MULTIDIMENSIONAL, WAVE-FUNCTION SUPERCONDUCTIVITY AND COSMOLOGY

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Abstract -

The Cooper pair state is responsible for superconductivity, as described in the BCS theory developed by John Bardeen, Leon Cooper, and John Schrieffer for which they shared the 1972 Nobel Prize. A Cooper pair or BCS pair is a pair of electrons (or other fermions) bound together at low temperatures in a certain manner first described in 1956 by American physicist Leon Cooper. These have some bosonic properties – properties similar to photons, gravitons and the Higgs boson. Bosons, at sufficiently low temperature, can form a Bose–Einstein condensate which is an example of macroscopic quantum phenomena (quantum behavior at the macroscopic scale, rather than at the atomic scale where quantum effects are prevalent). The best-known examples of macroscopic quantum phenomena are superfluidity and superconductivity. The fact that bosons can form a Bose–Einstein condensate which is related to superconductivity hints at superconductivity being a wave-function phenomenon. Also, the Complex Number Plane of mathematics in conjunction with the so-called Imaginary Time of physics suggests this wave-function might find practical application beyond abstract maths and could be multidimensional having "real", "imaginary" and "complex" types. The explanation of superconductivity by means of Cooper pairs confirms the validity of wave-particle duality.

This article also extends the quantum scale and the wave-function to computer science and the cosmic scale - commenting on gravitational superconductivity, dark energy, dark matter, the Big Bang and cosmological Inflation, Unification, Artificial Intelligence, and black holes.

Keywords -

Superconductivity; gravitational superconductivity; Big Bang; dark energy/matter; black holes; Unification; Artificial Intelligence

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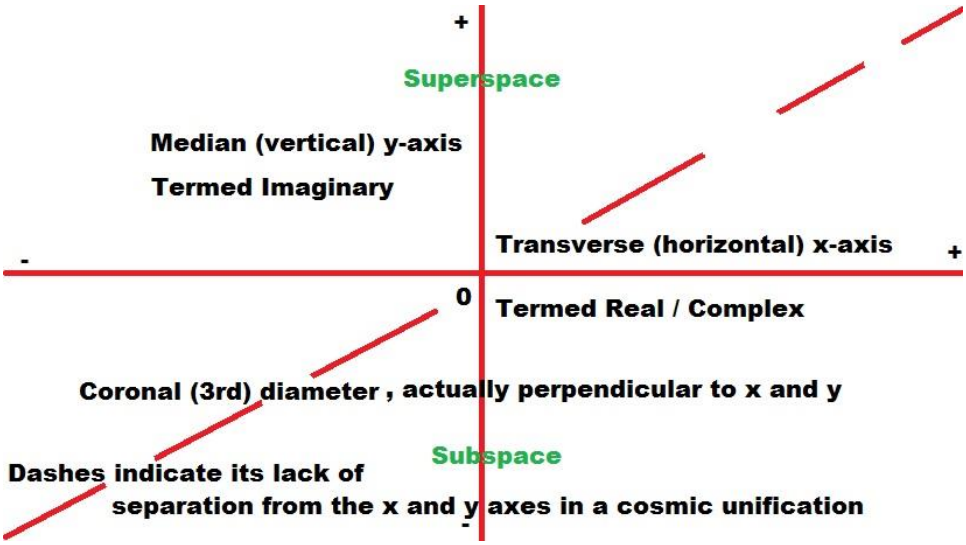
Content -

COMPLEX NUMBER PLANE

So-called imaginary time is a concept derived from special relativity and quantum mechanics. Geometrically, imaginary numbers are found on the vertical axis of the Complex Number Plane^, allowing them to be presented perpendicular to the real axis. One way of viewing imaginary numbers is to consider a standard number line, positively increasing in magnitude to the right, and negatively increasing in magnitude to the left. At 0 on this x-axis (the so-called ‘real’ axis), a y-axis (the so-called imaginary axis) can be drawn with "positive" direction going up - "positive" imaginary numbers then increase in magnitude upwards, and "negative" imaginary numbers increase in magnitude downwards. ("Positive" numbers increasing upwards correspond to superspace and imaginary time, while "negative" numbers increasing downwards describe subspace and imaginary time.*) Visualize space-time as defined by a horizontal diameter, a vertical diameter, and a third diameter that's perpendicular to both of these. These represent the cardinal directions gravitational waves can travel. One direction along the horizontal axis corresponds to going forwards in time and is called "real". The reverse direction along the horizontal axis corresponds to going backwards in time and is called "complex".^ The vertical axis represents the "imaginary time" described by the imaginary numbers of physics. The terms real, imaginary and complex come from the corresponding numbers in maths.

^ "Physics of the Impossible" by Michio Kaku (Penguin Books, 2009) states on pp. 276-277, "When we solve (19th-century Scottish physicist James Clerk) Maxwell's equations for light, we find not one but two solutions: a 'retarded' wave, which represents the standard motion of light from one point to another; but also an 'advanced' wave, where the light beam goes backward in time. Engineers have simply dismissed the advanced wave as a mathematical curiosity since the retarded waves so accurately predicted the behavior of radio, microwaves, TV, radar, and X-rays. But for physicists, the advanced wave has been a nagging problem for the past century." Suppose Einstein was correct about gravitational fields restating Maxwell's equations in terms of gravity.^^ Then gravitational waves would also have an "advanced" solution.

^^ Einstein's equations say that in a universe possessing only gravitation and electromagnetism (paragraph three in **DARK ENERGY, DARK MATTER**), the gravitational fields carry enough information about electromagnetism to allow the equations of Maxwell to be restated in terms of these gravitational fields. This was discovered by the mathematical physicist George Yuri Rainich (1886 -1968). See Transactions of the American Mathematical Society **27**, 106 - Rainich, G. Y. (1925).



*Perhaps the real space/imaginary time combination – possible because of unification - is, to borrow a word from science fiction (and mathematics too), known as subspace. This could be interpreted in the diagram above as subspace having a definite position (represented in the sketch by a line). Superspace has a location too. Superspace is regarded in particle physics as the outcome of the theory of supersymmetry (SUSY) which relates the two classes of elementary particles – bosons (force-carrying particles) and fermions (particles of matter). This article relates bosons to fermions through binary digits and the Mobius strip. You have to go around this strip twice to arrive at your starting point - and matter particles have quantum spin described as ½, which means they must be turned through two complete revolutions to look the same ("A Brief History of Time" by Stephen Hawking – Bantam Press, 1988, pp.66-67). In this article, superspace is the aggregate of all the spaces and includes sub-, real, and complex space. The world's largest and most powerful particle collider, the Large Hadron Collider (LHC) on the France-Switzerland border, has found no evidence for supersymmetry thus far and some physicists have decided to explore other ideas (Ellis, John: "The Physics Landscape after the Higgs Discovery at the LHC": 14 April 2015: arXiv:1504.03654)

DARK ENERGY, DARK MATTER

This section offers insights into dark energy and dark matter gained from viewing them in relation to the Complex Number Plane.

According to "Quantum gas goes below absolute zero - Ultracold atoms pave way for negative-Kelvin materials" by Zeeya Merali (http://www.nature.com/news/quantum-gas-goes-below-absolute-zero-1.12146): the sub-absolute-zero gas might help solve a cosmic mystery because "Another peculiarity of the sub-absolute-zero gas is that it mimics 'dark energy', the mysterious force that pushes the Universe to expand at an ever-faster rate against the inward pull of gravity." It does not seem necessary to invoke the existence of dark energy. The force acting against gravity could be gravity. Specifically, the gravity we know would be "real" gravity and it would be opposed by "complex" gravity, also called antigravity.

The 2012 article “How Einstein Discovered Dark Energy” by Alex Harvey (http://arxiv.org/pdf/1211.6338v1.pdf) states, “Recall that in 1918 the only elementary particles known were the electron and the proton. Physicists were attempting to understand why these were stable despite their internal electromagnetic repulsion. Most attempts were based solely on electromagnetic theory. For a review of these efforts see W. Pauli, 'Theory of Relativity', Pergamon Press, London (1958), see Part V, p.184 *ff.* Einstein’s effort was to construct a model in which stability was achieved through the use of gravitational forces. In particular, he used modified gravitational field equations which included the cosmological constant." [See Albert Einstein's “Spielen Gravitationfelder in Aufbau der Elementarteilchen eine Wesentliche Rolle?” (**Do gravitational fields play an essential role in the structure of elementary particles?)**, Sitzungsberichte der Preussischen Akademie der Wissenschaften, (Math. Phys.), 349-356 (1919) Berlin].

That attempt is, unfortunately, universally regarded as a failure because scientists now explain atomic stability through the strong nuclear force. Einstein is said to have fallen out-of-touch with science by the time the nuclear forces were discovered. He disagreed with the alleged necessity of the trend to big, expensive experiments. But that doesn't mean he was out-of-touch. Give the man his due. He invented General Relativity only a handful of years prior to that 1919 paper. Is it so hard to believe he was way ahead of his time – even ahead of our time - when he combined gravitation with electromagnetism? The discovery of the nuclear forces would do nothing to change the validity of those gravitational field equations if the nuclear forces are not fundamental. If the cosmos is made of 1’s and 0’s^, that possibility can be reconciled with gravitation uniting everything simply by proposing that the theoretical gravitons composing gravity actually exist, and that they're made up of the binary digits. Maybe those digits can be rearranged by nature ... perhaps by a quantum-scale version of gravitational lensing, which can split the image of an astronomical object into several images … rearranged into the particles constituting the other 3 forces (surrounding space-time's virtual particles and their produced digits are included in this rearrangement, to vary particle

mass). This makes gravity the one truly fundamental force and besides making the nuclear forces non-fundamental, confirms Einstein's Unified Field.

^ Transformation of gravitational-electromagnetic interaction into matter could be via photons of electromagnetic waves and the hypothetical gravitons of gravitational waves being disturbances in electromagnetic and gravitational fields. These disturbances are known as virtual particles and are equivalent to energy pulses ("A Brief History of Time" by Stephen Hawking - Bantam Press 1988, p.69 relates the virtual photons which can never be directly detected to the real photons that are the energy pulses within light waves). Those pulses produce the binary digits of 1 and 0 encoding pi, e, √2 etc. Matter particles [and even bosons like the Higgs, W and Z particles] are given mass by the energy of photons and gravitons interacting in "wave packets" (interaction within this term from quantum mechanics results in wave-particle duality). Production of the Higgs boson by gravitational-electromagnetic coupling means that interaction could more succinctly be called "the Higgs field". This is indeed plausible since alternative versions of Higgs theory still circulate in science in which the role of the Higgs field is played by various couplings (see M. Tanabashi; M. Harada; K. Yamawaki. Nagoya 2006: "The Origin of Mass and Strong Coupling Gauge Theories". International Workshop on Strongly Coupled Gauge Theories. pp. 227–241).

If real gravity is involved in ordinary matter's mass-production, complex gravity must be involved in the mass-production of other matter called "dark". One way of determining if dark matter belongs to a higher dimension would be to measure its gravitational effects in space dimensions (see "A Brief History of Time" by Stephen Hawking – Bantam Press 1988, pp. 164-165). In three dimensions, the gravitational force drops to 1/4 if one doubles the distance. In four dimensions (4th-dimensional hyperspace), it would drop to 1/8 and in five dimensions (5th-dimensional hyperspace) to 1/16. The positive direction on the x-axis (representing the 3 space dimensions of real space-time) is in continuous contact with the negative direction on x (the 5th space dimension of complex space-time). Therefore, real gravity is perpetually amplified by complex gravity. Using Professor Hawking's figures from the previous paragraph, the amplification equals ¼ x ¼ ie doubling the distance in 5 space dimensions causes gravity to become 1/16 as powerful. It is not ¼ x -¼ since numbers have the same property regardless of direction on the Complex Number Plane (they increase in value). To conserve this sameness, the second one must be +¼ if the first one is +¼. Alternatively, the gravity's strength is reduced 4 times and this number is multiplied by another 4 to reduce it 16 times overall. In the 4th space dimension/2nd time dimension represented by the imaginary axis, this y-axis is half the distance (90 degrees) from the real x-axis that the complex x-axis is (it's removed 180 degrees). So gravitational weakening from doubling distance in 4 space dimensions = (reduction of 4 times multiplied by another reduction of 4 times) / 2,

for an overall reduction of 8 times to a strength of 1/8. Only 5 space dimensions can exist – along with real time, imaginary time and complex time.

ELECTRIC WAVES

With more than three space dimensions, the electrical forces that cause electrons to orbit round the nucleus of an atom would behave in the same way as gravitational forces. The electrons would either escape from the atom or spiral into its nucleus. In either case, atoms as we know them could not exist (see "A Brief History of Time" by Stephen Hawking – Bantam Press 1988, p.165). How can electrical force behave in the same way as gravitational force in extra space dimensions? The strength has to be reduced a trillion trillion trillion times because an electromagnetic wave is 10^36 times more powerful than a gravitational wave. Referring to the diagram in **COMPLEX NUMBER PLANE** – when an electric wave is diverted from the x-axis to the y-axis representing the 4th spatial dimension, there is no wave motion in real time. This means there can be no amplitude or frequency except at the point marked 0 - and the electric wave has lost virtually all power, being "flattened" by imaginary time and giving rise to superconductivity.

SUPERCONDUCTIVITY

According to the article "superconductivity" in "Penguin Encyclopedia Edited by David Crystal" (Penguin Reference Library, 2006): this is "the property of zero electrical resistance, accompanied by the expulsion of magnetic fields (the Meissner effect), exhibited by certain metals, alloys, and compounds when cooled to below some critical temperature, typically less than –260 degrees C. Both effects must be present for true superconductivity."

Regarding zero electrical resistance: An electromagnetic wave can have its electrical part compressed, through eg introduction of copper-and-oxygen compounds called cuprates or use of hydrogen sulfide (speaking of molecules as well as waves refers to quantum mechanics' wave-particle duality). If compression is sufficient; the electric component no longer follows a long, curved path in Euclidean geometry. Its path is now linear and follows the shortest distance between two points. In other words, a superconductor that operates at room temperature and normal atmospheric pressure has been manufactured. Any resistance would, like a rock in a stream causing water to flow around it, lengthen the distance and mean the compound is not a perfect superconductor.

Regarding the Meissner effect: Think of the electromagnetic wave relativistically. To do that, it must be shown that electromagnetism is not dissimilar from the gravitation of General Relativity, which is a purpose of the section below. In General Relativity, the simple analogy of space-time being regarded as a rubber sheet is commonly used. Instead of resorting to complex and lengthy relativistic mathematics, we can simply picture an electromagnetic wave as made of rubber. Compressing the electric component will force the magnetic component to bulge outwards ie there will be no magnetic field within the superconductor, only an external magnetic field. An externally-applied magnetic field also conforms to the bulging outwards and is expelled from within the superconductor.

GSC (GRAVITATIONAL SUPER CONDUCTIVITY) AND COSMOLOGY

Now recall **DARK ENERGY, DARK MATTER** and the binary digits of 1 and 0, plus Albert Einstein's “Spielen Gravitationfelder in Aufbau der Elementarteilchen eine Wesentliche Rolle?” (**Do gravitational fields play an essential role in the structure of elementary particles?)**, Sitzungsberichte der Preussischen Akademie der Wissenschaften, (Math. Phys.), 349-356 (1919) Berlin].

A 2009 electrical-engineering experiment at America's Yale University demonstrated that, on silicon-chip and transistor scales, light can attract and repel itself like electric charges or magnets [“Tunable bipolar optical interactions between guided lightwaves” by Mo Li, W. H. P. Pernice & H. X. Tang - Nature Photonics 3, 464 - 468 (2009)]. Einstein believed electromagnetism (light is one form of this) and gravitation were related. Then the presently hypothetical gravitons of gravitation could also attract and repel at quantum scales. Maybe the relation is in the form of photons and gravitons being different compositions of 1's and 0's.

If electromagnetism is not dissimilar to gravitation (in the sense of photons and gravitons being different compositions of 1's and 0's), gravitational waves must also give rise to superconductivity (SC). SC means there's no resistance regarding electrons – GSC means there's no resistance regarding gravitons. Just as resistance to electron flow is reduced, or electrons are totally unimpeded, in SC; in GSC all gravitons can flow together^ into a singularity and delete distance. The binary digits generated by the virtual gravitons (virtual particles called gravitons) form a qubit*. The digits form the qubit at any temperature or pressure, and provide access of a person or device to all multidimensional space-time.

^ In 1925, the Austrian physicist Wolfgang Pauli discovered the exclusion principle [Hawking, S. W. – “A Brief History of Time” – Bantam Press, 1988, pp. 68-69]. This says two similar particles cannot have both the same position and velocity. If two electrons could have identical positions and velocities, they could all collapse into a roughly uniform, dense “soup”. Protons and neutrons would do the same, and there would be no well-defined atoms. So we need the exclusion principle. Force-carrying particles like photons and gravitons do not obey the exclusion principle.

*If the cosmos is made of 1’s and 0’s (bits), it would a) have AI or artificial intelligence like, but infinitely more powerful than, that of computers or androids; and b) may not be composed of separated stars, people and so on; but all space and time could be entangled in a qubit if all forms of distance are removed (a qubit is the basic element of information in quantum computing - just as "bit" is an abbreviation for "binary digit" in ordinary computers, "qubit" stands for "quantum bit" in quantum computers).

Electrical superconductors aren't necessarily always in use, so gravitational superconductance isn't either. At those times when the qubit is being realized, GSC means Isaac Newton's concept of gravity acting instantaneously across the universe is correct. Gravity transmitted instantly, and gravity travelling at light speed, both exist (they're in two frames of reference). This is reminiscent of Einstein's statement, '(Length contraction) doesn't "really" exist, in so far as it doesn't exist for a comoving observer; though it "really" exists, i.e. in such a way that it could be demonstrated in principle by physical means by a non-comoving observer.' (Einstein, Albert [1911]. "Zum Ehrenfestschen Paradoxon. Eine Bemerkung zu V. Variĉaks Aufsatz". Physikalische Zeitschrift 12: 509–510). The qubit is perpetually realized inside black holes and they therefore provide constant access to all multidimensional space-time. (They're portals to other regions of time and space within the infinite, eternal universe – see the article "Soft Hair on Black Holes" by Stephen W. Hawking, Malcolm J. Perry, and Andrew Strominger (Phys. Rev. Lett. 116, 231301 – Published 6 June 2016) which speaks of black holes being portals to other universes.

Necessarily embracing the Meissner effect, GSC might expel electromagnetism and the nuclear forces from fundamentalism. This unifies the cosmos using the single fundamental force of gravitation. And if everything – including gravitons - is composed of 1's and 0's, all objects and events in the time, space and dimensions of the cosmos are also linked or entangled. Entanglement disposes of Cosmic Inflation's idea that the uniformity in the cosmos means particles in the universe must have once been in

physical contact. And without the need for the universe to be tiny, there's no need for a Big Bang theory.
