Evolution of the Universe

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Abstract: This paper will provide some well based scientific arguments that time is neither a product of space nor an illusion; instead time is in a state of constant motion. That motion inflated space from the very beginning, the Big Bang, and it still does so now. We will name it "temporal motion" and provide a detailed explanation to why this concept is far more accurate than the current concept of "repulsive gravity" that dominates in the cosmic inflation studies. Temporal motion inflates space and creates the relationship between space and time known as the space-time continuum; time is dominant in this relationship since its motion started the initial inflation of space, giving birth to the Universe, and continues to inflate space. Evolution will be explained as one of the basic laws of physics.

Introduction

Some of the unexplained problems in physics can be explained and proven in a relatively simple way if we apply the logic of General Relativity on other fields of physics. The simplest way is to use “temporal motion” instead of “repulsive gravity” to explain the inflation of space from the initial inflation, often called “cosmic inflation”, to the present time.

We use a (-,+,+,+) metric, where (-) marks the dimension of time (t) as usual. Even in the simplest form of a (R^4) flat spacetime with (t, x, y, z) we have a metric:

$$(1)\ ds^2 = -c^2dt^2 + x^2 + y^2 + z^2$$

We will proclaim that temporal motion inflates space; the inflation is its equivalent of what a trajectory is for spatial motion. Temporal motion has a velocity ($-c$) which is impossible for spatial motion but necessary for temporal motion. Although it is difficult to form equations for a motion with negative velocity, it is possible.

Cosmological model

The Universe will be represented as homogenous and isotropic. Isotropy means that the metric must be diagonal since it will be show that space is allowed to be curved. Therefore we will use spherical coordinates to describe the metric.

The metric is given by the following line element:

$$(2)\ ds^2 = dr^2 + r^2(d\theta^2 + \sin^2\theta\, d\varphi^2)$$

where we measure (θ) from the north pole and at the south pole it will equal (π).

In order to simplify the calculations, we abbreviate the term between the brackets as:

$$(3)\ d\omega^2 = d\theta^2 + \sin^2\theta\, d\varphi^2$$

because it is a measure of angle, which can be thought of as “on the sky” from the observers point of view. It is important to mention that the observers are at the center of the spherical coordinate system.

Due to the isotropy of the Universe the angle between two galaxies, for the observers, is the true angle from the observers’ vantage point and the expansion of the Universe does not change this angle.

Finally, we represent flat space as:

$$(4)\ ds^2 = dr^2 + r^2d\omega^2$$

Robertson and Walker proved that the only alternative metric that obeys both isotropy and homogeneity is:

$$(5)\ ds^2 = dr^2 + f_K(r)^2 d\omega^2$$

where $(f_K(r))$ is the curvature function given by:

$$(6)\ f_K(r) = \begin{cases} K^{-1/2}\ for\ K > 0 \\ r\ for\ K = 0 \\ K^{-1/2} \sin h\left(K^{1/2} r\right) for\ K < 0 \end{cases}$$

which means that the circumference of a sphere around the observers with a radius (r) is, for $(K \neq 0)$, not anymore equal to $(C = 2\pi r)$ but smaller for $(K > 0)$ and larger for $(K < 0)$.

The surface area of that sphere would no longer be $(S = \left({}^{4\pi}/_{3}\right) r^3)$ but smaller for $(K > 0)$ and larger for $(K < 0)$. If (r) is $(r \ll |K|^{-1/2})$ the deviation from $(C = 2\pi r)$ and $(S = \left({}^{4\pi}/_{3}\right) r^3)$ is very small, but as (r) approaches $(|K|^{-1/2})$ the deviation can become rather large.

The metric in the equation (1) can also be written as:

$$(7)\ ds^2 = \frac{dr^2}{1 - Kr^2} + r^2 d\omega^2$$

If we determine an alternative radius (r) as:

$$(8)\ r \equiv f_K(r)$$

This metric is different only in the way we chose our coordinate (r).

We can now build our model by taking for each point in time a RW space. We allow the scale factor and the curvature of the RW space to vary with time. This gives the generic metric:

$$(9)\ ds^2 = -dt^2 + a^+(t)^2 [dx^2 + f_K(x)^2 x^2 d\omega^2]$$

the function $(a^+(t))$ is the spatial scale factor that depends on time and it will describe the spatial expansion of the Universe. We use (x) instead of (r) because the radial coordinate, in this form, no longer has meaning as a true distance.

Temporal Motion

Temporal motion needs three equations for a trajectory to successfully explain inflation since inflation can only occur in three spatial dimensions, unlike expansion that can happen in one or two dimensions.

We will evade the difficulty of negative velocity by establishing a “negative factor” (dД) which has no dimension or numerical value, it is only a $(-)$ although if the necessity arises it can be given an arbitrary value of (-1) for mathematical needs.

We write a simple equation of motion:

$$(10)\ \delta \twoheadrightarrow = \delta \int d\text{Д}\, L(a(t), \dot{a}(t))$$

Where ($\twoheadrightarrow$) is the symbol for temporal motion, $(a(t))$ is the three-dimensional trajectory/inflation and $(\dot{a}(t))$ is the velocity that equals (c) the speed of light. However, due to the negative factor the velocity is:

$$(11)\ \dot{a}^{-}(t) = -c$$

However we encounter a problem, negative velocity will not function and the equations will fail. Having in mind that temporal motion doesn’t have a trajectory but it instead inflates, therefore needing three spatial dimensions to describe its motion, we now define that negative velocity, that is negative motion, is the same as positive motion but it instead has a negative pressure (p). Therefore negative velocity $(-c)$ is a positive velocity with a negative pressure:

$$(12)\ \dot{a}^{-}(t) = -pc$$

Where the pressure (p) equals 1. This allows us to form the equations, three of them, for the temporal course of inflation.

And the trajectory describing inflation $(a(t))$ becomes $(a^{-}(t))$ due to the negative factor and functions as:

$$(13)\ a^{-}(t) \begin{cases} \twoheadrightarrow (x) = \log_{\lim\limits_{x\to\infty}\left(\frac{p}{x}+p\right)^{x}}(x) \\ \twoheadrightarrow (y) = \log_{\lim\limits_{y\to\infty}\left(\frac{p}{y}+p\right)^{y}}(y) \\ \twoheadrightarrow (z) = \sum\limits_{i=1}^{n} \pi y_i + \delta x_i \end{cases}$$

where we use the ($\twoheadrightarrow (z)$) function to make z-frames for every individual frame from (1) to (n).

When we draw the functions, we get an image:

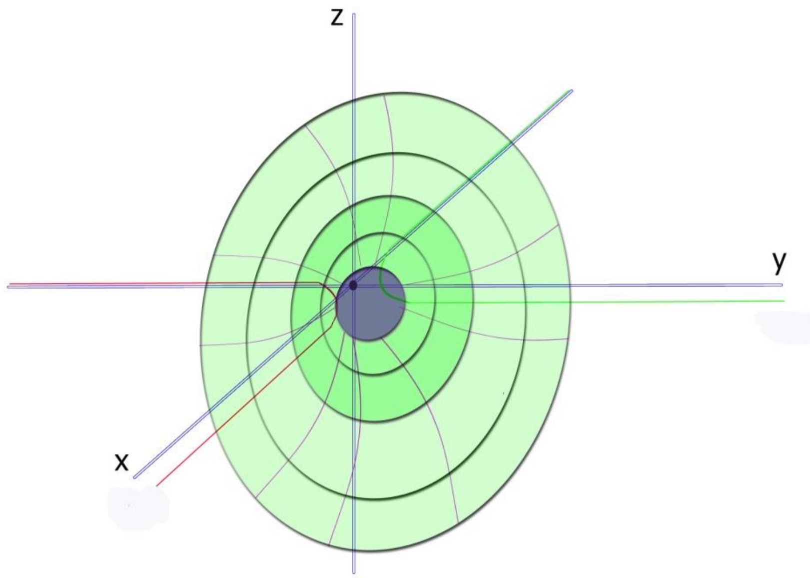

Figure 1: Functions $\twoheadrightarrow (x)$ is red, $\twoheadrightarrow (y)$ is green and $\twoheadrightarrow (z)$ are the ellipses from 1 to n.

When we remove the coordinate system it looks like this:

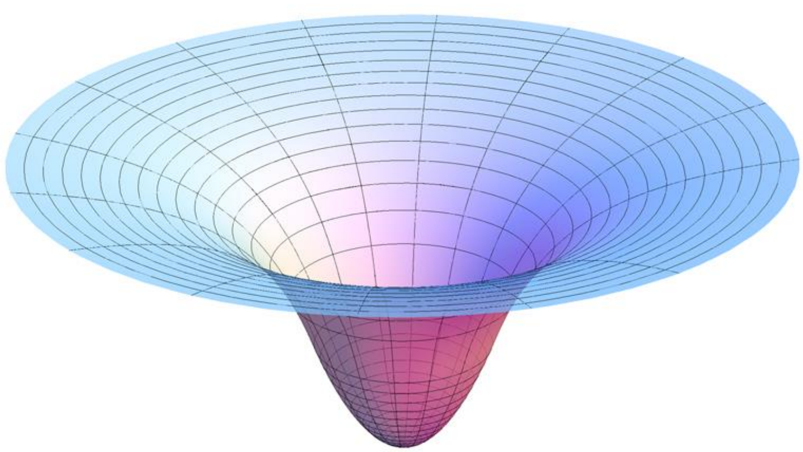

Figure 2: Trajectory of temporal motion.

These are the temporal equations, however they aren't independent but instead they are aligned with the spatial scale factor $(a^{+}(t))$ forming a relationship:

$$(14)\ a_{-}^{+}(t) = a^{+}(t) + a^{-}(t)$$

which is the relationship of space and time known as the spacetime continuum.

It is one of the simplest relationships in physics however also the most important one since all the fundamental forces function in a reverse way than temporal motion, most notably gravitation which is a reaction to temporal motion, its opposite.

Fundamental forces

Due to the relationship of space and time fundamental forces also have their temporal equations, which are the same for all of them, they function opposite to temporal motion.

$$(15)\ P_{compress}(t) \begin{cases} \twoheadrightarrow (x) = \log_{\lim\limits_{a^- \to 0}\left(\frac{p}{\alpha_x}+p\right)^{x/\alpha_x}}(x) \\ \twoheadrightarrow (y) = \log_{\lim\limits_{a^- \to 0}\left(\frac{p}{\alpha_y}+p\right)^{y/\alpha_y}}(y) \\ \twoheadrightarrow (z) = \sum_{i=1}^{n} \pi y_i + \delta x_i \end{cases}$$

All the forces are centralized due to $(a^- \to 0)$ and function as potential wells. We will draw an imaginary temporal line to represent the axis. Angles (α_x) and (α_y) are the angles between the imaginary line, the axis, and dimensions (x) and (y).

There are three cases to explain:

1) The Gravitational force. We draw an ellipse to represent a celestial body:

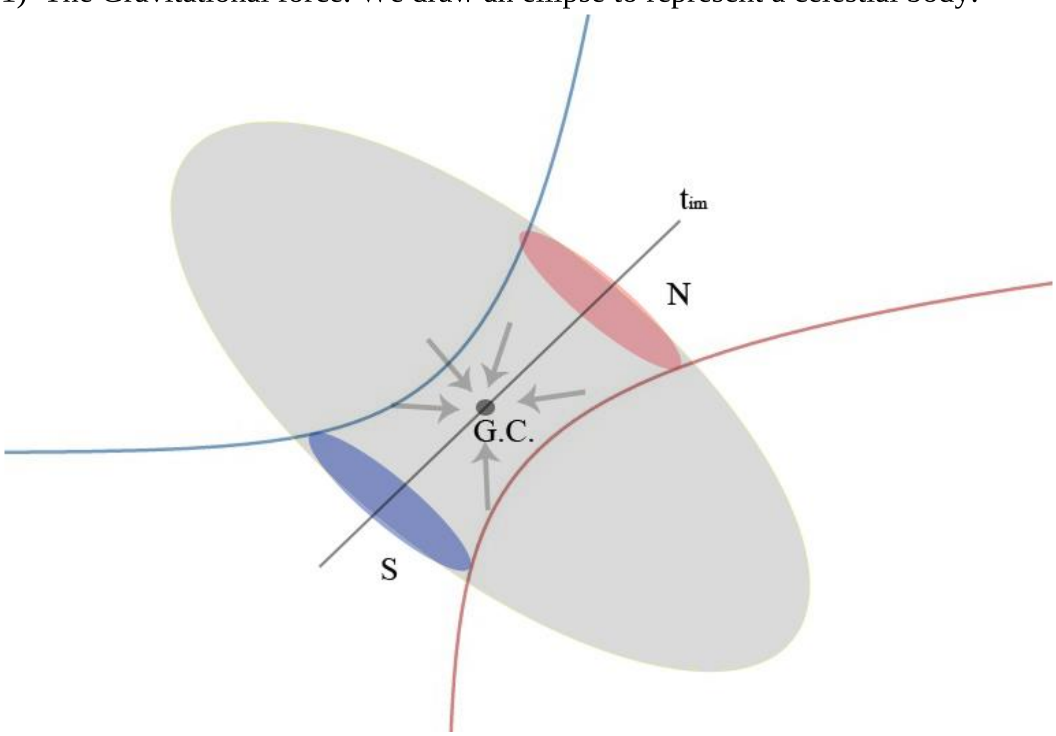

Figure 3: The Gravitational field of Earth.

The best way to describe the centralized nature of gravity is by gravitational compression, meaning that we need to describe the center of a gravitational field.

Any body that falls under the influence of a gravitational field of a celestial body will instantaneously react to its gravitational center regardless of the distance from the center. The body will react by gaining its own center of weight which is essentially the gravitational center of the body. A good example for this is a stick, holding a stick by its end takes more effort than to hold it by its center.

For uniform gravitational fields the gravitational center is the same as the center of mass, making it relatively simple to determine it. For non-uniform gravitational fields the gravitational center ($cg\ W = \int з\ dw$) becomes ($cg\ W = g\ \iiint з\ \rho\ dx\ dy\ dz$) where ($W$) is total weight, ($\rho$) is the density, ($з$) is the distance from a reference line, (dw) is an increment of weight and (cg) is the gravitational center. Here ($cg\ W = P_{compress}$) therefore for gravity we have:

$$(16)\ P_{compress} = g \iiint з\ \rho\ dx\ dy\ dz$$

What we get is a gravitational well. Due to such a nature, the gravitational time dilatation is the strongest at the poles of a celestial body.

2) The Electromagnetic force which is similar to the gravitational force on a macroscopic scale but much stronger than it.

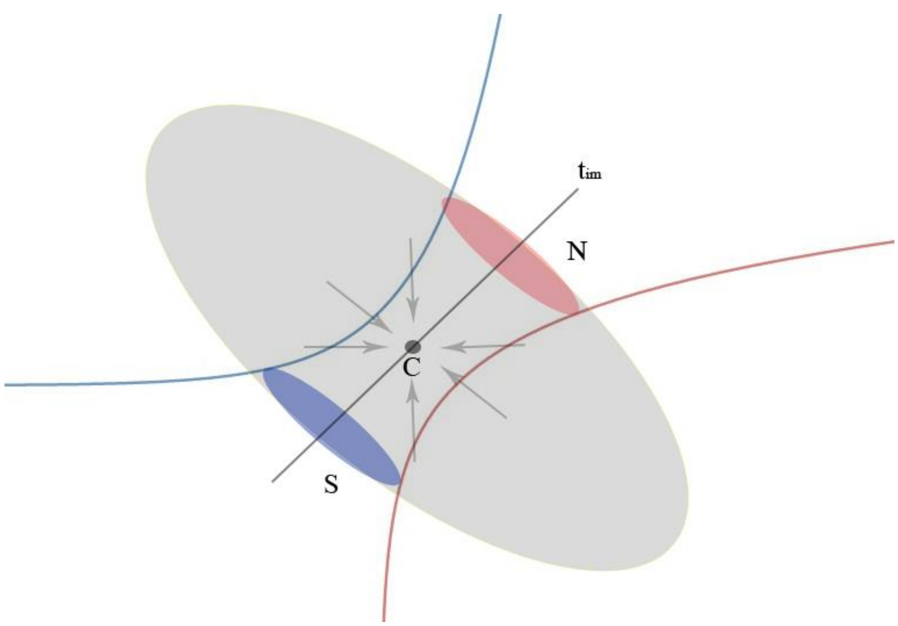

Figure 4: Electromagnetic force of Earth.

Similarly to the gravitational force, electromagnetic force will instantaneously polarize during a reaction; in essence it is forming dipoles instantaneously which is the ability known as polarizability.

Electromagnetic fields, such as Earths, function similarly as gravitational fields specifically it is their compression that is similar, with charge instead of mass.

In case of non-uniform electromagnetic field it is difficult to determine them without examining each field individually. For uniform electromagnetic fields we have:

$$(17)\ P_{compress} = \frac{4\sigma}{3c} T^4$$

where (σ) is the Stefan-Boltzmann constant and (T) is temperature.

We get an electric and a magnetic potential well, in short electromagnetic well.

3) The strong and the weak interaction.

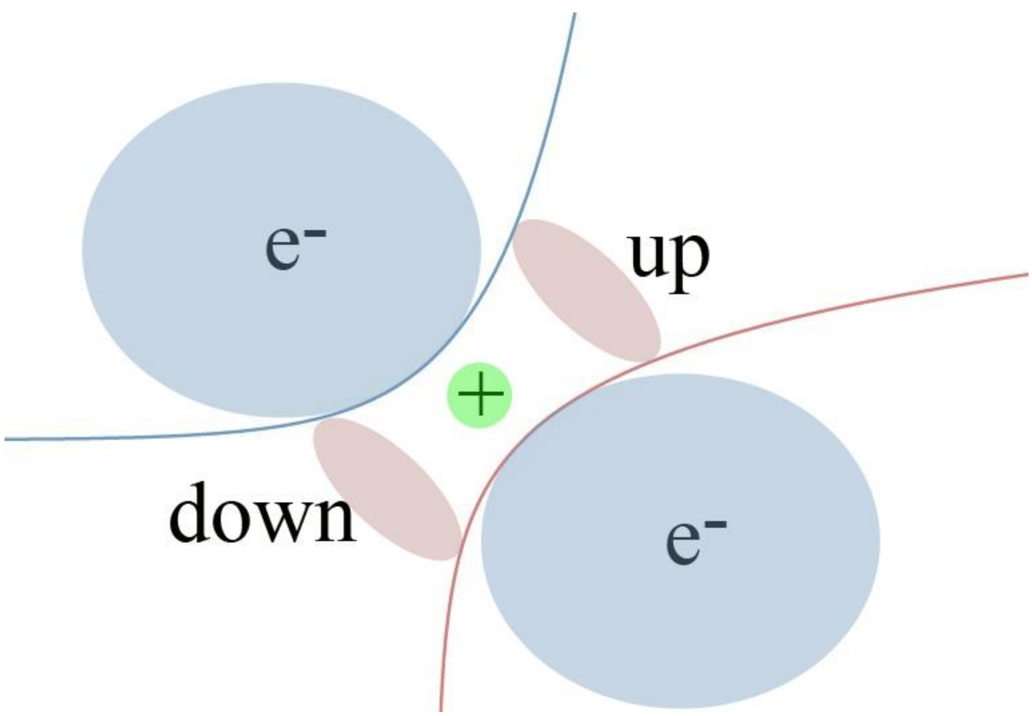

Figure 5: The Atom, where + and the green center is the nucleus and the blue cloud and e^- *represents the electrons.*

Most of the mass is in the nucleus where the nuclear force interacts between protons and neutrons and it is a product of the strong nuclear force that interacts between the quarks which form the protons and neutrons. The electromagnetic force interacts between protons and electrons, keeping electrons in a “cloud”.

The simplest way to explain the electron cloud would be with an electrostatic potential well. We could describe this with ($P_{compress} = \frac{E^2 \varepsilon_0}{2}$) where ($E = \frac{z \cdot e}{4\pi\varepsilon_0 \gamma^2}$) however it is difficult to apply a term such as pressure within the small microscopic size of the atom which is why we will describe the electrostatic well in a different manner.

The atom doesn't have poles but it does have "kinetic currents", two of them, and the two sides of the electron cloud have to be equal or the atom will grow increasingly unstable until it reaches the state of radioactive decay (a neutron turns into a proton, electron and a anti-electron neutrino in some cases) which is governed by the weak interaction.

Here we have a way to explain how the electrostatic potential well functions by using the kinetic energy of electrons. We describe the kinetic currents as up:

$$(18)\ \langle \hat{E}_u \rangle = -\frac{\hbar^2}{2m_e} \sum_{i=1}^{n} \langle \Psi \middle| \nabla_i^2 \middle| \Psi \rangle$$

and down:

$$(19)\ \langle \hat{E}_u \rangle = \frac{\hbar^2}{2m_e} \sum_{i=1}^{n} \langle \Psi \middle| \nabla_i^2 \middle| \Psi \rangle$$

where (∇_i^2) is the Laplacian of the system and (m_e) is the mass of the electron. The currents change their positions often.

Further on we define that:

$$(20)\ \Psi_{n_x n_y n_z} = \sqrt{\frac{8}{L_x L_y L_z}} \sin\left(\frac{n_x \pi x}{L_x}\right) \sin\left(\frac{n_y \pi y}{L_y}\right) \sin\left(\frac{n_z \pi z}{L_z}\right)$$

also:

$$(21)\ E_{n_x n_y n_z} = \frac{\hbar^2 \pi^2}{2m_e} \left[\left(\frac{n_x}{L_x}\right)^2 + \left(\frac{n_y}{L_y}\right)^2 + \left(\frac{n_z}{L_z}\right)^2 \right]$$

which defines the electrostatic potential well. It could be argued that the kinetic currents give a "kinetic shape" to the atom.

Due to their currents, atoms put under high pressure will start forming crystallized structures that are mistakenly defined by chemists as counter-intuitive.

Periods of Evolution

We return to General Relativity and use the notion of z-frames. Every individual z-frame is represented by a value of (z), for example the current period is $(z = 1)$, to represent different eras of the Universe.

For $(z \simeq 1000)$ we have a value:

$$(22)\ a^{+}(t) \simeq \left(\frac{3}{2} H_0 \sqrt{\Omega_{m;0}}\, t\right)^{2/3}$$

Which is a z-frame know as "matter dominated era". Earlier than that, in a z-frame known as the "radiation dominated era", a period when the Universe was dominated by radiation, around $(z \gtrsim 3200)$ we have a value:

$$(23)\ a^{+}(t) \simeq \left(2 H_0 \sqrt{\Omega_{r;0}}\, t\right)^{1/2}$$

The early, radiation dominated Universe expanded as:

$$(24)\ a^{+} \propto \sqrt{t}$$

Every frame has slightly more temporal-kinetic energy, or "dark energy", than the previous one but since the differences in the trillions of frames is complicated to determine it is therefore simpler and more productive to use only some frames.

Due to the negative velocity of temporal motion, that is positive velocity with a small negative pressure, its kinetic energy which is "dark energy", also has a negative pressure $(-p)$. Having such a pressure, dark energy accelerates the inflation of space conducted by temporal motion.

Conclusion

Evolution is among the oldest and most influential laws of physics that seeks to increase entropy on every scale, in every different system in the Universe and it is time-dependant. This is the reason for the drastic increase of entropy in the Universe.

Evolution can become one of the most crucial and beneficial branches of physics which could effectively unite Quantum Mechanics with General Relativity and Thermodynamics, most notably due to its second law that describes entropy. The best equation to describe the Evolution of the Universe is the "collective equation" (14) that is $a^{\pm}_{-}(t) = a^{+}(t) + a^{-}(t)$.

References

[1] S.W. Hawking & G.F.R. Ellis: The Large scale structure of space-time. Cambridge University Press (1973).

[2] R.M. Wald: General Relativity. University of Chicago Press (1984).

[3] G.F.R. Ellis & H.V. Elst: Cosmological Models. University of Cape Town (2008).

[4] A. Riotto: Inflation and the Theory of Cosmological Perturbations. INFN, Sezione di Padova, Padova, Italy.

[5] P. J. E. Peebles & Bharat Ratra: The Cosmological Constant and Dark Energy. Joseph Henry Laboratories, Princeton University, Princeton (2002).

[6] R. Barbieri, G. Dvali, A. Strumia, Z. Berezhiani, L. Hall, Nucl. Phys. (1994).

[7] E. Stewart, Phys. Rev. D 51 (1995) 6847.

[8] T. Banks, M. Berkooz, P. Steinhardt, Phys. Rev. D 52 (1995) 75.

[9] L. Randall and S. Thomas, Nucl. Phys. B 449, 229 (1995).

[10] A. Guth and S.-Y. Pi, Phys. Rev. Lett. 49, 1110 (1982).