domain: How can independently excited, randomly decaying, noninteracting atoms produce a pattern of photon arrivals that oscillates in time? Note that the synchronization required for the beats to survive ensemble averaging does not imply that emitting atoms communicate with or influence one another. Rather, an apt analogy, if there be any, would be that of a large number of independent clocks all separately wound and set to the same time by the clockmaker." (See *More Than One Mystery : Explorations in Quantum Interference*, Mark P. Silverman, 1995, p. 100 to 102, ISBN 0-387-94376-5)

In Young's experiment the interference pattern is most easily seen on a screen placed behind the two slits. The pattern of fringes is stable and varies with spatial position, but not with time. Of course, it is also possible to map out the interference pattern by spatially moving one little photon detector back and forth behind the two slits, and then plotting the detected intensity versus spatial position on a graph. This might be done, for example, when a screen or photographic plate cannot be used. The graph shows the existence of an interference pattern, much like what is seen on the photographic plate. In the experiment described above by Silverman, the detector remains in one spatial location, and the intensity of photon arrival varies over time, instead of over spatial position. When the intensity is plotted versus time, a graph showing similar interference effects is produced. Roughly speaking, the light seems to be winking on and off with the passage of time. The specific experimental conditions imposed require this to be a temporal manifestation of an interference effect. At the single photon level, this is just as mysterious and counterintuitive as that for Young's double slit experiment.

Operators, commutation and angular momentum

Commutation and angular momentum are very important topics in quantum mechanics. But to discuss them, I have to first say a bit about operators, non-commutative mathematics, and commutators.

An *operator* is a mathematical symbol that specifies an operation (some kind of action) on its operands, which can be a simple number, a variable, or a function. For example, the + symbol is the "addition operator" as in 2 + 3 = 5. The x symbol is the "multiplication operator" as in 2 x 3 = 6. The symbol d( )/dx is the "differentiation operator" as in $d(x^2)/dx = 2x$.

In quantum mechanics, the so-called "observables" are represented by operators.

"In classical mechanics one is accustomed to working with the distance *x*, the momentum *p*, the total energy *W*, etc. These are examples of quantities called dynamical variables. In the solution of practical problems one finds expressions involving these variables, which will give numerical values under any specified conditions.

In quantum mechanics the dynamical variables play a completely new role. They are converted by a set of rules into mathematical operators which then operate on the wave function **Ψ**" (*Introduction to Quantum Mechanics*, C. W. Sherwin, 1959, p. 13)

To create a quantum mechanical expression, we write the applicable classical expression and then convert it into the quantum mechanical version by making certain substitutions. For instance, we may have a situation where the expression for total energy (kinetic + potential) would be useful. Classically, it is expressed as:

$$\frac{1}{2m} p^2{}_x + V(x) = W$$

To convert it into a quantum mechanical expression, all we need to do is make the appropriate substitutions. Usually, we can find these substitutions in any introductory book on quantum mechanics. They are often given in tabular form:

Dynamical variable:	**becomes this *operator*:**
x	*x*
f(x)	*f(x)*
p_x	$h/(2\pi i)\{ \partial /\partial x \}$
W	$- h/(2 \pi i)\{ \partial /\partial t \}$

These operators will "operate" on a wave function, **Ψ**, which is assumed to exist, and which is assumed to contain all that is knowable about the quantum mechanical system. We would then solve the resulting equation to get the particulars.

And so, in this example, we can write the substitutions into the classical expression for total energy. Wherever we find "x" (which classically means "x coordinate position" we put in " x **x** " (which in operator terminology, means "multiply by x". The multiplication symbol is always omitted however, and so in the resulting equation, you will see just "x"; make a mental note that this is now an *operator*, not the usual kind of algebraic variable. The same applies to constants like *h* and *i*.

However, *time,* in quantum mechanics is a parameter, *not* an operator, *not* an observable.) When we make the substitution for p_x (momentum along the x axis) we note that this term is squared, and so we have to square the expression that is substituted for it. We will assume that Ψ is some function of position and time and will write that aspect in the usual notation as $\Psi(x, t)$ It all comes out as:

$$-\frac{h^2}{8m\pi^2}\frac{\partial^2\psi(x,t)}{\partial x^2}+V(x)\psi(x,t)=-\frac{h}{2\pi i}\frac{\partial\psi(x,t)}{\partial t}$$

How did physicists arrive at these particular substitutions? Historically, it came down to noticing some strong clues, and to a lot of intuition and effort. The substitutions that worked were retained and the ones that did not were dropped. (There are also other substitutions applicable to relativistic systems, electrical and magnetic systems, and so forth.)

But let's not get sidetracked. I just want you to know what an operator is at this point, and to get an inkling about how they are used in the mathematics of quantum mechanics. Our ultimate topic is commutation and angular momentum.

Operators, are, in general, not commutative. That means that when operators are applied to, say, a function, the final result will depend on the sequence of the operations. Applying operator *A* and then operator *B,* will give a result different from applying operator *B* and then operator *A.*

Let's perform two identical operations on some term like "x^2+1" as an example and see what happens when we apply the operators in different sequence. We will use multiplication and differentiation because these are commonly used in quantum mechanics:

multiply by x, then differentiate by x:
x^2+1 gives x^3+x which then gives $3x^2+1$

differentiate by x then multiply by x:
x^2+1 gives $2x$ which then gives $2x^2$

Obviously $3x^2+1$ is not equal to $2x^2$. The order or sequence of the operations was important.

Mathematicians have a special word for the *difference* in these results. It is called a "commutator". *Quanta: A Handbook of Concepts*, P. W. Atkins, 2nd ed.,1994, p. 60-61:

> "A **commutator** of two operators *A* and *B* is denoted [*A,B*], and is the difference *AB-BA.* The symbol *AB* means that operation *B* is performed first, and is followed by operation *A*; *BA* implies that *A* precedes *B.*
>
> Two operators are said to commute if their commutator is zero. If a commutator is nonzero, the final result of performing two operations depends on the order in which the operations are done: operation *A* followed by operation *B* results in a different outcome from operation *B* followed by *A.*
>
> . . .
> The importance of commutators in quantum mechanics comes from the identification of physical observables with operators, not all of which commute with each other. It turns out that if two operators do not commute with each other, then the observables they represent cannot be determined simultaneously. . . . The fact that some operators do not commute with each other is a principal factor underlying the differences between quantum and classical mechanics."

Angular momentum in quantum mechanics, it turns out, is defined by a set of commutation relations:

> "In quantum mechanics, an angular momentum is most generally defined in terms of a set of commutation relations. *Any* set of observables represented by three operators that satisfy the commutation rule $[j_x,j_y] = ihj_z$ (and cyclic permutations of the subscripts) is called an angular momentum. (*Quanta: A Handbook of Concepts*, P.W. Atkins, 2nd ed.,1994, p. 8)

Customarily, the symbol j is used to denote total angular momentum, l is used for orbital angular momentum, and s is used for spin angular momentum. For our purposes we will use the following cyclic permutations:

$$[l_x,l_y] = \mathrm{i}hl_z$$
$$[l_y,l_z] = \mathrm{i}hl_x$$
$$[l_z,l_x] = \mathrm{i}hl_y$$

For completeness I'll include $[l^2, l_q] = 0$

The former can be written compactly in vector notation as:

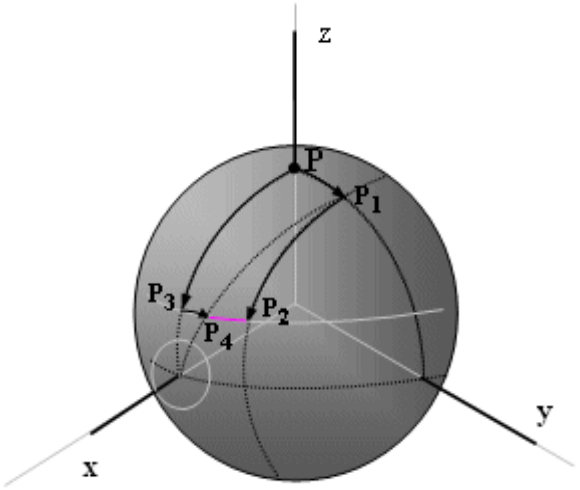
$$\boldsymbol{l} \times \boldsymbol{l} = \mathrm{i}h\boldsymbol{l}$$

But be careful here. Anyone who knows elementary vector algebra will tell you that the cross product of a vector with itself is always zero, not something like $ih\boldsymbol{l}$. Again, remember, that despite the appearances, $\boldsymbol{l}$ is a vector *operator*, not a classical vector.

Ok. So what is the meaning of something like $[l_x,l_y] = ihl_z$? And why should we care? Consider the following diagram which shows two results of two rotational displacements that are performed in different order. The illustration is greatly exaggerated to show the effect, but the results are equally valid with small rotations. In the first sequence, point P on the surface is rotated around the x axis, say 30 degrees. This result (P_1) is followed by a rotation around the y axis, say 60 degrees. Its final position is P_2.

For the second sequence we start all over again at the original P. The second sequence rotates around the y axis first by 60 degrees (resulting in P_3) and this is followed by a 30 degree rotation about the x axis (resulting in P_4).

Then we evaluate what has happened. We see that the two final points do not coincide. In other words, rotational displacements are non-commutative. Furthermore, because the two endpoints end up at the same "latitude", the *difference* in the locations (P_4 and P_2) could be expressed as a small single rotation about the z axis. This small rotational displacement is the geometric equivalent of a commutator. It is the analogue of $[l_x,l_y] = \mathrm{i}hl_z$ in quantum mechanics.



". . . the difference between two infinitesimal rotations is equivalent to a single infinitesimal rotation . . . about the *z* axis, which is geometrically plausible. . . . The *reverse* argument, that it is geometrically obvious that the difference is a single rotation, therefore implies that $[l_x,l_y] = ihl_z$. Hence, the angular momentum commutation relations can be regarded as a direct consequence of the geometrical properties of composite rotations." *(Molecular Quantum Mechanics*, Peter Atkins, Ronald Friedman, 4th ed. p. 162)

This also seems like a convenient place to introduce the Pauli spin operators, which express the same idea:

$$S_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \qquad S_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \qquad S_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

Let's see what $[S_x, S_y]$ evaluates to:

$$[S_x, S_y] = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \quad - \quad \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

For this one you'll have to use the rule for matrix multiplication:

$$\text{If } A = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \text{ and } B = \begin{pmatrix} e & f \\ g & h \end{pmatrix} \text{ then } AB = \begin{pmatrix} ae+bg & af+bh \\ ce+dg & cf+dh \end{pmatrix}$$

Hence:

$$\begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix} - \begin{pmatrix} -i & 0 \\ 0 & i \end{pmatrix}$$

$$\begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix} + \begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix}$$

$$\begin{pmatrix} 2i & 0 \\ 0 & -2i \end{pmatrix}$$

$$2i \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

$$2i\, S_z$$

Hence, $[S_x, S_y]$ evaluates to $2iS_z$. And so, as above, "the difference between two infinitesimal rotations is equivalent to a single infinitesimal rotation . . . about the *z* axis"

I hope this helps educate your intuition about commutators. But what is the significance?

> ". . . we shall say that an observable is an angular momentum if its operators satisfy these commutation relations. [main text] Because all the properties of the observables are the same, this seems to be an appropriate course of action. However the procedure does capture some strange bed-fellows. The electric charge of fundamental particles is described by operators that satisfy the same set of communication [*sic*] relations, but should we regard it—or imagine it—as an angular momentum? Electron spin is also described by the same set of communication [*sic*] relations, but should we regard it—or imagine it—as an angular momentum? [footnote]" (*Molecular Quantum Mechanics*, Peter Atkins, Ronald Friedman, 4th ed. p. 100-101)

What I hope you will get from this presentation:

1. That spin and angular momentum are very important in quantum mechanics. This reinforces my suspicion that *composite rotations are the basis for the existence of all particles* (photons, electrons, atoms, etc., —everything).

2. That complex numbers are used in spin operator representations, and that although spin "is a rigorous feature of real Dirac theory . . . it remains hidden in the matrix formulation". (Hestenes; See Effects of Spin)

3. That commutators for angular momentum have an intuitive geometric interpretation.

4. That quantum mechanical wave equations can be constructed from classical analogues.

5. The notion that the mathematical machinery of quantum mechanics is “too classical”, too indirect, and unnecessarily cumbersome.

The last point needs some elaboration. Intrinsic rotations result in a difference with the linear progression of space/time, and that in turn creates a "thing" that may be observable. In the example given there, gravitation evolved out of the concept of fundamental rotations. The implication is that electrical, magnetic, and gravitational forces can actually arise from the "geometrical properties of composite rotations" (Atkins, as above). And within the “quantum realm” the forces are orientable (due to spin) and have an actual three-dimensional geometry (but it is in three-dimensional time, not space). These characteristics result in the existence of the whole Periodic Table and all the chemical relationships that are implied by it. It should be possible to calculate dipole and quadrupole moments, bond angles, bond energies, bond distances, transition and decay probabilities, and so on from very fundamental principles based on composite rotations. The methodology would state the problem directly in terms of s/t ratios), work out the solution with the operations inherent to that realm, and then translate the results back into the spatial reference system. This would seem to be a more direct approach than that currently used in quantum mechanics.

Both QM and QED are not actual physical theories, like, for example, Newtonian celestial mechanics. Instead, their development was guided by empirical principles. The math is "invented" and then experiments are consulted to see which math agrees with the experiment. This method produces math that can lead to practical results, but may also imply some concepts that are physically impossible, or way off into the weeds.

> In other words, the mathematical system of present quantum theory is, like that of epicycles, unconstrained by any physical principles. Those who have not perceived this have pointed to its empirical success to justify a claim that all phenomena must be described in terms of Hilbert spaces, energy levels, etc. This claim (and the gratuitous addition that it must be interpreted physically in a particular manner) have captured the minds of physicists for over sixty years. And for those same sixty years, all efforts to get at the nonlinear ‘chromosomes and DNA’ underlying that linear mathematics have been deprecated and opposed by those practical men who, being concerned only with phenomenology, find in the present formalism all they need.

The Electron: New Theory and Experiment, David Hestenes, A. Weingartshofer (1991) p.2

See also the last few paragraphs of Inverseness.

Fun fact: In the Stern-Gerlach experiment if spin up (z+)and spin down (z-) beams are combined, they produce a spin polarization in the x-y plane not simply "spinlessness". (missing reference)

For the mathematically inclined, see also "How to Derive the Schrödinger Equation" by David W. Ward, Feb 2008 at: http://arxiv.org/PS_cache/physics/pdf/0610/0610121v1.pdf (One thing that I realized when reading this article is that the Schrödinger equation actually has the form of a diffusion equation, not a wave equation. A diffusion equation uses the second derivative of space, and the first derivative of time, whereas the classical wave equation uses the second derivative of space with the *second* derivative of time. Ref: *Engineering Mathematics Handbook*, Jan J. Tuma, 2nd ed., (1979) p. 210-211)

Effects of Spin

Spin is at the very foundation of certain features of quantum mechanics. It offers us a conceptual basis for the de Broglie wavelength, the all-important interference effects, the Heisenberg uncertainty principle, and a poorly understood effect I will call "localization". Crucial to the understanding of these properties is the idea that spin does not exist independently, but is intimately interrelated to translational motion. The (charged) electron has been the most studied in this respect:

> "The fact that "spin effects" appear in plane waves implies that one should not regard "spin" as an independent kinematical property of the electron, but rather as an essential aspect of its translational motion." —*Introduction to Quantum Mechanics*, Chalmers W. Sherwin, 1959, p. 300

More recent studies of the Dirac electron theory by physicist David Hestenes have led to similar conclusions:

> "The Dirac equation has a hidden geometric structure that is made manifest by reformulating it in terms of a real spacetime algebra. This reveals an essential connection between spin and complex numbers with profound implications for the interpretation of quantum mechanics. Among other things, it suggests that to achieve a complete interpretation of quantum mechanics, spin should be identified with an intrinsic zitterbewegung."
>
> . . .
>
> "A related mystery that has long puzzled me is why Dirac theory is almost universally ignored in studies on the interpretation of quantum mechanics, despite the fact that the Dirac equation is widely recognized as the most fundamental equation in quantum mechanics. . . . I hope to convince you that Dirac theory provides us with insights, or hints at least, that are crucial to understanding quantum mechanics and perhaps to modifying and extending it. Specifically, I claim that an analysis of Dirac theory supports the following propositions:
>
> (P1) *Complex numbers are inseparably related to spin in Dirac theory.* Hence spin is essential to the interpretation of quantum mechanics even in Schroedinger theory.
>
> (P2) *Bilinear observables are geometric consequences of rotational kinematics, so they are as natural in classical mechanics as in quantum mechanics*
>
> (P3) *Electron spin and phase are inseparable kinematic properties of electron motion* (zitterbewegung)."

Later, in a section about spin and Zitterbewegung ("jittering motion"), he offers this comment:

> "At last we are ready to grapple with the most profound insight and the deepest mystery in the real Dirac theory: *The inseparable connection between quantum mechanical phase and spin!* This flies in the face of conventional wisdom that phase is an essential feature of quantum mechanics, while spin is a mere detail that can often be ignored. We have seen that it is a rigorous feature of real Dirac theory, though it remains hidden in the matrix formulation." (Annales de la Fondation Louis de Broglie, Volume 28 no 3-4, 2003, "Mysteries and Insights of Dirac Theory", David Hestenes, 2003; all *italics* are his; see also http://www.ensmp.fr/aflb/AFLB-283/aflb283p367.pdf , http://modelingnts.la.asu.edu/pdf/MysteriesofDirac.pdf , http://modelingnts.la.asu.edu/pdf/ZBW_mod.pdf , http://modelingnts.la.asu.edu/pdf/Kinematic.pdf)

If you want to know more about David Hestenes' insights, please consult the references. I am simply trying to point out that physicists recognize an intimate connection between spin, translational motion, the de Broglie wavelength, and quantum mechanical phase. More on the Dirac equation can be found at https://en.wikipedia.org/wiki/Dirac_equation . Also, when authors use terms, like “real Dirac equation” or "real vector space", think “real versus complex”, not “real versus unreal”.

Such connections would be expected. In the space/time ratio interpretation, intrinsic spin is a continuous change of direction instead of position, but it qualifies as a "motion" nevertheless. The motion causes it to not participate in the general expansion "nothing datum" of the Universe. The result is a "not-nothing" entity that moves with multidimensional linear motion just like that of our familiar gravitational reference system, and such an entity can therefore come to rest in the context of that system. The (charged) electron (4π spin system) is an example. Hence, there is clearly a connection ("Zitterbewegung" ?) between gravitation ("motionless motion") and intrinsic spin.

If it also moves with an additional ordinary motion, it acquires a de Broglie wavelength ($\lambda = h/p$). Note that the wavelength is inversely proportional to momentum which has the space/time dimensions of t^2/s^2 and not velocity, which has the dimensions of s/t. Momentum is regarded as the product of mass and velocity. In space/time dimensions, that is $p = mv$ or t^2/s^2 [=] $(t^3/s^3)(s/t)$. This is important because temporal motions are non-directional in the spatial reference system.

When an electron moves towards a so-called "scattering center", its temporal description is "re-emitted" or "updated". (For our purposes a scattering center is some kind of spatial discontinuity; it might be a dust particle in air or a tiny hole in a metal film.) The re-emission is necessarily non-directional and is conceptualized as a spherical wave spreading out in all (spatial) directions. Physicists use the term "Huygens wavelets" to describe this situation. You can see drawings of them in almost any introductory college physics textbook.

If the electron is directed towards a hole in a thin metal foil, the points around the edge of the hole (the entire circumference) serve as multiple scattering centers (we will say millions of them). This results in multiple re-emissions and multiple spherical waves. (Remember that the temporal description is anywhere/everywhere in the spatial system; three o'clock in the kitchen is also three o'clock everywhere else in the house. Hence, the single temporal description can be "reused" multiple times on multiple scattering centers.) If the hole is large compared to the de Broglie wavelength, the *envelope* of all the wavelets looks like one hemispherical wave on the other side of the hole. The wavelets can also be thought of as producing an interference pattern, but if the hole is large, the pattern is so fine and lacking in contrast that it is normally not visible.

If the hole size is smaller and more comparable to the wavelength, the interference pattern becomes coarse and is readily seen. A stream of electrons will build up an exposure pattern on a phosphor screen downstream from the hole that looks like a bullseye archery target (the so-called "Airy disc" is the bright central spot. https://en.wikipedia.org/wiki/Airy_disk

If the hole is rectangular (a slit), instead of circular, the same arguments apply, but the pattern appearing on the screen with be that of a slit, not a hole. The image will be surrounded by rectangular "diffraction fringes" instead of the archery target pattern. (All ordinary images are actually formed by diffraction; see *Optical Physics*, Lipson, Lipson, and Tannhauser, 3rd ed., Chapter 12)

If the round hole is made still smaller, it becomes essentially *one* scattering center, and the illumination beyond the hole becomes (guess what) very uniform and very dim. This is because each electron will be scattered in a completely random direction.

So when an electron is diffracted from a hole, its momentum acquires a spread in values. Each electron tends to move radially away (perpendicular) from the original line of motion to various extents. The amount of uncertainty in this direction is directly related to the size of the hole and the de Broglie wavelength. The math reduces to the following:

$$\Delta x \, \Delta p \; > h/4\pi$$

which is the well-known uncertainty relation. As the hole closes down (Δx decreasing) the *radial* spread of the momentum increases (Δp increasing) and the stream of electrons illuminate a larger and larger area on the screen beyond the hole. Note that the formula refers specifically to *momentum*, not velocity; the latter has a "path" and is not particularly important in quantum mechanics; also, because of spin, momentum and velocity are not necessarily collinear; momentum or "quantity of motion" is a better fit to the problem.

As pointed out above, the diffraction occurs even when electrons (or photons) are sent into the apparatus one-at-a-time. There is no way to predict where any individual electron will go; but the overall diffraction pattern which builds up after a long exposure is very predictable and very definite. The overall pattern is determined by quantum mechanical phase, and that, as Hestenes has pointed out, is linked to spin.

Interference arises from the phase of the wavelets combining constructively or destructively. In quantum mechanics the various phases are described mathematically and then are summed to allow them to interfere. The square of the resulting amplitude is taken to get the probability density that an electron will appear in a particular place. These are the "matter waves", "pilot waves", or "probability waves" that you read about in the literature of quantum mechanics. They are usually diagrammed as transverse waves, but keep in mind that "There is no evidence that matter waves actually consist of transverse vibrations." (Sherwin, p. 297; for that matter, there is no evidence that there is even a "propagation velocity" associated with matter waves or de Broglie waves)

These non-physical, abstract, mathematical matter waves give us a description where the electron is most likely to be found, or most likely to be absent. But the math alone does not give us a clue about the underlying reason or mechanism. In a transverse wave like a water wave, the most water will be found where the wave height (amplitude) is highest. In a longitudinal wave like a sound wave in air, the most particles will likewise be found where the amplitude is highest. But matter waves aren't anything "physical" as far as we know. Why is the "whereness and thereness" or "localization" of an electron described so effectively by a heap of abstract mathematics?

We suspect that it has something to do with spin, but unfortunately the exact mechanism has so far eluded description. When we talk about electrons getting together or avoiding each other, the word "spin" (instead of charge) enters the conversation. Two electrons can have only two spin orientations with respect to each other: parallel or antiparallel. There are no intermediate values or orientations. These orientations somehow affect what I call "localization". Here is an example that has to do with Fermi holes and Fermi heaps:

> "Because of the quantum mechanical effect of spin correlation, two electrons with the same spin cannot be found at the same point. Thus, a plot of the probability of finding a second electron relative to the location of the first falls to zero at zero separation. . . . There is a corresponding decrease in amplitude of the wave function for the location of the second electron, and that wavefunction is close to zero in a small region surrounding the location of the first electron. This region of almost zero amplitude is the **Fermi hole** in the wavefunction of the second electron.
>
> If the two electrons have opposite spins, there is an enhanced probability of finding the second electron close to the first. That is, instead of a Fermi hole, there is a corresponding **Fermi heap** . . . which is an enhanced amplitude in the wavefunction of the second electron wherever the first electron happens to be at any instant." (*Quanta,: A Handbook of Concepts*, P.W. Atkins, 2nd ed. (1994), p. 122-123;

See also

"Fermi holes and Fermi heaps General Chemistry",
http://quantum.bu.edu/notes/GeneralChemistry/FermniHolesAndHeaps.html ;

"Wonder conductors will spin up cooler computers", Catherine Zandonella, Aug 2010,
http://www.newscientist.com/article/mg20727751.400-wonder-conductors-will-spin-up-cooler-computers.html?full=true

"From photon bunching to electron antibunching", Christian Schönenberger (Jan. 2003)
http://www.nanoelectronics.ch/publications/papers/2003/SSOM-2003.pdf
http://pages.unibas.ch/phys-meso/Research/Papers/2002/Electron-Antibunching-PhysWorld.pdf

Finally, this is probably a good place to remind readers that our concepts of space and time come from motion. Motion is what we actually observe and measure. Our concepts of space and time are derived from the type of motion we observe. Motion is the primary concept (the basic "substrate"), whereas space and time are secondary concepts (or abstractions). Think of a box. The box has an "inside" and an "outside", but these are secondary concepts. They are not needed to construct a box; but if the box already exists, the concept of an "inside" and "outside" can then be defined in terms of the box. Without the box, the concepts cannot be defined.

Moreover, when trying to understand a given physical phenomenon, we need to determine what kind of inherent motion we are observing, *and* what kind of *reference system* we are using to view *the* motion. What we actually observe is a *combination* of the physical phenomenon itself and the effects of the reference system. Viewing translational temporal motion from the standpoint of a linear spatial reference system leads to the *apparent* paradoxes in Special and General Relativity. On the other hand, the concept of rotational spatial motion leads us to a better understanding of the electron as a unit of rotational space, and to a better understanding of concepts in electrodynamics.

The concept of spin, along with the concept of temporal motion, could probably explain all the major mysteries of quantum mechanics in a satisfying way if we could just shake ourselves loose from our current blind spots and misconceptions.

On a side note, I should say something about the terms "uncertainty" and "indeterminacy." These have acquired various meanings over the years. I prefer to use the term "indeterminate" in reference to how a temporal motion maps into a spatial reference system. Conceptually, it either has no position, direction, state, etc. or an infinite number of simultaneously existing potential positions, directions, states, etc., that can be "superposed". One of these potential states will materialize during an interaction with the spatial system. An act of measurement, for instance, forces the temporal phenomenon to participate in the spatial system.

"Uncertainty", on the other hand, seems to have more to do with the product of two quantities equating to a constant. The uncertainty in their values is inversely related, and consequently I sometimes use the term "inverseness" to emphasize this aspect. See article.

Zitterbewegung : "An oscillatory motion of an electron suggested in some interpretations of the Dirac electron theory, having a frequency greater than $4\pi mc^2/h$ . . . or approximately 1.5 x 10^{21} hertz" (*McGraw-Hill Dictionary of Scientific and Technical Terms*, 5th edition, 1994)

"Electron time, mass and zitter", David Hestenes, 2008. Hestenes_Electron_time_essa.pdf ;
http://www.fqxi.org/community/forum/topic/339

"In general, the momentum p is not collinear with the local velocity $v = v(x)$, because it includes a contribution from the spin." ("Mysteries and Insights of Dirac Theory", David Hestenes, p.9 http://modelingnts.la.asu.edu/pdf/MysteriesofDirac.pdf

See also: "Noncollinearity of Velocity and Momentum of Spinning Particles", O. Costa de Beauregard, *Found. Physics* 2: 111–126 (1972) http://www.costa-de-beauregard.com/fr/wp-content/uploads/2010/12/OCB-1972-12.pdf

Quantum Mechanics and the Hamiltonian

Back in the 1830s Sir William Rowan Hamilton devised a system of classical mechanics that would turn out to be ideally suited, with some reformulation, for use in quantum mechanics nearly 100 years later. In classical mechanics the Hamiltonian, H, of a system is the sum of the kinetic energy, T, and potential energy, V, of all the particles present. The relation is expressed as:

$$H = T + V$$

In quantum mechanics the expression must be converted into an operator:

$$\hat{H} = -\frac{\hbar^2}{2m}\frac{d^2}{dx^2} + V(x)$$

The Hamiltonian operator appears in Schrödinger's wave equation in the following form:

$$-\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2} + V(x)\psi(x) = E\,\psi(x)$$

One cannot help but wonder why Hamilton's description of motion is so useful in quantum mechanics. Newton's F=ma and its various derivatives were much more popular than Hamilton's. Yet in quantum mechanics, we have to use Hamilton's. The quantum world is a realm of 3D time and so spatial path descriptions (Newton) cannot be used. Quantum mechanical formulations therefore use scalar (non-directional) descriptions like "energy" or "action".

In classical form the Hamiltonian is expressed as:

$$H = \frac{p_x^2}{2m} + V(x)$$

This states that for a conservative system, the total energy is the sum of the kinetic and potential energy.

We can determine the space/time dimensions for energy from an equation like $E=mc^2$ as was done above, and it turned out be t/s . But will this work in the Hamiltonian? To find out, we will have to re-write it slightly. The p will be expressed as mechanical momentum, mv, and so kinetic energy will be $^1/_2\ mv^2$; potential energy is force through a distance and will be expressed as (ma)x. So we have:

$$E\ [=]\frac{1}{2}\,mv^2+(ma)x$$

$$[=]\ \frac{t^3}{s^3}\frac{s^2}{t^2}+\left(\ \frac{t^3}{s^3}\frac{s}{t^2}\ \right)s$$

$$[=]\ \frac{t}{s}\ +\ \frac{t}{s}$$

Note that the units of the two terms are consistent, as they must be before they can be added together. Note also that they have the space/time dimensions of energy!

Quantum phenomena are normally studied at very low energies (room temperature or even cryogenic temperatures) and at very tiny dimensions. Relativistic phenomena occur at high speeds or high temperatures and can involve astronomical distances. You would not expect one to have much in common with the other. But the Hamiltonian allows both types of activity to be described in the space/time dimensions of energy.

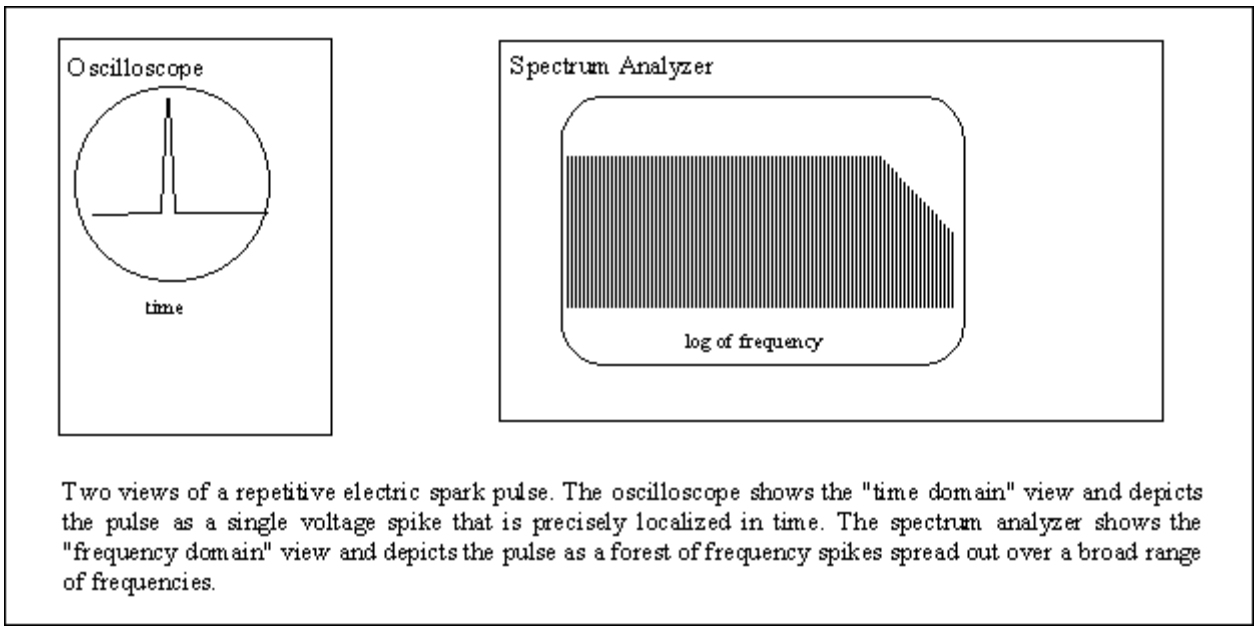
See also:

https://profoundphysics.com/lagrangian-vs-hamiltonian-mechanics/
https://profoundphysics.com/lagrangian-mechanics-for-beginners/

The Problem of Least Action (below)

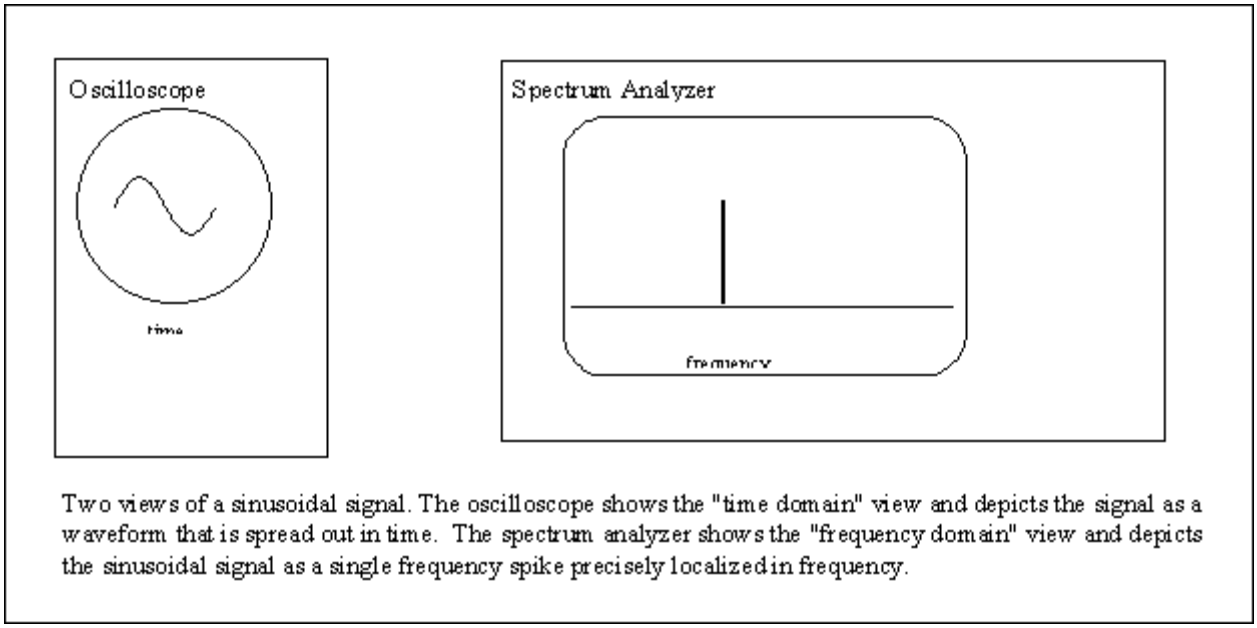
Inverseness, Complementarity, and the Wave/Particle Duality

Suppose that we are in an electronics laboratory and have before us two instruments, an oscilloscope and spectrum analyzer, which are connected to a device that makes electric sparks (like the spark plugs in your car). These two instruments give us two views of what a spark looks like electrically. The views are quite different and look something like the following:



Two views of a repetitive electric spark pulse. The oscilloscope shows the "time domain" view and depicts the pulse as a single voltage spike that is precisely localized in time. The spectrum analyzer shows the "frequency domain" view and depicts the pulse as a forest of frequency spikes spread out over a broad range of frequencies.

Next we disconnect the spark generator and now connect both instruments to a source of pure sine wave voltage, such as that coming from an ordinary electrical outlet in the lab. We would see something like this:



Two views of a sinusoidal signal. The oscilloscope shows the "time domain" view and depicts the signal as a waveform that is spread out in time. The spectrum analyzer shows the "frequency domain" view and depicts the sinusoidal signal as a single frequency spike precisely localized in frequency.

Note that these sets of two illustrations each show *complementary* views of the same phenomena. Note that there are *two concepts of location*: time and frequency. As the phenomena in one view become more precisely localized, the same phenomena, in the other view, become more spread-out. The amount of preciseness in one view is "inverse" to the preciseness in the other. This is like the momentum-position relationship in quantum mechanics:

$$\Delta p \, \Delta x \; > h/4\pi$$

The more precisely we know *p*, the less precisely we know *x*. And the more precisely we know *x*, the less precisely we know *p*. The two are inversely related mathematically.

"But I am not an electronics technician, and these little pictures don't mean anything to me." Okay. Try this. Get a really cheap AM broadcast band radio and place it near something that can create electric sparks, like an ordinary light switch. First, tune the radio to a blank spot in the band (and be sure you are using the AM, not FM mode if it is a dual mode radio). Then flip the light switch on and off. You will hear a pop or a click come from the radio. This shows that the act of interrupting ordinary 60 Hertz house current (second illustration) creates additional frequency components way up into the Megahertz range, which can be received by the AM radio (first illustration). Precisely locating the electrical event in the time view, causes the "location" in the frequency view to spread out.

So when you ***remove*** something from a pure sine wave you actually create ***additional*** frequency components! This may seem counter-intuitive but that is only due to our limited view of our world. We see our ordinary world mostly in terms of particles, not waves and particles. When we throw a basketball through a hoop, it does not spread out (diffract) into a field of "ball waves". We only see the basketball as a "particle". Our comprehension of the quantum world, however, freely utilizes both views (wave and particle) and we must educate our intuition if we are to feel comfortable with the resulting implications.

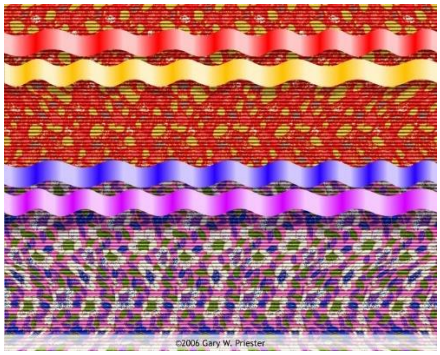
Much has been written on this subject in the literature of quantum mechanics. It is known there as "Bohr's principle of complementarity":

> "In quantum mechanics, **complementarity** refers to the impossibility of specifying simultaneously the wave and corpuscular attributes of a particle. (Etymologically, the wave and corpuscular attributes are both needed to give a 'complete' picture of a particle.) The wave and corpuscular properties of particles' are complementary in the sense that if we specify the precise value of a wavelike property we cannot simultaneously specify a corpuscular property." (*Quanta: a handbook of concepts*, P. W. Atkins, 2nd ed. 1991, p. 61)

The concept can be illustrated by examining the properties of light:.

> "Furthermore, in the sense of the uncertainty principle, the number of photons in a beam is complementary to the phase of the wave. That is, if the phase of a light wave is known exactly, nothing can be said about the number of photons present. This restriction is an aspect of the dual character of electromagnetic radiation: the number of photons is an intrinsically particle property and the phase of the radiation is an intrinsically wavelike property; speaking precisely in the language of one precludes speaking precisely in the language of the other." (*Quanta: a handbook of concepts*, P. W. Atkins, 2nd ed. 1991, p. 281)

The idea that one object, when subjected to different viewing methods, can give different appearances, is not in itself a cause for concern. Look at the picture below:



"Ribbons" by Gary W. Priester
http://www.eyetricks.com/3dstereo97.htm

On the surface, it appears to be something we would find in an art gallery or a wallpaper shop. But this image encodes some additional information: depth. It is called a "stereogram" and we have to stare at it (or through it) for a while before we see the "other" image. Although this is a bit out of the ordinary, there is nothing inherently baffling or self-contradictory about it.

According to the complementarity concept, a quantum mechanical entity may be seen as a wave or as a particle. This creates a problem for physicists and philosophers: if something is ***really*** particle, it cannot ***be*** a wave; conversely, if it is ***really*** a wave, it cannot ***be*** a particle. Although the views may be "complementary", they are fundamentally incompatible. The question is not "How does it look under a particular viewing method?" but instead, "What ***is*** it? What is it ***really***?" Is there a way to get a more complete, more fundamental view of this thing? Is there a more natural view that is free of basic incompatibilities? We can get a clue to answering these questions by reviewing how the wave/particle concept developed in the first place:

> "Given the historical matrix from which quantum mechanics emerged, it is not surprising that a great deal of early quantum theory was expressed in terms of wave and particle concepts. For every physicist at the turn of the century, these were ready-to-hand pieces of theoretical equipment. For sound pragmatic reasons physicists were loath to discard them. In 1900, however, with Planck's attribution of particle properties to electromagnetic waves, they began to be used in unorthodox ways; Planck's move was mirrored twenty-five years later by de Broglie's attribution of wave properties to electrons.
>
> These episodes in the prehistory of quantum theory do not teach us to abjure a unified understanding of quantum phenomena in favor of a doctrine of epistemological complementarity, according to which we are compelled to move to and fro between two incompatible ways of picturing the world. They teach us merely that neither of these ways is fully adequate. We can draw a different conclusion than did Bohr, even while agreeing with him that "The two views on the nature of light are rather to be considered as different attempts at an interpretation of experimental evidence, in which the limitations of the classical concepts are expressed in complementary ways". *(The Structure and Interpretation of Quantum Mechanics*, R.I.G. Hughes, 1989, p. 231)

Here is a similar thought from a textbook:

> "Actually the electron is neither a particle nor a wave. It is a fundamental entity of matter, and it cannot be described by saying it is something else more familiar. . . . Likewise, the photon is neither a particle nor a wave. It also is a fundamental entity, characterized by certain properties." (*Introduction to Electromagnetic Fields and Waves*, Charles, A Holt, 1963, p. 25)

Maybe physicists have simply been asking the wrong question. Instead of asking "Is it a wave or is it a particle?" maybe they should be asking something like: **"How does an inherently rotational entity appear to an observer in a linear, extensional reference system?"** It turns out that it would be seen either as a particle or as a wave, depending on the experimental set up.

The Problem of Quantum Reality

An issue among physicists, and the subject of much debate in both popular and scientific publications, is about the picture of reality presented by quantum mechanics.

Reality is defined as something that is factual, objective, actual, not merely seeming, pretended, or imagined.

If you find it hard to believe that *physicists*, of all people, are confused about what constitutes reality, then consider the following quotations:

"Questions like these [about elementary particles] raise doubts as to whether the conceptual scheme of nuclear physics is a 'real' account of the structure of the universe." (*Modern Science and Modern Man*, J. B. Conant, (1952), p. 46)

———

"The physicist thus finds himself in a world from which the bottom has dropped clean out; as he penetrates deeper and deeper it eludes him and fades away by the highly unsportsmanlike device of just becoming meaningless. No refinement of measurement will avail to carry him beyond the portals of this shadowy domain which he cannot even mention without logical inconsistency. A bound is thus forever set to the curiosity of the physicist. . . . The world is not a world of reason, understandable by the intellect of man, but as we penetrate ever deeper, the very law of cause and effect . . . ceases to have meaning. The world is not intrinsically reasonable or understandable; it acquires these properties in ever-increasing degree as we ascend from the realm of the very little to the realm of everyday things; here we may eventually hope for an understanding sufficiently good for all practical purposes, but no more." *(Reflections of a Physicist*, P.W. Bridgman, (1955), pp. 185-186)

———

"When we thought we were studying an external world our data were still simply our observations; the world was an inference from them. Until this century it was possible to make such an inference intelligibly . . . But now we find that . . . we can no longer express them as the structure of an external world unless we accept a world which is arbitrary, irrational and largely unknowable." (*The Scientific Adventure*, Herbert Dingle, (1952), p.260)

———

"The 'real' world is not only unknown and unknowable, but inconceivable—that is to say, contradictory or absurd." (*A Century of Science*, Herbert Dingle, (1951), p. 315)

———

"Some physicists would prefer to come back to the idea of an objective real world whose smallest parts exist objectively in the same sense as stones or trees exist independently of whether we observe them. This however is impossible."—Werner Heisenberg

Physicists arrived at these distasteful conclusions only after decades of debate and examination of perplexing experimental facts. In the single momentous year of 1925 three quantum theories had appeared on the scene: Schrödinger's wave mechanics, Heisenberg's matrix mechanics, and Dirac's transformation theory. Although they seemed quite different, they were found to be all mathematically equivalent. (A forth one, by Feynman, and fundamentally different, would appear in the late 1940s). The picture of reality implied by these theories was simply unbelievable and was the focus of much debate. The famous Bohr - Einstein debates over quantum theory and reality took place from about 1925 to 1935. Eventually the views of Niels Bohr, Werner Heisenberg, and Max Born prevailed and by the mid 1930s the "Copenhagen interpretation", as it came to be called, emerged as the generally accepted doctrine. This doctrine holds, among other things, that there is no deep reality to our world. This view is easily seen in the above quotations.

Mind you, there were no debates about whether an electron exists or that it possesses innate attributes like mass, charge, and spin. But it could not be denied that other attributes, like position/momentum, seemed to be inextricably linked to the measurement process. The former were called static attributes and the latter, dynamic attributes. The electron seemed to have no innate position, or even to possess an infinite number of simultaneously existing positions, until a position measurement was actually made. If you took away the measuring apparatus, you would actually take away the position attribute.

A rather loose illustration would be like asking "What is the color of a chameleon?" and the answer is that "It depends on the color of what it is sitting on." Well, how can that be? Doesn't a chameleon have a color in the same sense that trees and stones have color? In the thinking patterns of a quantum physicist, a chameleon is a creature that simultaneously exists in the form of multiple colors, and its "color" becomes actualized only when an observation is made. The "color" of a chameleon is thus a dynamic, rather than static, attribute.

We think of color as a real property of an object. but we also know it is not an innate attribute. Several years ago, many people here in Arizona wanted low pressure sodium vapor lights required for outdoor commercial lighting. They wanted these lights used because they would cause less interference with the sensitive telescopes at Kitt Peak. But many other people did not want them because they made everything look weird. I drove to a local Kmart store one night where the parking lot was illuminated with these lights. My white car appeared to be yellow. Two cars next to me were both black, until the headlights of a passing car illuminated them and one turned red and the other blue. If you had been there, would you have said that color is a "real and objective" property? Or rather that color depends somehow on external conditions and a "coupling to the observer"?

Let's make this example a little more extreme. Take a close look at a yellow spot on a color TV display or a color monitor on a computer. If you look at the pixels with a 15x jeweler's loupe, you can see that there is no yellow phosphor on an RGB (Red, Green, Blue) display. Yellow is made by exciting the red and green phosphors and the combination is perceived as yellow. Ask yourself, using Heisenberg's words about trees and stones, whether Yellow exists objectively on a color monitor in the same sense that Red and Green exist. You could say that Yellow has "no deep reality" but that in the words of Bridgman, "it acquires these properties in ever-increasing degree as we ascend from the realm of the very little to the realm of everyday things."

And what would you think if one day your monitor created Yellow from Red and Green, and the next day from White and Black, and the next day from Purple and Orange, and so on? Let's say that you study this for years and conclude, reluctantly, that a color monitor can make Yellow from any color, just ANY color! Wouldn't you conclude that the world of Yellow on color monitors is, in the words of Dingle, "a world which is arbitrary, irrational and largely unknowable"? Or that the answer to this question "fades away by the highly unsportsmanlike device of just becoming meaningless"? (Fortunately, color monitors are not this extreme, nor is color itself. But see also "Benham's disc" https://www.youtube.com/watch?v=c0iPfImf0pM)

The "reality question" has not changed any from the earlier days. Says "Clash of the Quantum Titans", Tom Siegfried, *Science News*, Nov 20, 2010, p.15-21, http://www.sciencenews.org/index/feature/activity/view/id/65056/title/Clash_of_the_Quantum_Titans :

> Those same fundamental questions that concerned Einstein and Schrodinger continue to disturb many physicists today. What quantum mechanics really means, where it ultimately comes from, why it denies the cause-and-effect certainly of traditional physics are all questions that haunt the deepest scientific thinkers--and divide them almost as badly as 21st century political parties. Physicists simply can't agree on how to interpret quantum physics. They fight like cats and dogs over it. . . ."There are different views," says physicist Nino Zanghi of the University of Genoa in Italy. "And the different views are defended by sensible people."
>
> At the heart of these disputes is the very nature of reality itself, and whether quantum physics is the last word on how to describe it. Zeilinger, of the University of Vienna, advocates the standard quantum view of reality's fuzziness. "It turns out that the notion of a reality 'out there' existing prior to our observation . . . is not correct in all situations," he points out
>
> . . . if you design an experiment to see if electrons are waves, you get waves. If you design an experiment to test whether electrons are particles, you get particles. . . . Heisenberg's limit had nothing to do with human capabilities; an electron simply does not possess a well-defined position or momentum before a measurement. Unobserved, an electron exists in multiple locations at once, just as Schrodinger's cat is both alive and dead until somebody opens the box. All physics can provide are the odds of spotting the electron in any given place. . . .

My view is that the reality issue involves at least two different questions which could be stated as: Is it a wave or a particle? and Does something exist (quantum mechanically) because we measure it? I believe both of these questions have very reasonable and intuitively accessible answers.

The first one boils down to another question which no one seems to have asked, namely: "How does an *inherently* rotational entity appear to an observer in a linear, extensional reference system?" The answer, in short, is that it can appear as a wave or as a particle depending on the experimental situation. Also, remember that "quantum mechanics is *the bridge*" between our accessible world and the quantum world. Quantum mechanics is *not* the quantum world itself. Our only contact with that world is through what physicists call the "expectation value" of quantum mechanics. That limitation, plus reference system induced misconceptions, has led us to believe that the quantum world itself is weird and strange. But it is not. When understood with the proper insights, it is just as logical and reasonable as anything else in factual physics.

The second question, about existence-because-of-measurement, also has an answer. All these measurements are done in a three-dimensional spatial reference system. The actual system that the Universe uses, appears to be one comprised of three-dimensional space and three-dimensional time. We have two "realms" in effect, one of "where" and another of "when". In general, these would be mutually orthogonal and completely independent; neither has any relation to the other. A definite position or direction in 3D space cannot be mapped into a definite position in 3D time and vice versa. The relationship can only be random. However, there is one thing that can relate or link these two realms: motion. *Motion* is *defined* as a *relationship* between space and time. It can be linear motion or intrinsically rotational motion. And it can be motion in space ("local" motion) or motion in time ("non-local" motion).

If our reference system used "motional dimensions" directly we could see things just as they "really" are. But alas, we are limited. We have to use three dimensions of spatial displacement, and one dimension of progressive time displacement. The outcome of this is that the temporal part of the phenomenon can only exist "potentially" as a spatial possibility. Only when the experiment or measurement is carried out does the potential become the actual. The act of measurement—that is, forcing the entire phenomena to manifest itself within the limits of a spatial reference system—produces both irreducible randomness and irreducible predictability (in the statistical sense). And so, as was said above, "an electron exists in multiple locations at once, just as Schrodinger's cat is both alive and dead until somebody opens the box. All physics can provide are the odds of spotting the electron in any given place. . . ."

A somewhat different but related perspective on this comes from the theory of superconductivity developed by Bardeen, Cooper, and Schrieffer. In this scheme electrons are paired and act like bosons. But these "pairs" aren't quite what we think they are. Says physicist Feynman:

> "I don't wish you to imagine that the pairs are really held together very closely like a point particle. As a matter of fact, one of the great difficulties of understanding this phenomena originally was that that is not the way things are. The two electrons which form the pair are really spread over a considerable distance; and the mean distance between pairs is relatively smaller than the size of a single pair. Several pairs are occupying the same space at the same time." (*The Feynman Lectures on Physics*, *op. cit.*, Vol. 3, page 21-7)
> https://www.academia.edu/28997196/The_Feynman_Lectures_on_Physics_VOL3

If you danced this way with your partner, he or she would be located across the room; other couples would be similarly separated from their partners, but the mean distance between couples would be smaller than the distance between you and your partner. We could call this kind of dancing "non-local" in that the partners are "connected" not so much by space, but by music (time). Other examples of non-local effects can be given from the speed of gravity, the speed of electric fields, and the EPR paradox.

"Reality" and "locality" are intimately connected. So please read the section below too.

The Problem of Quantum Locality

"Locality" is defined as:

> "The condition that two events at spatially separated locations are entirely independent of each other, provided that the time interval between the events is less than that required for a light signal to travel from one location to the other." (*McGraw-Hill Dictionary of Scientific and Technical Terms*, Sybil P. Parker (editor), 1994, 5th ed., under "locality")

Let's say that I have two cigars and a cigarette lighter. One cigar is located here on Earth and is in my immediate possession and control. But the other one is located out on Mars in a top-secret laboratory there. I claim that these cigars have been "correlated" by a special process that "entangles the phase of their matter waves" and that when I light the one here on earth, the one on Mars will light up too, and at the very same time. You claim that this idea is ridiculous, that no such thing can possibly happen, that it defies common sense, that the idea is "voodoo physics", "magic", "spooky action-at-a-distance" and so forth. We devise a careful experiment which we both agree will settle this claim in a definite, unambiguous way. Then we perform the experiment. It turns out that the cigar on Mars lights up exactly when I light up the cigar on Earth. We repeat the experiment and even retry it with several different variations. But we always get the same result. We agree that there is no question at all about what actually happens to the cigars. But we now start wondering about just what the word "location" means. How can two things be located far away from each other, and yet—somehow—also act like they are located in the same place?

This is essentially the situation that arose after Einstein, Podolsky, and Rosen jointly wrote a scientific paper in 1935 pointing out that quantum mechanics predicted such an effect (the so-called "EPR Paradox").While it cannot be done with cigars, it can be demonstrated with specially prepared atoms or photons, and today has a solid experimental basis. It thus raises the same sort of questions at the atomic level: What is locality? What is reality? You will see comments like the following in journals and textbooks:

From *Quantum Reality*, Nick Herbert, 1985, p. 214:

> "Non-local influences, if they existed, would not be mediated by fields or by anything else. When A connects to B non-locally, nothing crosses the intervening space, hence no amount of interposed matter can shield this interaction.
>
> Non-local influences do not diminish with distance. They are as potent at a million miles as at a millimeter.
>
> Non-local influences act instantaneously. The speed of their transmission is not limited by the velocity of light.
>
> A non-local interaction links up one location with another without crossing space, without decay, and without delay. A non-local interaction is, in short, *unmediated*, *unmitigated*, and *immediate*."

From *Quantum Chemistry*, Levine, p. 196:

> "Further analysis by Bell and others shows that the results of these experiments and the predictions of quantum mechanics are incompatible with a view of the world in which both realism and locality hold. Realism (also called objectivity) is the doctrine that external reality exists and has definite properties independent of whether or not this reality is observed by us. Locality excludes instantaneous action-at-a-distance and asserts that any influence from one system to another must travel at a speed that does not exceed the speed of light. Clauser and Shimony stated that quantum mechanics leads to the "philosophically startling" conclusion that we must either "totally abandon the realistic philosophy of most working scientists, or dramatically revise our concept of space-time" to permit "some kind of

action-at-a-distance." (Clauser and Shimony, *Rep. Prog. Phys.*, **41**, 1881; see also B. d'Espagnat, *Scientific American*, Nov. 1979, p. 158.)

Physics Today, April 1985, p .38, D. Greenberger, quoted in N.D. Mermin

> Quantum theory predicts and experiments confirm that when measurements are made on two particles that once interacted but now are separated by an unlimited distance the results obtained in the measurement on one particle depend on the results obtained from the measurement on the second particle and depend on which property of the second particle is measured. Such instantaneous "spooky actions at a distance" (Einstein's phrase) have led one physicist to remark that "quantum mechanics is magic"

From *The New Physics*, Paul Davies (editor), 1989, p. 395 (ISBN 0-521-43831-4):

> "It does not seem feasible to interpret quantum mechanical indefiniteness, chance, probability, entanglement and nonlocality merely as features of the observer's knowledge of a physical system. Rather, they seem to be objective features of the systems themselves. Thus, the conceptual innovations of quantum mechanics are likely to remain a permanent part of the physical world view." (Abner Shimony)

From "Physicist disentangles 'Schrodinger's cat' debate"
http://www.sciencedaily.com/releases/2013/08/130826123037.htm：

> "According to nonlocality, if any two entangled objects are sent in opposite directions and the state of one of them is altered, the second instantly alters its state in response no matter how far apart the two may be. Hobson cites direct experimental evidence supporting his analysis, from experiments performed in 1990 involving nonlocal observation of entangled pairs of photons.
>
> The strange thing is that the action happens instantly, with no time for light or an electromagnetic signal or radio signal to communicate between the two," Hobson said. "It is a single object that is behaving as a single object but it is in two different places. It doesn't matter what the distance is between them." "

A careful reading of these views, including the definition of "locality" given above, suggests that "non-local" simply means "non-spatial". Hence, we need another concept of "locality" that is non-spatial, but the effects of which can still be made manifest in a spatial reference system and which are still scientifically accessible. The concept of a deep reality need not be abandoned, but we must "dramatically revise our concept of space-time".

The revision that needs to be made apparently requires space-time to be changed to "space/time" or "time/space". That is, there are locations in space, and locations in time, and the two are always linked together into a ratio. The locations in time are "non-local" in the context of a spatial reference system. When I sit at my desk, my location in s*pace* does not change, but my location in *time* is progressing at (apparently) the speed of light (approximately). I am in *motion*, but it is not spatial motion.

The Problem of Quantum Uncertainty

Anyone who studies quantum mechanics soon encounters the Heisenberg uncertainty principle:

> "The relation whereby, if one simultaneously measures values of two canonically conjugate variables, such as position and momentum, the product of the uncertainties of their measured values cannot be less than approximately Planck's constant divided by 2π. Also known as Heisenberg uncertainty relation." (*McGraw-Hill Dictionary of Scientific and Technical Terms*, Sybil P. Parker (editor), 1994, 5th ed., under "uncertainty relation")

Over the years this principle has acquired many faces, and it is often confusing to sort them out:

"That this was the case is best illustrated by the fact that Ernan McMullin, presently chairman of the Philosophy Department of Notre Dame University, wrote a Ph.D. thesis in 1954 on the different meanings of the "quantum principle of uncertainty." He distinguished between at least four major classes of interpretations: Heisenberg's principle is regarded (1) as a *principle of impossibility* according to which it is impossible to measure simultaneously conjugate variables, (2) as a *principle of limitations* in measurement precision according to which the accuracy of previously acquired knowledge about one variable decreases by measuring its conjugate, (3) as a *principle of statistics* relating the scatter of one sequence of measurements with that of another, and (4) as a *mathematical principle* expressing the duality or complementarity of quantum phenomena." (*The Philosophy of Quantum Mechanics*, Max Jammer,1974, p. 79)

Let's first consider the measurement problem:

"We must consider light and matter as either waves or particles. This leads to quite an awkward result. Let us consider a measurement of the position of an electron. If we wish to locate the electron within a distance Δx, then we must use light with a wavelength at least that small. For the electron to be "seen," a photon must interact or collide in some way with the electron, for otherwise the photon will just pass right by and the electron will appear transparent. The photon has a momentum $p=h/\lambda$, and during the collision some of this momentum will be transferred to the electron. The very act of locating the electron leads to a change in its momentum. If we wish to locate the electron more accurately, we must use light with a smaller wavelength. . . . Because some of the photon's momentum must be transferred to the electron in the process of locating it, the momentum change of the electron becomes greater.

Heisenberg . . . showed that it is not possible to determine exactly how much momentum is transferred to the electron.

The Uncertainty Principle states that if we wish to locate any particle to within a distance Δx, then we automatically introduce an uncertainty in the momentum of the particle. . . . It is important to realize that this uncertainty is not due to poor measurement or poor experimental technique but is a fundamental property of the act of measurement itself." (*Quantum Chemistry*, Donald A. McQuarrie, 1983, p. 36-37)

In the above view, the Uncertainty arises only when a measurement is performed. Contrast that with the following:

"It must not be supposed . . . that the quantum uncertainty is somehow purely the result of an attempt to effect a measurement—a sort of unavoidable clumsiness in probing delicate systems. The uncertainty is inherent in the microsystem—it is there all the time, whether or not we actually choose to measure *x* or *p* [position or momentum]." *(Quantum Mechanics*, P.C.W. Davies, 1984, p. 8)

And then with this:

"In quantum physics, uncertainty is a precise and definite thing. There are pairs of parameters, known as conjugate variables, for which it is impossible to have a precisely determined value of each member of the pair at the same time. The most important of these uncertain pairs are position/momentum and energy/time.

The position/momentum uncertainty is the archetypal example, first described by Werner Heisenberg in 1927. It means that no entity can have both a precisely determined momentum . . . and a precisely determined position at the same time. This is not the result of the deficiencies of our measuring apparatus—it is not just that we cannot measure both the position and momentum of, say, an electron at the same time, but that an electron *does not have* both a precise position and a precise momentum at the same time. . . . (Some reference books still tell you that quantum uncertainty is solely a result of the difficulty of measuring position and momentum at the same time; do not believe them!)

The uncertainty in position multiplied by the uncertainty in momentum is always greater than the parameter $\hbar$ ["h bar"], Planck's constant divided by 2π. So although you can (in principle) get as near to this limit as you like, the more precisely one parameter is determined, the less accurately the other one is constrained. This is related to the basic wave-particle duality of the quantum world. A particle (in the everyday sense of the word) is capable of being precisely located at a point, but a wave is not." (*Q is for Quantum: An Encyclopedia of particle physics*, John Gribbin, 1998, under "Uncertainty")

The modern view of Uncertainty could be illustrated like this: Consider an apparatus that passes a stream of photons through a single tiny hole and then onto a photographic plate a short distance away from the hole. As the photons pass through the hole, they create an exposed spot directly behind it. But photons have a wave nature and a wave spreads out after passing through a hole, especially if the diameter of the hole is comparable to the wavelength. As the diameter of the hole is decreased, a diffraction pattern appears. It looks something like an archery target. The bullseye is called the Airy disk. (You can see something like it by pricking a tiny hole in a piece of aluminum foil and then looking at a distant street light at night through the hole.)

If the hole is made still smaller, the bullseye pattern enlarges. If made smaller still, the pattern enlarges so much it washes out and the exposure becomes dim but uniform. Finally, as the hole closes, the illumination is extinguished altogether.

So if the hole is made smaller in an attempt to confine the exposure to a narrower region, the exposed region actually spreads out even more. If the hole is made larger, there is less spreading beyond the edges, but then the position of the photons is not known as precisely. Recall that momentum represents both a magnitude and a direction. Changing the diameter of the hole, somehow alters the direction, and therefore momentum of the photons. We could say that precise simultaneous knowledge of both position and momentum are at odds with each other. We call them "conjugate variables".

The most commonly used uncertainty relations are momentum-position and energy-time:

momentum-position: $\Delta p \, \Delta x > h/4\pi$
energy-time: $\Delta E \, \Delta t > h/4\pi$

The space/time dimensional equivalents are :

momentum-position: (t2/s2)(s)
energy-time: (t/s)(t)

Note that both of these reduce to t^2/s. That should be a strong hint about the nature and origin of the Uncertainty relationships, as well as the wave-particle duality.

See also:
Operators, commutation and angular momentum (above)
The Problem of Least Action (below)

Just a note:
"In applications where it is natural to use the angular frequency (i.e. where the frequency is expressed in terms of radians per second instead of cycles per second or hertz) it is often useful to absorb a factor of 2π into the Planck constant. The resulting constant is called the **reduced Planck constant** or **Dirac constant**. It is equal to the Planck constant divided by 2π, and is denoted $\hbar$ (pronounced "**h-bar**" (http://en.wikipedia.org/wiki/Planck_constant)

The Problem of Least Action

"In classical mechanics, the Least Action Principle states that the motion of a particle along some path always minimizes the *difference* between its kinetic energy and its potential energy. Mathematically,

the motion of a particle always minimizes the Lagrangian action functional."
(http://www.conservapedia.com/Least_Action_Principle)

"Action" is defined as the difference between Kinetic Energy and Potential Energy integrated over time:

$$Action = S = \int_{t_1}^{t_2} (KE - PE)dt$$

Let's say you are an expert at throwing a football here on Earth. When you throw the ball across the field, you know exactly where it is going to land. Now suppose NASA sends you to a big asteroid that is composed of irregularly distributed clumps of dense massive material ("masscons") in a matrix of much less dense material like sand. You note that these masscons distort the gravitational field. In some places, when you drop the ball, it falls straight down. But in other places, it falls a bit sideways, sometimes to your left, sometimes to your right, depending on where you are standing, and the location of a masscon. You are now going to throw the ball to your fellow astronaut on a miles-long football field. But what path will the football take? This is not like Earth where you get a smooth, very predictable trajectory. On the asteroid the gravitational irregularities will cause the ball to zig zag. It could actually take one of quite a number of possible trajectories. How do you know which one it will take?

The answer to this question is that *you don't know*. However, *the ball does "know"*. It will always take the trajectory of "*least* action" (t^2/s), even if *you* have no way of knowing what that is. Why, or how, does nature act this way?

If you wanted to go to the library by way of "the path of least gasoline", would your car be able to figure it out all by itself? Despite the traffic lights, the construction zones, all the other variables and possible routes . . . ? And why would it choose "least gasoline" and not "least time" or "least noise" or "least turns"?

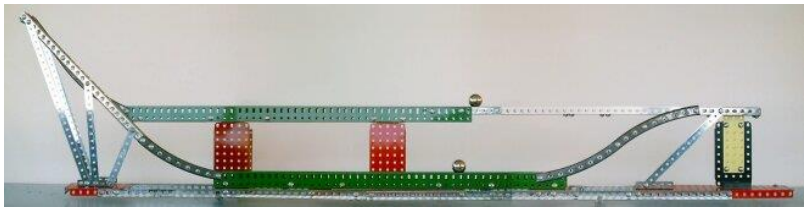
You may be familiar with Feynman's puzzle of the tossed clock. There are two clocks, exactly synchronized. One remains on the ground. The other is tossed up in the air. General Relativity says that when a clock is high up in a gravitational field, it runs slightly *faster* that the reference clock on the ground. But it also says that a clock moving a high speed will run slightly *slower* than the reference clock. You are supposed to toss the clock so that it returns when the reference clock indicates 100 seconds has elapsed. You know the two clocks will not show the same time due to the two interacting Relativity effects. You are supposed to toss the clock so that it indicates that *greater* than 100 seconds has elapsed when the reference clock says 100 seconds. Indeed, the puzzle requires that the difference be a positive *maximum* for the tossed clock. What trajectory will you choose? Feynman's answer:

> "Find out how fast you have to throw a ball up into the air so that it will fall back to earth in exactly 100 seconds. The ball's motion—rising fast, slowing down, stopping, and coming back down—is exactly the right motion to make the time the maximum on a wrist watch strapped to the ball.
>
> . . . the law of motion in a gravitational field can also be stated: *An object always moves from one place to another so that a clock carried on it gives a longer time than it would on any other possible trajectory*—with, of course, the same starting and finishing conditions. The time measured by a moving clock is often called its "proper time". In free fall, the trajectory makes the proper time of an object a maximum. . . . So the law of gravitation can be stated in terms of the ideas of the geometry of space-time in this remarkable way. The particles always take the longest proper time—in space-time a quantity analogous to the "shortest distance". That is the law of motion in a gravitational field." (Feynman, *Lectures*, Vol II, pages 42-12, 42-13)

How would you design a system that acted like this? Space, time, and gravitational fields must have very specific properties to behave like this. We know the mathematical equations. But what is the underlying conceptual "machinery".

Here are a few other puzzles to ponder:

http://en.wikipedia.org/wiki/Brachistochrone_curve
http://en.wikipedia.org/wiki/Tautochrone_curve



The balls are released at the same time and same height. But the lower path is longer than the top path. Which ball wins the race?
See http://www.lhup.edu/~dsimanek/scenario/demos.htm

Note that all the examples of least action occur in a gravitational reference system.

Links:

"The Principle of Least Action" (Feynman, *Lectures*, Vol II, ch 19; this is quite good, and available online) http://yima.csl.illinois.edu/psfile/ECE553/FeynmanLecturesOnPhysicsChapter2-19.pdf

http://www.scholarpedia.org/article/Principle_of_least_action
http://www.cleonis.nl/physics/phys256/least_action.php
http://en.wikipedia.org/wiki/Principle_of_least_action
http://www.eftaylor.com/leastaction.html
http://www.physicsinsights.org/lagrange_1.html
https://en.wikipedia.org/wiki/Stationary-action_principle
https://www.feynmanlectures.caltech.edu/II_19.html

The Problem of Entropy

Entropy is defined as “a thermodynamic quantity representing the unavailability of a system's thermal energy for conversion into mechanical work, often interpreted as the degree of disorder or randomness in the system. :

As disorder increases, we can say that the entropy increases. Put a drop of food coloring in a cup of still water. Do not mix it, but come back and look at it a day later. The drop will be gone, and the water will be uniformly colored. What caused it to mix? Thermal motion you say? But what causes thermal motion? And why would it *mix* things, not just *heat* things? Is there a way to “automatically” un-mix the mixture to get back to the original configuration? Apparently, the disorder is irreversible.

This is one of those conundrums that seems to bother only physicists and engineers (and maybe chemists and students).

What causes it? It is simply “temporal momentum.”

The basic idea is that molecules have momentum and that this momentum can be completely and fully described only in "motional dimensions", that is, a dimensional system that uses space/time ratios (or time/space ratios) as the fundamental dimension, not the commonly used spatial displacement and time progression displacement dimensions. The common system describes the *spatial* momentum component, but the full motion also has a *temporal* momentum component. The former corresponds to the common momentum description that has a magnitude and direction in a spatial reference system. The latter however, is "non-local" and does not have a direction in a spatial reference system. It is therefore a component that has a magnitude but no direction. It therefore has an effect like *diffusion*. Another sort-of, kind-of, related word for that is *entropy*. "It is often said that entropy is an expression of the disorder, or randomness of a system . . . " http://en.wikipedia.org/wiki/Entropy .

The Schrodinger equation (in quantum mechanics), incidentally, has the form of a diffusion equation, not a wave equation.

———

One intriguing question that arises here concerns the behavior of entropy in the framework of the speed spectrum. At certain natural unit boundaries, like the speed of light, physical behavior seems to "invert". This means that spatial entropy could become temporal entropy, or that spatial diffusion could become spatial "un-diffusion". Something that we expect to be *diffuse* (like particles in an explosion) would actually become *dense*. Perhaps this could explain certain high-density astronomical objects like white dwarfs, compact galaxies, and the "compact jets" being emitted from galaxies like M87 (see also HVGC-1). High speeds and high energies would be required in this context. More speculatively, if a device that uses electric and magnetic fields (already non-local, and non-thermodynamic) could be made to operate in the "inverted" spectrum, it could conceivably obtain "power from nowhere", because something that is naturally slowing down and losing energy from the temporal standpoint, is actually gaining energy from the spatial standpoint. None of this will make sense unless a reference system of "motional dimensions" is used.

The physics of actual, authentic, fundamental, temporal motion itself seems to be largely uninvestigated, or at least unpublished. Prior to, during, and somewhat after World War II, Nazi scientists were apparently "poking around" in this kind of physics (sometimes called "monstrous physics" because it was so different from the normal, spatial kind) and stumbled into some startling phenomena and applications. That in turn led to the development of a "wonder weapon" (or weapons) which they believed were "decisive for the war". They ran out of time, however, before such weapons could be deployed. After the war, development apparently continued secretly in other parts of the world. This kind of physics is still not publicly available, but is believed to have something to do with the phenomena of "flying saucers" or UFOs.

In Search of the Geometry of Space, Time, and Motion

The problem of metrics

The Euclidean metric worked fine for thousands of years, and still works fine today for ordinary purposes. But in the last two hundred years or so, questions have been raised about the physical applicability and scope of the Euclidean metric:

Tensor Analysis Theory and Applications to Geometry and Mechanics of Continua, I. S. Sokolnikoff, 2nd ed. (1964) p.105-016:

> There is no branch of mathematics in which the tyranny of authority has been felt more strongly than in geometry. The traditional Euclidean geometry, based on a set of "self-evident truths" and created largely by the Alexandrian School of mathematicians (around 300 B. C.), dominated the thought and shaped the development of physics and astronomy for over 2000 years. There were a few bold souls, even among the ancient mathematicians, to whom "self-evident truths" contained in Euclid's axioms did not seem convincing, but the prestige of logical structure of Euclid's *Elements* was so high and the hand of authority so heavy that they hindered the development of mathematics for centuries.
>
> In 1621, Sir Henry Savile raised some questions concerning what he called "two blemishes" in geometry, the theory of proportion and the theory of parallels. . . . In 1826, a Russian mathematician, Nicolai Lobachevski, presented to the mathematicians faculty of the University of Kazan a paper based on an assumption that it is possible to draw through any point in the plane two lines parallel to a given line. The geometry developed by Lobachevski proved just as devoid of inner inconsistencies as Euclidean geometry. Indeed, it contained the latter as a special case and implied the arbitrariness of the concept of length adopted in Euclidean geometry.
>
> In 1831, a Hungarian mathematician, John Bolyai, published results of his independent investigations which conceptually differ little from those of Lobachevski, but which perhaps contain a deeper appreciation of the metric properties of space. Bolyai pointed out, just as Lobachevski did, that his geometry in the small is approximately Euclidean and only a physical experiment can decide whether Euclidean or non-Euclidean geometry should be adopted for the purpose of physical measurement. Thus it appears that there are no *a priori* reasons for preferring one geometry to another. However, it was only after Riemann's profound dissertation on the hypotheses underlying the foundations of geometry appeared in print (published posthumously in 1867) that the mathematical world recognized fully the role played by the metric concepts in geometry.
>
> Riemann appears to have been unaware of the work of Lobachevski and Bolyai, although it was well known to Gauss. Later, Beltrami published his classical paper on the interpretation of non-Euclidean geometries (1868) in which he analyzed the work of Lobachevski, Bolyai, and Riemann and stressed the fact that the metric properties of space are mere definitions. . . .

The reason this is important today is because non-local effects must be considered in the more general physical picture of space, time, and motion. In a non-local situation, events and entities are demonstrably intimately and immediately connected, but not by *spatial* proximity or *spatial* contact, and are therefore free of the limitations normally imposed by spatial distance. Consider the EPR effect. This effect implies that two photons can be spatially separated by light years and yet still be "together" in some way, such that an action on one affects the other instantaneously. In other words, it implies that it is possible to set up instant Star Trek-like communications between spacecraft that could be hundreds of lights years apart in space.

And so what is your metric for "distance" in this situation? What is a realistic measure of "separation"? It is certainly not Euclidean. But the Euclidean notion of distance is 'a mere definition'. Might another definition be more appropriate? And could this have physical applications, say, for space travel? Might things actually be *closer* than we think they are, just not in space?

When you sit in your chair and read this article, you are at equilibrium with Earth's gravitational force. Nevertheless, you are experiencing an acceleration of about 9.8 m/sec^2. But you are not moving to a new "where". Gravitation is a non-local motion. It moves you to a new "when". If you don't believe me just look at your watch. It is ticking off the seconds while you are in the same place. Still don't believe me? Remember, General Relativity teaches that clock rates are affected by gravitation. Clocks slow down in a high gravity environment, and experiments have demonstrated this effect. You have both a "when" and a "where" location. And so does your chair. Acceleration can affect the locations of both. So how do you write an expression specifying the true "physical distance" between you and the chair? And will it still be valid for interatomic distance? Or for stars in ultracompact

galaxies? And at very high speeds, motion acquires more of a non-local character. What will you see when you look out the window of your spacecraft? How will you measure "distance" and do navigation?

Our notions about motion are in need of adjustment too. As per Einstein's Special Relativity, physicists believe that nothing can exceed the speed of light in a vacuum. But today this needs to be interpreted as "nothing can exceed the ***spatial*** speed of light in a vacuum." There may be other kinds of speeds, that is, other kinds of motions. Consider astronomical redshifts:

> "The most distant observed gamma ray burst was GRB 090423, which had a redshift of z = 8.2.[65] The most distant known quasar, ULAS J1120+0641, is at z = 7.1 .[66][67] The highest known redshift radio galaxy (TN J0924-2201) is at a redshift z = 5.2 [68] and the highest known redshift molecular material is the detection of emission from the CO molecule from the quasar SDSS J1148+5251 at z = 6.42."(http://en.wikipedia.org/wiki/Redshift)

Z is the redshift that the telescope sees compared to the laboratory reference value. It is just a number. The interpretation is left up to the astronomer. A Z that is greater than one, implies speeds that are greater than light. Simplistically, a Z of 5.2 would imply a speed of over 5 times that of light. But because of the acceptance of Special Relativity, physicists and astronomers find this interpretation hard to accept. And so they use Special Relativity theory to "correct" these speeds to sublight values. In other words, they map the speeds into a system of purely *spatial* motion, so that it is always less than the speed of light.

We see the same "corrections" applied in other situations. Experiments show that the speed of gravity and the speed of electric fields is instantaneous. But today's theories win out over fact. The speed of gravity gets "corrected" down to that of light, even though NASA cannot use this "correction" in their orbital calculations. Only an instantaneous speed for gravity gives the correct answers.

Clearly, we need a more comprehensive metric for motion. Our notions about space and time are derived from motion. Motion is not "made of" a relation between space and time. Motion comes first. Think of how you make a box. Do you start with an "inside" and an "outside"? Or do you start with the box itself first, and then *define* what is meant by an "inside" and an "outside"? Motion is the primary concept, space and time are secondary, derived concepts.

Problems with "time"

Our view of motion affects our view of time. In physics, time is generally treated as a parameter, not as a variable. Action occurs "in space", not "in time" Time is used as a *descriptor* not a *participator*. Time is "external" to the motion. Because of this, physicists have proposed eliminating the concept of time as being fundamental. Consider Amrit S. Sorli's paper, "Time is Derived from Motion through Timeless Space":

> "A growing number of modern researchers are challenging the view that space-time is the fundamental arena of the universe. They point out that it does not correspond to physical reality, and propose "timeless space" as the arena instead. . . . Time and clocks are man-made inventions. Motion is primary, time is secondary. Time is an artifice of measurement, a useful tool that permits us to build mental and mathematical models for our daily lives as well as for our physics and cosmology. But time as a fundamental entity has no role in physics.
>
> [Conclusion] When physical objects move, they move through space, not through space-time, and not through time. Time is derived from this motion through space, and space itself is timeless. Whilst the speed of light is considered to be a maximum rate of motion, this varies with the local environment, the photon is an extended entity that experiences no time, and some atomic-scale physical phenomena appear to be timeless. Clocks are macroscopic measuring devices which accumulate local internal motion, and we can record a sequencing of that motion and the changes that occur in

space. But we can find no evidence to support the existence of space-time as a fundamental entity. Accordingly we must conclude that we live in a timeless atemporal universe of space and motion, where the past and future only exist in the human mind, and the only eternity is now." ("Time is derived from motion through timeless space", Amrit S. Sorli, http://www.fqxi.org/data/forum-attachments/TIME_IS_DERIVED_FROM_MOTION.pdf)

And this from Carlo Rovelli's paper "Forget time" (2008):

"Following a line of research that I have developed for several years, I argue that the best strategy for understanding quantum gravity is to build a picture of the physical world where the notion of time plays no role at all. I summarize here this point of view, explaining why I think that in a fundamental description of nature we must "forget time", and how this can be done in the classical and in the quantum theory. The idea is to develop a formalism that treats dependent and independent variables on the same footing. In short, I propose to interpret mechanics as a theory of relations between variables, rather than the theory of the evolution of variables in time. " ("Forget Time", Carlo Rovelli, 2008, http://www.fqxi.org/data/essay-contest-files/Rovelli_Time.pdf)

And this from "The Nature of Time" by Julian Barbour

"I will not claim that time can definitely be banished from physics . . . . Nevertheless, I think it is entirely possible—indeed likely—that time as such plays no role in the universe." ("The Nature of Time", Julian Barbour http://www.fqxi.org/data/essay-contest-files/Barbour_The_Nature_of_Time.pdf

And this from " 'Space Travel is Utter Bilge' ", a quote from astronomer Sir Richard Wooley in 1956, used as the title of an article by Donald Yeomans (2002), a JPL senior research scientist wherein he states:

"We must re-examine the physical properties of space itself if we are to understand the relation between electromagnetic and gravitational forces. We must also re-examine our concept of time. It is possible that time is more than one-dimensional." http://greyfalcon.us/restored/Secrets%20of%20the%20Saucer%20Scientists.htm

And this from "Physical Principles of Advanced Space Propulsion Based on Heims's Field Theory", Walter Dröscher, Jochem Häuser (2002) http://www.hpcc-space.com/publications/documents/PrinciplesOfAdvancedSpacePropulsionAIAA-paper-2002-4094.pdf

"In this context, space and time are not the container for things, but are, due to their dynamic (cyclic) nature, the things themselves. This is an entirely different physical picture from the approach of simply adding the stress-energy-momentum tensor of the electromagnetic field to the right-hand side of Einstein's field equations . . "

For additional articles about time see: http://www.fqxi.org/community/essay/winners/2008.1 And http://milesmathis.com/time.html

Problems with "space"

Similar arguments could just as validly be applied to space. We might need to "forget space" too, at least as a ***fundamental*** concept. I have asserted that the quantum mechanical world is a world that is limited to one unit of space. There is no "inside" to this space. It is non-metrizable. We therefore cannot specify trajectories or velocities in the quantum world. The "happenings" are in three-dimensional time, not space. Only a non-local (and therefore non-directional and probabilistic) description can be given.

Clearly, a choice of metric will be affected by quantization boundaries: phenomena that involve one unit of space, one unit of time, or one unit of their ratio (space/time or time/space) may appear/behave/measure in a strangely non-intuitive manner from the view point of humans who are accustomed to a reference system that is quite "distant" :-) from these boundaries. According to

current views in physics, the photResearch needed on monopolar pulsed high voltage levitation https://www.academia.edu/29945834/Research_needed_on_monopolar_pulsed_high_voltage_levitation on, for example, experiences no time flow at all. Now it is appropriate to ask, Does it even experience space flow? Like a leaf in a river, it might be stationary with respect to what is really moving.

A choice of a distance metric also affects interatomic distance measurements, and we know something weird is going on with that. When certain salts are melted, the volume of the melt increases compared to the volume of the unmelted solid. This would lead us to expect that the interatomic distances in the melt would increase slightly. But in fact the distance *decreases*:

> "There is another important fact about the melting process. When many ion lattices are melted, *there is a 10 to 25% increase in the volume of the system* (Table 5.10). This volume increase is of fundamental importance to someone who wishes to conceptualize models for ionic liquids because one is faced with an apparent contradiction. From the increase in volume, one would think that the mean distance apart of the ions in a liquid electrolyte would be greater than in its parent crystal. On the other hand, from the fact that the ions in a fused salt are slightly closer together than in the solid lattice, one would think that there should be a small volume decrease upon fusion. How is this emptiness—which evidently gets introduced into the solid lattice on melting—to be conceptualized?" (*Modern Electrochemistry: ionics*, John O'M.Bockris, Amulya K. N. Reddy, 2nd ed, 1998, p. 611-612)

"Such "volumes of nothingness" must be present to account for the large increase in volume upon fusion while at the same time the internuclear distance decreases (see Tables 5.9 and 5.10)" (Bockris, *ibid.*, p. 619)

> ". . . this space is counterintuitive to the internulcear distances given by X-ray or neutron diffraction. The internuclear distances found in molten salts are smaller, not bigger, as might be thought from the increase in volume." (Bockris, *ibid.*, p. 620)

(For more on this see above.)

Still more trouble with the interatomic distance metric is suggested by the ultra high density of matter inside white dwarf stars:

> "the average density of matter in a white dwarf must therefore be, very roughly, 1,000,000 times greater than the average density of the Sun, or approximately 10^6 grams (1 tonne) per cubic centimeter.[1] " (http://en.wikipedia.org/wiki/White_dwarf)

Scientists try to explain this fantastically high density with very contrived "explanations" like "electron degenerate matter" and "neutron stars". But again the whole problem may result from some misconceptions about the appropriate metric for interatomic distance. It is important for us to understand what is going on here, and it has implications for space travel.

The density of matter in a white dwarf is greater than that of ordinary water by a factor of 10^6. In a so-called neutron star it is 10^{14}. What if "space" could, by technical means, be shortened somehow by a factor of 10^{14}? The Andromeda galaxy is approximately 2 x 10^6 light years from Earth. If by artificial means we would "shrink" the distance by a factor of 10^{14}, then Andromeda would only be 10^{-8} light years distant. That is about 0.3 light seconds—closer than the Moon is to Earth. Distances in the universe would become trivial from a space travel standpoint. That may seem far-fetched and hard to visualize. But if *motion* is the *real* metric, as suggested above, our concepts of what we call space or time are quite artificial. Motion is a ratio between space and time (s/t). Suppose we could somehow put more *time* between atoms. That would decrease the effect of the spatial unit, seemingly shrinking it. Ultrahigh density matter could be made in the laboratory. Nature does it somehow. Why can't we

do the same? And if we could do it in the laboratory, why not in open space? The "inverseness" of the space/time relationship in *motion* implies that *spatially* distant objects might be close *temporally*.

Related: Is it possible to have an "inverted star"? That is, a star where the *heavy* elements "ungravitate" to the surface and the *lighter* elements gravitate to the core? Here is a note from *Science News* "Odd white dwarf offers peek at core", Christopher Crockett (April 30, 2016,) p. 12-13:

> White dwarfs . . . are the last place astronomers expected to find a nearly pure oxygen atmosphere. . . . a newly discovered white dwarf . . . has no hydrogen or helium at its surface. Its atmosphere is dominated by oxygen. . . . While oxygen dominates this white dwarf's atmosphere, neon and magnesium come in second and third . . . . In 2007, Dufour and colleagues reported a similar strange sighting: several white dwarfs whose atmospheres were loaded with carbon instead of hydrogen and helium. . . . "This white dwarf might only be a freak. . . . Although often in science, it's the exception that makes you understand a great deal later on."

And there are other astronomical objects that suggest problems with the distance metric. But instead of space between atoms, the problem is space between stars. One example pertains to 'ultra-compact dwarf galaxies' :

> "UCDs were discovered in 1999. Although they are still enormous by everyday standards, at about 60 light years across, they are less than 1/1000th the diameter of our own Galaxy, the Milky Way."
> http://www.sciencedaily.com/releases/2009/02/090212093900.htm

Another pertains to the internal structure of quasars:

> "Some quasars display changes in luminosity which are rapid in the optical range and even more rapid in the X-rays. Because these changes occur very rapidly they define an upper limit on the volume of a quasar; quasars are not much larger than the Solar System.[4] This implies an astonishingly high energy density." (http://en.wikipedia.org/wiki/Quasar)

Quasars are apparently super-compact galaxies. They seem to be an extreme example of the UCDs.

Apparently, large galaxies can eject compact objects that expand. Those "knots" in the M87 jets could each be a highly 'compressed' collection of stars that eventually expand back out into small galaxies after ejection:

> "To the unconventional astronomer, especially to Halton Arp, who has been the primary collector of these discrepant observations, it looks as if the primary galaxy is ejecting "babies" that grow up into companion galaxies."
> http://www.thunderbolts.info/tpod/2005/arch05/050106universe-arp.htm

An energetic process like an explosion will scatter explosion products outwards and spherically. We would not expect such an explosion to produce a narrow jet light years in length. It maybe that these jets are so energetic that the resulting motion involves two temporal dimension and only one spatial dimension. If we could ride the beam, we would see "relativistic aberration"--essentially a two-dimensional view of the Universe. The spatial view from the outside, however, would be one-dimensional, like a line.

The idea of compressed structures expanding back out into normal density structures reminds me of nova (novea) associated with white dwarf stars. As already noted above, these stars are comprised of extremely dense material. Novea could be a manifestation of a process that causes an ultradense star to adjust its density back to normal. Exactly what is going on here is not at all clear, but it probably involves a quantization boundary, which in turn requires a "motional metric" (discussed below) to be properly understood.

Following this line of thought, there is even a several decades old theory that the Earth itself is physically expanding:

"Global Expansion Tectonics: A Significant Challenge for Physics" (2012)
https://beyondmainstream.org/scientist/dr-james-maxlow/

> "Mathematical modeling of this seafloor mapping shows that Earth radius is increasing exponentially through time, and radius is currently increasing at a rate of 22 millimetres per year. While this seafloor mapping quantifies Global Expansion Tectonics as a viable alternative to conventional tectonic theory, a fundamental challenge is presented to physics, whereby an explanation is required to explain how and where additional matter is generated and accumulated within the Earth in order to comply with the increase in Earth radius, as evidenced from empirical seafloor crustal data.

"The Expanding/Growing Earth", David Bressan (2011):
http://historyofgeology.fieldofscience.com/2011/01/expandinggrowing-earth.html

> "The geological model at the end of the 19th century was characterized by a static earth, slowly cooling and therefore shrinking until the molten interior became completely frozen.
> The accumulating observations that continents once were connected led to the formulation of various hypotheses allowing vertical and horizontal movements of earths crust.
> In the middle of the 20th century a new idea proposed that earth is in fact expanding, and the continents are remnants of old crust surrounded by younger rocks generated along the mid ocean ridges, explored between 1920-1960."

http://en.wikipedia.org/wiki/Pascual_Jordan

> "A much stranger idea to explain the assumed phenomena was proposed by the German physicist Pascual Jordan in 1966 - the increase of earth was imputable to the general dilatation of the space-time continuum."

> "In 1966, Jordan published the 182 page work *Die Expansion der Erde. Folgerungen aus der Diracschen Gravitationshypothese* (The expansion of the Earth. Conclusions from the Dirac gravitation hypothesis)[4] in which he developed his theory that, according to Paul Dirac's hypothesis of a steady weakening of gravitation throughout the history of the universe, the Earth may have swollen to its current size, from an initial ball of a diameter of only about 7,000 kilometres (4,300 mi). . . . Despite the energy Jordan invested in the expanding Earth theory, his geological work was never taken seriously by either physicists or geologists. "

The Observational Impetus For Le Sage Gravity - Halton Arp's official website

> *Expanding Earth*
> As long ago as as 1958 S. Carey reported detailed geological data which implied the earth had been expanding. K.M. Creer (1965) was one of many who showed how accurately the continents fitted together in the past and M. Kokus (1994) calculated how the observed sea floor spreading in the mid Atlantic ridge supported this interpretation. Naturally without an identifiable physical cause most scientists abandoned these empirical conclusions in favor of the theory that there was nothing of significance to explain. It is appropriate to quote Creer, however: "For an adequate explanation we may well have to await a satisfactory theory of the origin and development of the universe."

See also https://en.wikipedia.org/wiki/Expanding_Earth

No increase in mass nor a modification of the gravitational constant is needed to explain the expansion of the Earth. Our solar system is slightly below the Main Sequence. That implies it still has a small amount of excess time displacement that has not yet come into full equilibrium with the spatial system. Hence, it is slowly expanding. See Planet formation and Type 1 supernova (above).

Something like this has been seen on Earth, but in an entirely different context, in a German patent by Karl Nowak (Verfahren und Einrichtung zur AEnderung von Stoffeigenschaften oder Herstellung von stark expansionsfaehigen Stoffen . in English: "Method and arrangement to the Change of

Material Characteristic or Manufacture of Strongly Expansive-Capable Materials"), German No. 905 847 Class 12g, Group 101 (1943, published 1954; DE0905847C) Similar: https://patents.google.com/patent/WO1985001891A1/de)

Henry Stevens offers these comments:

> According to Karl Nowak's 1954 German patent, patent number 905847, Class 12g, Group 101, by a process of extreme cooling coupled with pressure, the basic atomic structure of material can be changed. It is reduced, narrowed and confined in terms of atomic, crystalline structure. . . . Admittedly, at first the idea of compression cooling as a means to change atomic structure sounds a lot like junk science.
>
> At this point Dr. Gordon Freeman weighs in with some remarkable scientific insight. According to Dr. Freeman, an elements [*sic*] behavior is determined by its arrangement of electrons orbiting the nucleus of that elemental atom. Seven electron shells are present around the core. Under high pressure electrons are shifted to lower orbits and new orbital overlappings are formed. This changes the whole behavior of the element concerning color, boiling temperature, density, and so forth.
>
> The trick seems to be to cool and compress the material and then gradually release the pressure. The material will retain its new properties at least for several months. (*Hitler's Suppressed and Still-Secret Weapons*, Henry Stevens (2007) p. 127;)

Such a claim is both hard to believe and hard to ignore. Certainly there are strong suggestions from several sources that we still have a lot to learn about interatomic distance and related effects. (See also "Scientists Fabricate Room Temperature Superconducting Material" http://www.nextenergynews.com/news1/next-energy-news3.19a.html)

Here is another little tidbit to consider. Cryogenic processing of ferrous metals is used to transform austenite into martensite even after the usual heat tempering treatment:

> Factually, if you were to examine mass heat treated items like many available drill bits, saw blades, etc., you would find many that show only 50% to 60% transformation. This is the area in which cryogenics can really strut its stuff. The reason is that cryogenics is the only method known that can complete the transformation to 99.8% to 100% martensite, or come at all close to it. Martensite, as you recall is the fine hardened grain structure that you strive for in the heat treat process. . . .
>
> Deep freezing of metals has been around for many years. It has been in use for at least 30 to 35 years to stress relieve cast iron gears and weldments. This is the reason you will find dry ice at a welding supply store. Welders discovered many years ago that they could rely on dry ice to stress relieve welds. . . . The Chinese . . . are now selling end mills that have been cryogenically frozen.
>
> Cryogenic processing has also been used to reclaim "overcooked steel". This kind of steel has a high percentage of "retained austenite", which greatly reduces hardenability. Its magnetic properties have been so severely altered, a magnetic chuck might not be able to hold it in position for machining. This kind of steel may actually *shrink* during heat treatment. The internal structure of this metal is so messed up that reheat treating the part usually does not remedy the problem. However, it can usually be completely restored by cryogenic processing. (*Heat Treatment Selection, and Application of Tool Steels*, William E. Bryson, 2009, p. 107,114,170-171)

The point here is that even in a metal soaked to liquid nitrogen temperatures, there are still plenty of things happening. The metal may look inert and inactive, but it is not.

These are examples of instances where space itself seems to have 'shrunk', or at least is not behaving in the way we expect it to. Certainly it does not behave in the manner implied by a simple Euclidean metric.

Special and General Relativity

Keep in mind that Special Relativity and General Relativity are *local* theories. They artificially (but usefully) map temporal motion into a spatial reference system:

> In 1905 Albert Einstein's Special Theory of Relativity postulated that no material or energy can travel faster than the speed of light, and Einstein thereby sought to reformulate physical laws in a way which obeyed the principle of locality. He later succeeded in producing an alternative theory of gravitation, General Relativity, which obeys the principle of locality. ("Principle of locality", http://en.wikipedia.org/wiki/Principle_of_locality)

In General Relativity, the "locality" arises by treating space as a connecting medium, rather than as something that separates. It is much like the Faraday/Maxwell *field concept* where the field was "action through a medium from one portion to the contiguous portion". The idea of being "spatially connected" is virtually the definition of "locality".

The Universe is both *local* and *non-local* in its fundamental nature. It is a mistake to try (in general) to map non-local phenomena into a local reference system. This realization was not around in 1905. The only well-known non-local phenomena back then were the action-at-a-distance "fields" of gravitation, magnetism, and electrostatics. The field concept was an attempt to make their non-local behavior more like local behavior, and thus more compatible with human intuition. Arguably, the first "hard-core" contact with non-locality came with Quantum Mechanics in the 1920s. Later, came the EPR "paradox" (1935) at Einstein's own hand, who again argued for a "local" interpretation. The Aharonov–Bohm effect emerged in 1949-1959. Then Chalmers W. Sherwin and Robert D. Rawcliffe experiment in 1960. Then Bell's Inequality Theorem in 1964. Then the experiments of John Clauser and Stuart Freedman (1972) and Alain Aspect (1981). These experiments (and others) demonstrated non-local behaviors at a fundamental level.

Out-of-scope application of Relativity to non-local phenomena at the insistence (tyranny?) of the scientific community has resulted in a lot of misunderstandings (and animosity) and has held back advancement of physics for over 100 years. Scientists still insist that the speed of gravity, magnetic, and electric fields are limited to the speed of light, but this is a major misconception. See the speed of gravity and the speed of electric fields)

Einstein's Special and General Relativity theories are, as the names suggest, theories of *relative* motion. You cannot expect such theories to deliver deep insights about *absolute* motion, because that kind of motion is simply out-of-scope.

SR and GR Paradoxes

The belief that motion is “purely relative” results in various paradoxes. Some of these have already been discussed. But here is a very short recap:

Consider this one: Two identical twins of the same height walk away from each other. Each sees the other as "shrinking in the distance". Which twin does the *real* shrinking? Is this an actual effect (a change in physical dimensions)? Or is it just a reference system effect (a matter of appearances only)? What happens when the twins come back together?

The so-called Twin Paradox has a similar standing. This is where one twin stays on Earth and the other goes away in a rocket ship at some significant fraction of the speed of light. Upon his return, he has aged *less* than his twin on Earth. But this is not the official paradox; this is just a simple

prediction of Special Relativity. The paradox is that *either* twin can be viewed as being younger than the other, because the motion can only be "purely relative". The fact that the *cause* of one type of motion can be distinguished from the other is irrelevant to the paradox. (There is no paradox if the ages are referred to the progression of an "orthogonal sum clock" that incorporates *both* time and space progression effects.)

Examples for Special Relativity effects are usually presented as something with high speed motion as measured from a gravitational reference system (Earth). Two spaceships with identical, initially synchronized clocks are moving at 50% of the speed of light. Which spacecraft, without reference to an Earth-like gravitational reference system, has the slow clock?

You have probably read through the Einstein train example in the textbooks. There are two lightning strikes, one at either end of the train. Both are simultaneous to an observer on the ground at the midpoint next to the train. But they are not simultaneous to the observer riding at the middle of the moving train (at least that is what we think, even though no one actually asks). The math is simple. The logic is self-consistent. Some would call the whole thing "beautiful and elegant". The train example seems intuitive, ironclad, and irrefutable. But does *nature* really work this way?

We have to be careful. Remember quantum mechanics? It is illogical, non-intuitive, even weirdly perverse, until you take into account the ("non-local") effects of three-dimensional time. Then it becomes substantially more intuitive. Photons are very quantum mechanical, even those used by Einstein's train. If you add in the effect of temporal motion to the train problem, you will preserve simultaneity of distant events. But if you do that, you are effectively working the problem in "motional dimensions" instead of 4-dimensional space-time, and again Special Relativity does not apply.

What about the situation where one dimension of an object seems to shrink in the dimension of its high speed motion. This likewise seems to be only a reference system effect, not an actual physical effect (one that would result in high densities, high temperatures, etc.). As noted above (Sorli), there are strong doubts that the Universe actually uses this particular metric (the so-called "Minkowski space" ; and because of the *ict* term, it is obviously non-Euclidean, in case anyone is wondering). Another problem is implied by the compensation given to clocks in the Global Positioning System. Clocks in orbit will run slow compared to a clock on the ground. Hence, the clocks for orbit are precalibrated to run slightly fast while they are on the ground so that they will have the same manifested clock rate as the ground clock when in orbit. It is clear that this compensation cannot be symmetric. That is, the same compensation cannot be applied to either set of clocks. That means that the motion is not "purely relative" as claimed by Special Relativity.

That physicists so readily accept and defend these paradoxes as science says some really awful things about our science institutions.

A "motional metric"

We presently use spatial displacement and time progression displacement as our reference system. It is based on *differences* of location, not on true physical units of space and time, and it creates an arbitrary zero datum. The construct is useful, but not fundamental. Of course, physicists will complain that there isn't any such thing as a "physical unit" of space or time. But that is ok. As was quoted above, their comrades are trying to get rid of the concept of space and time as being *fundamental* anyway. They are claiming that motion is primary, and that space and time are derived

concepts. In other words, we really need a "motional metric" and need to work some of our physics problems in "motional dimensions", not space or time displacement dimensions.

This notion does indeed have a basis in fundamental physical equations. We are all familiar with $E=mc^2$. Note that there is no separate time term. E=cB (in electromagnetics) is another one. Again, note that there is no separate time term. And Newton's gravitation: $F = G (m_2m_2)/r^2$. No time term there either. Time shows up only when connected with space, as in *c*, the speed of light. Its appearance in Newton's gravitation is concealed as a "motional potential" (expressed as force), and motion is, again, a relationship between space and time. Even in quantum mechanics, time is merely a parameter. The implication is that space and time are not truly ***fundamental***, and that *motion* should be a more useful and ***fundamental*** concept. But if motion is the fundamental concept, then *both* space/time ("velocity") and time/space ("inverse velocity" or energy) are legitimate concepts. The former is "local" and the latter is "non-local". (The implications of this are mind-boggling.)

There will be resistance to this kind of thinking, the likes of which have occurred before. Remember our troubles with numbers? First, there were the "counting integers", which made perfect sense. Then someone came up with the concept of a "zero" —a number to represent nothing (unknown to the Romans). Then *negative* numbers came along (how could you have a *number* that was *less* than *nothing*?!). Then along came Pythagoras and "irrational numbers", the geometric representation of which, could be constructed with an ordinary compass and straight-edge (scandalous!). Still later, "imaginary numbers" came on the scene. At first, this baffled even the most brilliant mathematicians. But the need for them arose naturally in fairly ordinary mathematics, and the concept is now well accepted and very useful. I think the same will happen with "inverse velocity" (the term is actually self-contradictory because there is no trajectory and the effect is instantaneous).

Fundamentally, space and time seem to be *progressing*. They are not static. They are "emergent" as some physicists are claiming. This is no surprise, really, if ***motion*** is the fundamental entity for the physical universe. Space and time could be identical twins that are always linked together in a ratio called motion. This requires them to progress, for example, as 1/1, 2/2, 3/3 etc. The individual units are always changing, progressing, but the ***ratio*** remains constant. The ratio is "stationary" even though it has "moving parts", progressing at the speed of light (we will suppose). The "rest frame" is not resting! The speed of light thus becomes the new "zero" (actually 1/1), the datum for no activity. This realization will allow physicists to develop a new metric, one that actually applies ***fundamentally*** to the physical universe.

The use of "motional dimensions" as a fundamental unit implies that where (or when) there is no (fundamental) motion, there is no "physical" universe. There is no "where" there, and no "there" there either. If there is no "box", there is no inside or outside either. (The same arguments apply to time.)

There is no reason a spatial viewpoint has to be preferred in the ultimate reference system. Motion can be in space or in time (s/t or t/s) If we could view things from the standpoint of the speed of light (in three dimensions), space would not be expanding. The progression of time cancels the progression (expansion) of space, given the supposition that they are always paired into a ratio. Photons would be stationary. They go no-where and no-when. Mass would be what has actual motion (gravitation) relative to the 1/1 motional datum "fabric" or "ether". Gravitation would make mass move "towards" other masses and those masses would be colliding with the stationary photons in the process. (Photons "collide" or "separate" only when space or time locations are considered individually; this is the reverse of the EPR effect;)

All this is exactly backwards to the way we think the Universe "obviously" works. Physicists and astronomers seem to have little trouble believing that "space exploded" and caused the Universe to come into existence. But the views presented here will seem even weirder, and so don't expect classes in hyperspace navigation to be offered at your local university anytime soon.

Links:

"Universe boundary in Einstein 1931 same as Lemaître 1927" (http://adsabs.harvard.edu/abs/2015AAS...22521504S) a snippet: ". . . universe in balance, changing but always steady, eternal but ever-reborn, is exactly what we observe.")

"Einstein's aborted attempt at a dynamic steady-state universe", http://arxiv.org/ftp/arxiv/papers/1402/1402.4099.pdf

Michelson-Morley Experiments Revisited and the Cosmic Background Radiation Preferred Frame, Reginald T Cahill , Kirsty Kitto (2002)
https://www.academia.edu/13337736/Michelson_Morley_Experiments_Revisited_and_the_Cosmic_Background_Radiation_Preferred_Frame https://qut.academia.edu/KirstyKitto?swp=tc-au-13337736

Conclusion

Speeds greater than that of light are *temporal* ("non-local") and cannot be simply represented in a *spatial* reference system. This leads to some very strange structures that can be observed by telescopes. To understand these, the spatial equivalent of temporal motion and reference system inversion effects must be understood, as well as the effect of all matter in the Universe having a time limit.

At the beginning of this paper, we have seen how Einstein's equation of $E = mc^2$ gives fascinating insights into the deep nature of time, space, motion, and reference system effects. For the nature of gravity, a simple phenomenon, has been given a simple explanation. There were no gravitons, space warps, gravitational waves, 11 dimensional strings, etc. There were no built-in mysteries like how mass grabs space-time and warps it. There were no bottomless questions like "What are particles made of?" The concepts are very different from what is taught in the schools, but are not hard to understand.

You can see why non-local physics is not published in the mainstream science journals. When an editor sees statements and terms like "photons are stationary" and "motionless motion" and "motion that has no direction" and "direction that has no motion", and "the atom does not 'have' a nucleus" he will simply throw the submission into the trash can. The article will never even see peer review, let alone publication. The public and mass media would pass it off as "junk science" and have no idea what they are missing out on. The physics of non-locality is basically "stuck" back in 1905 (quantum mechanics excepted).

The irony of all this is that much needed information on these topics has already been published and has been available for several decades. All of it is right under our noses, concealed in plain sight, but we do not recognize it because of social and political pressures from corrupt and dysfunctional institutions. Examples:

https://www.academia.edu/29945834/Research_needed_on_monopolar_pulsed_high_voltage_levitation
https://www.researchgate.net/publication/319002136_Research_needed_on_monopolar_pulsed_high_voltage_levitation

https://www.academia.edu/41485052/Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems
https://www.researchgate.net/publication/338293585_Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems

https://www.academia.edu/45461890/Atom_Or_Nucleus
https://www.researchgate.net/publication/349961631_AtomOrNucleus

Control of gravity and control of locality, would give us the ability to travel to the stars without traversing the intervening space. It would give us new forms of energy, and new ways of shaping our world, as well as many other astonishing things. But, clearly, there is a lot of work to do before we get there. At a minimum the currently "reigning paradigm" in physics must change and include things that are Beyond Einstein.

An appeal to my readers

The paper "**Beyond Einstein: non-local physics**" indicates that approximately half of our potential physics knowledge, the non-local portion, is missing. So far, we have only the non-local physics of quantum mechanics ("physics of unit space") which has a limited (but important) scope. The non-local "physics of unit speed" has been completely ignored, as has the important role played by other unit quantity boundaries. It now seems possible to combine the local and non-local descriptions into ONE seamless physical theory based on nothing more than space and time relationships (mass and charge would be derived concepts).

This would be a huge undertaking. Currently there is nothing in mainstream science or mainstream publications that even hints of serious interest in this direction. Engineerable technology has been admirably well developed but the science—the basic understanding of how the Universe truly works—is still way off in the weeds. After 100 years we are still arguing about Special and General Relativity, and even something as simple and basic as gravity is still enigmatic at its roots.

Another problem is mathematical representation of physical phenomena. It is highly desirable to have seamless mathematics for a seamless physical theory. The mathematical framework must comfortably and naturally handle some rather strange and thoroughly unfamiliar (but still accessible) concepts:

1. It must accommodate an absolute reference system based on centerless expansion of fundamental discrete unit space/time and time/space (i.e., motion and its inverse) and its relationship to a differential (relative) reference system such as the one in common use. It must comfortably accommodate motion with direction, motion with no direction (scalar motion), direction with no motion (intrinsic rotation), and a fundamentally stationary photon.

2. It must support the derivation of properties of space and time from motion; i.e., what kind of space (or time) comes from what kind of motion?

3. It must clarify a fundamental relationship between intrinsic rotation (spin) and translational motion (*i.e.*, wave/particle behavior).

4. It must support mappings of non-local to local reference systems (and vice versa) including representations of fundamentally discrete units, unit quantity boundary inversions, indeterminacy, uncertainty, wave/particle manifestations, quantum interference, probability, effects of unit dimensional equalities ($1^1 = 1^2 = 1^3$), etc.

All of this could be handled by the various specialized, piecemeal mathematical systems commonly taught at the college level, but there seems to be a better choice: **Geometric algebra**:

> "Geometric algebra and its extension to geometric calculus unify, simplify, and generalize vast areas of mathematics involving geometric ideas, including linear algebra, vector calculus, exterior algebra and calculus, tensor algebra and calculus, quaternions, real analysis, complex analysis, and euclidean, noneuclidean, and projective geometries. They provide a common mathematical language for many areas of physics (classical and quantum mechanics, electrodynamics, special and general relativity) computer science . . . and other fields." (*Linear and Geometric Algebra*, Alan MacDonald (2010) Preface)

"Scientific knowledge is expressed mathematically, but the importance of the optimal choice of the appropriate mathematical language is often underestimated. . . .The geometric algebra (Clifford algebra) formalism, according to Occam's razor principle, is by far the best choice for modern physics. Clifford algebra provides a simple and unifying mathematical language for coding geometric entities and operations ... . It integrates different mathematical concepts highlighting geometrical meanings that are often hidden in the ordinary algebra. ..." (*Maxwell's Equations and Occam's Razor,* Francesco Celani, Antonino Oscar Di Tommasoy, Giorgio Vassalloz, *J. Condensed Matter Nucl. Sci.* 25 (2017) 1–29
https://www.researchgate.net/publication/320274378_Maxwell%27s_Equations_and_Occam%27s_Razor)

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"Even though Gibbs was able to reduce Maxwell's twelve equations down to four, as mentioned, his formalism for vectors had significant structural limitations. For example, the cross product only applies in three dimensional space, because in four dimensions there is an infinity of perpendicular vectors. However, probably most serious in terms of students learning physics, is that, conventional vectors do not integrate with established algebraic intuitions regarding basic operations. That is, there is no division operation, the cross product does not apply in two dimensions and one cannot freely add vectors to previously known algebraic elements (scalars), so that vector algebra becomes a monolithic structure unto itself. Hence the intuitive understanding of physics concepts, as well as general geometric understanding, which depends on the understanding of vectors, is significantly reduced. Historically, as vectors became more popular in physics and in various other fields, new scientific discoveries such as quantum mechanics and relativity meant that vector analysis needed to be supplemented by a basket of other mathematical techniques such as: tensors, spinors, matrix algebra, Hilbert spaces, differential forms etc. As noted in 7 , 'The result is a bewildering plethora of mathematical techniques which require much learning and teaching, which tend to fragment the subject and which embody wasteful overlaps and requirements of translation'. " ("A simplified approach to electromagnetism using geometric algebra", James M. Chappell, Azhar Iqbal, Derek Abbott (November 11, 2010) https://arxiv.org/pdf/1010.4947.pdf See also: *Vectors and Beyond: Geometric Algebra and its Philosophical Significance*, Peter Simons, dialectica Vol. 63, N 4 (2010), pp. 381–395 DOI: 10.1111/j.1746-8361.2009.01214.x
http://www.tara.tcd.ie/bitstream/handle/2262/61825/Vectors%20and%20Beyond%20as%20Printed.pdf?sequence=1)

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All of this could keep an army of scientists, mathematicians, and engineers busy for 100 years. It is the scientific equivalent of "fill the Earth and subdue it" or staffing a newly discovered planet. An effort of this enormous scope will need divine help.

"Let your cry come to me, and I will give you an answer, and let you see great things and secret things of which you had no knowledge." (*Bible in Basic English*, Jeremiah 33:3)

"Though your beginning was insignificant,
Yet your end will increase greatly. Job 8:7, *NASB*

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Articles by Brian Fraser:

Beyond Einstein: non-local physics, 4 th ed
https://www.academia.edu/s/0bd5f952ce

Atom Or Nucleus
https://www.academia.edu/45461890/Atom_Or_Nucleus

Basis for Scriptural Physics
https://www.academia.edu/45268861/Scriptural_Physics

Research needed on monopolar pulsed high voltage levitation
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Intuitive Concepts for Atomic and Photon Spin Systems
https://www.academia.edu/41485052/Intuitive_Concepts_for_Atomic_and_Photon_Spin_Systems