Hypothesis: Dark Energy or just Energy?

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This letter hypothesizes that matter expands proportionally with space. The expansion of the universe could be causing gravity instead of opposing it. The new perspective works without dark matter, extra dimensions, big bang, great attractor, and does not require changes to the established laws of physics. Five different approaches are proposed to validate the hypothesis at the macro- and micro level.

Can the expansion be causing gravity instead of opposing it? The following sketch will help explaining how the expansion may produce the predicted by general relativity (GR) space-time curvature near Earth. The assumption will be that matter expands proportionally with space, with the elementary particles expanding in a discontinuous step-wise manner.

Four different approaches are proposed to validate the hypothesis at the macro- and microscale.

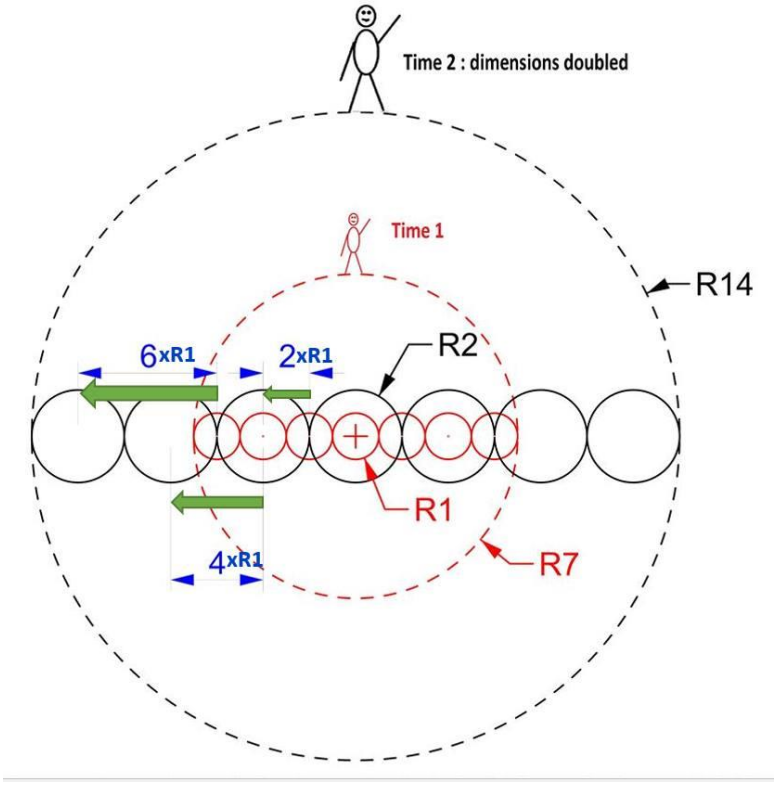

Figure 1: The lagging expansion of matter can be a source of space-time curvature

The sketch in Fig.1 shows two consecutive moments in red and black. The absolute dimensions have doubled between time 1 and time 2. An observer wouldn't notice such a change, because he would have doubled in size, too. He may feel the acceleration (g) at his feet, though. Most importantly, the sketch shows the centers of gravity of the constituents moving outwards even though the relative sizes and distances are not changing. The constituents would be moving outwards even after re-normalizing by a factor of 2.

According to GR, the space-time curvature (or the time dilation) near Earth is equivalent to the dilation produced by a speed equal to the escape velocity of 11.2 km/s. The ratio between 11.2 km/s and the absolute speed of our planet's hypothetical surface expansion can be calculated as 10^{-6}, presuming atoms expand with the speed of light at every step*. A similar ratio of 10^{-6} can be also derived independently after excluding the expansion of space inside and outside the atoms, which does not contribute to the true motion of the constituents. The latter estimate is equal to the ratio between the radius of the nucleus (~10^{-15}m) and the lattice size (~10^{-9} m). The similarity of these two independent ratios implies the expansion of matter can produce space-time curvature as a function of radius r and density ρ, mimicking the escape velocity formula written in density terms:

$$V = \sqrt{\frac{2GM}{r}} \sim \sqrt{\rho}\, r, \qquad (1)$$

Note that in reality every atom may be expanding its size not twice, but 1836 times at every step, giving a new meaning to Schrodinger's wave function.

Now, let's consider a much larger than Earth sphere, which constituents represent millions of galaxies. Assuming flat space, one can calculate time dilation matching the red-shift measurements. Based on Fig.1, however, the red-shift would not produce changes in the relative dimensions and distances inside the expanding sphere. This is equivalent to a static universe, without a Big Bang. Besides, if expansion causes gravity, then the critical density[1] relation $\rho_c \sim H_0^2$ and formula (1) imply that the Hubble constant H_0 depends on the square root of the density within the selected mega sphere: $H_0 = \sqrt{8/3\pi G\rho}$. This may explain the latest discrepancies in the Hubble constant since the CMB measurements correspond to a much larger and more homogeneous sphere than the rest of the measurements[2,3]. Formula (1) also corresponds to

$$a = \frac{H_0^2}{2} r \qquad (2)$$

relation for the acceleration of the universal expansion. Such correlations may help to validate the hypothesis.

There are at least four other ways to validate the hypothesis:

1. At the macro-scale:
    a. **Dark Matter or Kinematic Time Dilation:** The sketch demonstrates the following relation: (velocity) => (time dilation) => (space-time curvature). Applying the same logic to spiral galaxies or galactic clusters means their rotational velocities should also add to the space-time curvature because they contribute to the expansion lag of the multi-body system. It is easy to show that the rotational curves flatten in areas, where the curvature due to kinematic time dilation exceeds the curvature due to gravitational time dilation. There is no

* The Hubble relation $V = \dot{r} = H_0 r$ implies an exponential character of the absolute expansion, where only the last step is mathematically significant when deriving the velocity from a geometrical progression with a common ratio of 1836. The step duration of 10^{-20}s is tentatively selected to match the gamma frequency associated with the electron mass at rest (0.511 MeV/c^2) because atoms mostly interact via their electron clouds.

need to introduce dark matter. Mathematical details and correlation with velocity measurements are available[4].

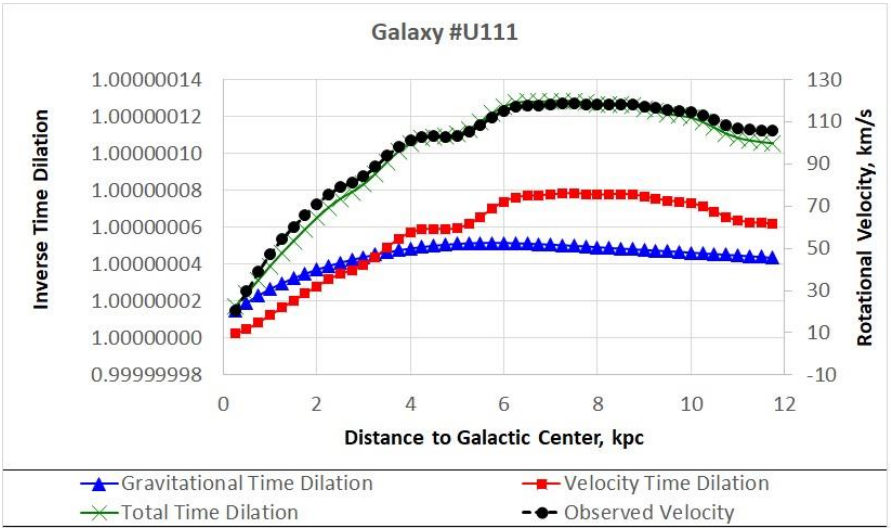

Figure 2: The lagging galactic rotation can be another source of space-time curvature

b. **Great Attractor or Time Dilation:** The space-time curvature at the Solar System location within the Milky Way can be decomposed into gravitational time dilation component (equivalent to ~550 km/s escape velocity) and kinematic rotational velocity term of ~230 km/s. The vector sum produces ~600 km/s, which is also the estimated velocity of the Milky Way towards the hypothetical Great Attractor. According to the proposed model, this is not a true velocity but a skewed perspective due to distorted curvature at our off-center location within the galaxy. This would also explain why the great attractor appears to be approximately in the galactic bulge direction. Our 600 km/s time dilation would also produce a bias in the red-shifts of the galaxies in the local group creating a false motion appearance. The galactic red shifts may be additionally affected by the overdensity in this particular direction[5] per formula (1).

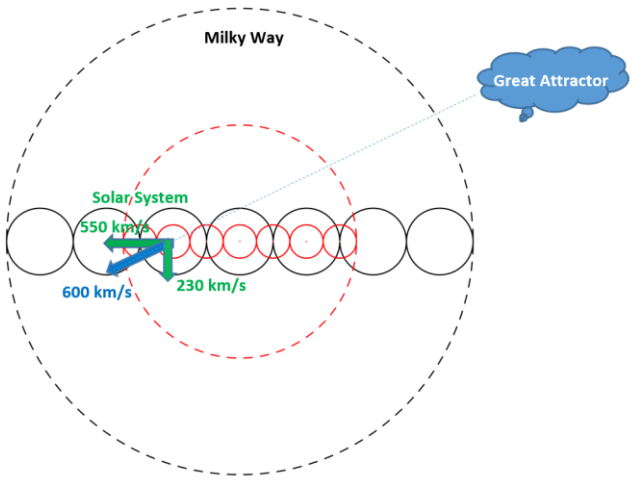

Figure 3: Our skewed off-center perspective can create illisionary motion appearence

c. **Solar / polar winds with an "antigravity" component:** The solar wind is made of collisionless plasma ejected at the speed range of 400 - 750 km/s, while the escape velocity of our Sun is 618 km/s. There is no consensus on the complete mechanism accelerating the solar wind.
The expansion hypothesized in Figure 1 portrays gravity as a group phenomenon caused by the relativistic delay of the expanding mass. The outward layer's expansion velocity must be equal to the escape velocity to generate time dilation consistent with the GR-predicted space-time curvature. The expanding layers do not normally eject mass because every constituent of the mass acts as a group expanding (pushing) against the other parts of the mass. The collisionless plasma, however, does not act as a group, because its charged particles do not collide/push against each other. If gravity is a group phenomenon, then the collisionless plasma may be exempt from this interaction, allowing direct observation of velocities associated with the expanding matter. It resembles the addition of an "antigravity" component to the other known thermal and magnetic interactions. Such ejection process should be present on every level: planetary (polar winds), stellar (stellar winds), galactic (in the hot galactic corona), inter-cluster (in the hot inter-cluster plasma), universal (CMB). The corresponding 11 km/s "antigravity" component for collisionless plasma near Earth should be verified with laboratory tests, if possible.

2. At the micro-scale: The expansion energy cannot produce quantum effects unless particles expand in a discontinuous step-wise manner at very high rates, possibly in the gamma range. Due to the energy-frequency relation, different type particles should step their sizes up at different rates (e.g. 1836:1 for proton vs. electron); see the appendix. The relative sizes would vary because of the asynchronous expansion, but the discontinuities would average out and smoothen out at the macro-scale producing continuous Einsteinian curvature. Out-of-phase particles would make space for each other mimicking attraction while expanding in-phase particles would mimic repulsion. The rapid relative fluctuations may also give a physical meaning to the spin property. At every step, a particle would create a disturbance (a photon) that would appear virtual because it would be quickly outgrown by the particle. The inertial mass may be redefined as an average quantity showing how often a particle is available for interaction. The conservation laws would still work due to the very stable averages at these high rates of fluctuation. There would be, however, instantaneous mass outliers to be exploited. Quantum tunneling may represent such an outlier where a particle can breach a classically impossible energy barrier due to its instantly smaller mass (Imagine an out-of-phase particle being squeezed out while small by two synchronously expanding neighbors). According to quantum mechanics, momentum is conserved during tunneling. The outlined here step-expansion model implies momentum may not be always preserved because of the mass outliers. If this is correct, a large number of quantum tunneling events can be organized to develop a reactionless drive (similar to NASA's EM Drive that aims to enable interstellar travel). We are currently experimenting[6] with orienting electrically the nitrogen inversion of ammonia for propulsion purposes. There is 10 TW of inversion power stored in 1 m^3 of ammonia waiting to be released in an environmentally safe way. Cooperation with THz laser labs is being sought for the project.

References

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APPENDIX 1

Step Expansion and Quantum Randomness

This appendix outlines how the step-expansion at the particle level can mimic the electromagnetic interaction. As assumed, particles normally step up their absolute sizes at a rate equal to the corresponding gamma photon created during annihilation (e.g. 1.24 x10^{20} Hz for the electron, and 1836.2 times higher rate for the proton). Such step-expansion would cause the sizes of opposite sign particles to oscillate relative to each other. For example, when the electron size steps up, the proton size would be on average 50% of its maximum. This way, the predominately out-of-phase expansion of two opposite sign particles can result in attraction because one of the particles would be making space for the other one to expand into. The previous statement is however only valid in an average sense; the red dashed lines in Fig.4 demonstrate the source of the quantum randomness in the interaction.

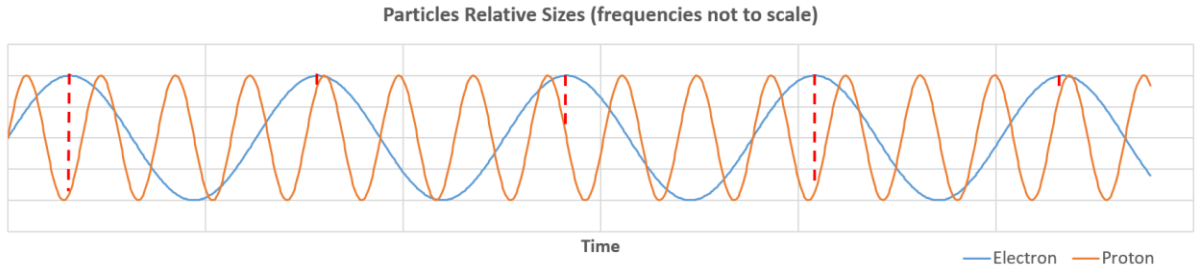

Figure 4: Opposite sign particles expanding out of sync

A mathematical check for the above logic follows. The intent is to demonstrate that the step-expansion can produce a normal orbital velocity component corresponding to a correct radius of the hydrogen atom. The numbers in Fig. 5 are given[7], while the average normal velocity and the average corresponding electron orbital radius will be calculated based on the new model.

Since the opposite sign particle sizes are on average 50% out-of-phase, the maximum average step of an electron towards the proton is half radius[1]; see Fig. 6. Based on the gamma rate, the step duration is $\Delta t = 1.24\ 10^{-20}$ s, and the corresponding distances that the electron can step in tangential and normal directions are $S_t = 1.82\ 10^{-14}$ m and $S_n = R_e/2 = 1.41\ 10^{-15}$ m respectively. The two particles are not next to each other, so the normal component needs to be corrected for the expanding in-between space with a factor of $\sqrt{R_p/R_H}$, in a similar to formula (1) manner. This is a standard mathematical correction for the "sink"-type singularity produced by the shrinking relative size of the proton in this case. The average radius of the electron orbital calculated based on the step-expansion rate becomes:

$$R = \frac{S_t}{asin\left(S_n\sqrt{R_p/R_H}/S_t\right)} = 5.78\ \ 10^{-11}\ m \qquad (3)$$

[1] One normalized radius per step may be the absolute limiting rate for interaction; see Fig. 7

The calculated in formula (2) value shows that the average electron position is within 9% of the 5.29 10^{-11}m Bohr radius.

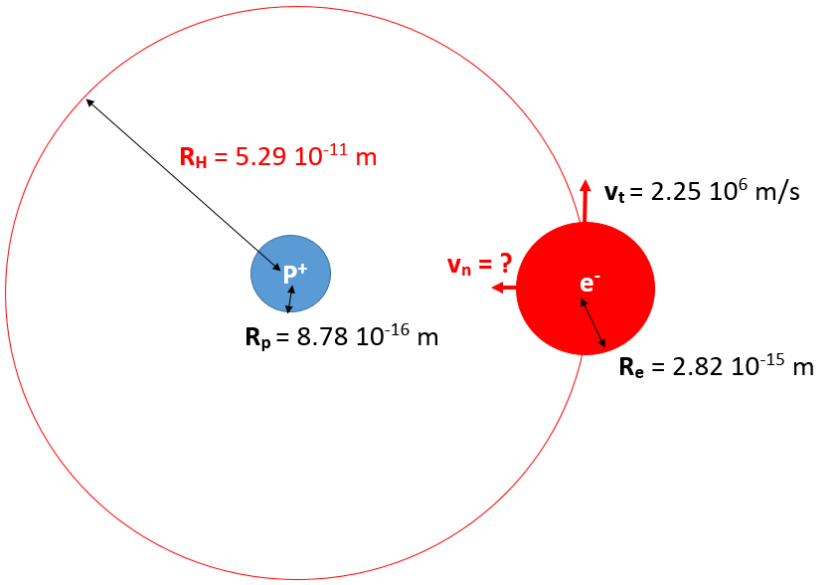

Figure 5: Would the step-expansion produce a correct radius for the hydrogen atom?

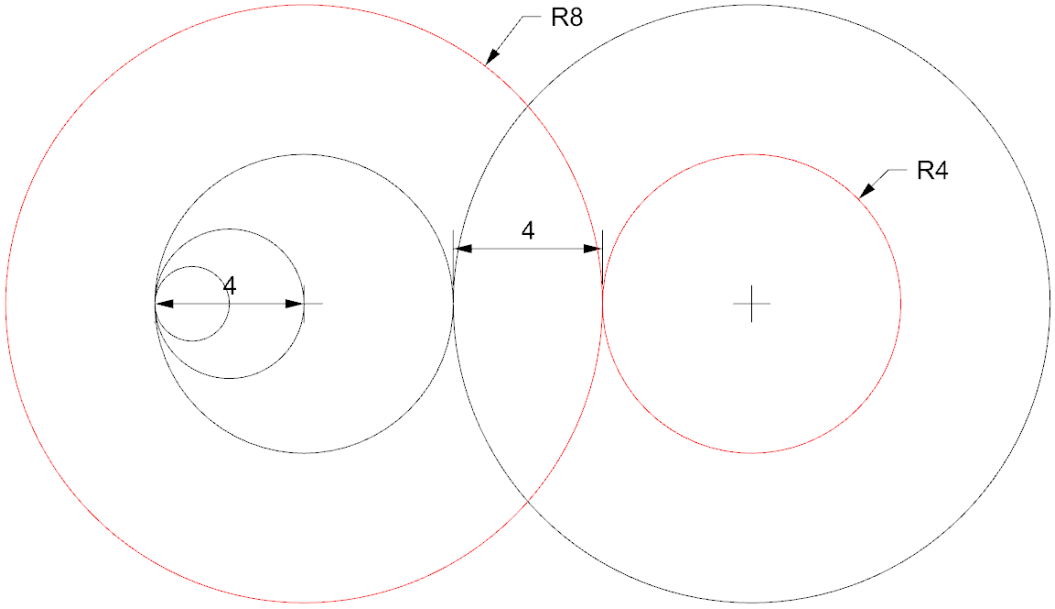

Figure 6: Opposite-sign particle shift by a half normalized radius (4/8)R

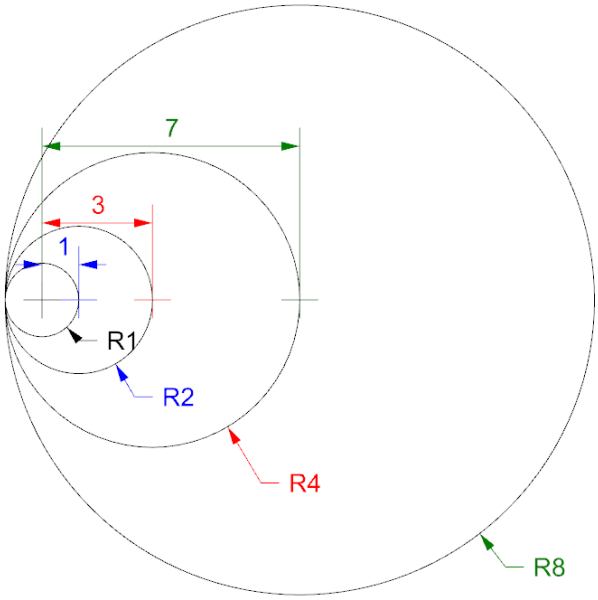

Figure 7: A possible absolute limting value for the rate of interaction is:

$\lim_{n\to\infty}\left(\frac{n-1}{n}\right) = 1$ *normalized radius per step shift for the center of the particle*

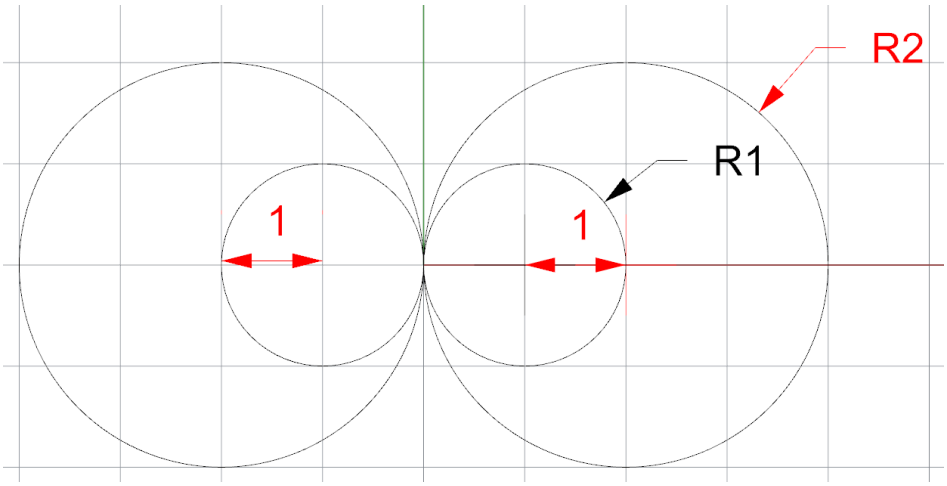

Figure 8: Same-sign particles shift by a half normalized radius (1/2)R

Proton's higher mass would correspond to a much lower expansion rate X per step, according to the following equation:

$$X^{1836.2} = 1836.2 \qquad (4)$$

APPENDIX 2

Step Expansion and CMB

The universe is accelerating away from us. Accelerated charged particles are displacing other charged particles at every expansion step. The accelerating charged particles are radiating. The Larmor radiation is proportional to the square of the acceleration, or to the square of the distance in the expansion case. The Larmor radiation is not coming directly in our direction because it is never parallel to the acceleration vector. This means that any radiation coming towards us has been scattered first. The Larmor spectra can be reduced to CMB-type blackbody spectrum in some cases, but additional work is required to verify this for the step-expansion model. Similar to the James Peebles' reasoning, the CMB peaks can be caused by:

- the 5/100 ratio between us being external observers and participants in different non-inertial frames of reference of the universal expansion process
- the 26/5 ratio between the space-time curvature due to rotating and expanding mass components (Fig.2)