Title: The Illusion of Cosmic Acceleration: A Hypothesis of Expanding Atomic Scales and Temporal Dilation

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Introduction: How the Idea Was Born

While contemplating the paradox of galaxies receding faster than the speed of light, I realized that this does not violate special relativity because space itself is expanding. However, this raised a deeper question: if matter is inseparable from the fabric of spacetime, could it also be expanding? And if so, would we be able to detect it from within the system?

This thought led to a striking realization: if atomic scales grow in proportion to the cosmic expansion, and time dilates accordingly, then what we interpret as "accelerating expansion" might be an illusion—caused by our own evolving system of measurement.

Main Hypothesis

The observed acceleration of the Universe's expansion is the result of:

1. Synchronous expansion of matter (e.g., atoms);
2. Corresponding slowdown of local time (temporal dilation).

In this model, the Universe expands at a constant rate in coordinate time:

$$a(t) \propto t$$

But observers, whose measuring systems are themselves expanding and whose time slows down, perceive the process as acceleration.

Mathematical Framework

Let:

- t: cosmic (true) time
- τ: local (observer) time
- $l_{atom}(t) \propto t$: atomic length grows linearly
- $d\tau \propto dt/t \Rightarrow \tau \propto \ln t$

Then:
- True scale factor: $a(t) \propto t$
- Observed scale factor: $a(\tau) = a(t(\tau)) \propto e^{\tau}$

Thus, although the true expansion is linear, the observer perceives exponential growth—mimicking the effects of dark energy.

Furthermore, if we reverse the logic and assume that the observed exponential expansion is “real,” it would imply rapidly increasing distances between objects without changing the objects themselves. In contrast, our model explains that this illusion of acceleration arises precisely because the scale of objects—atoms, molecules, reference systems—is also changing. Hence, the illusion of acceleration is created by the combination of atomic scale growth and the slowing of local time.

Redshift Explanation in This Hypothesis

In standard cosmology, the redshift z is defined by the relative increase of a photon's wavelength:

$$1 + z = a(t_0) / a(t_e)$$

where $a(t_0)$ is the scale factor at observation and $a(t_e)$ at emission.

In our model, the wavelength remains fixed in absolute coordinates, but the observer’s unit of measurement changes. If λ is constant and atomic rulers grow with time, the observer sees the same photon as “stretched”:

$$\lambda_{obs} \propto l_{atom}(t_0) / l_{atom}(t_e) = t_0 / t_e$$

Therefore:

$$1 + z = \lambda_{obs} / \lambda_{em} = t_0 / t_e$$

This yields the same result as standard cosmology (for $a(t) \propto t$) but with a fundamentally different interpretation: redshift is not due to the photon stretching, but due to the growth of the measuring standard.

Critical Remarks

1. Testability of Atomic Growth: There is no observational evidence yet that atomic sizes change with cosmic time.
2. Verification of Time Dilation: A method is needed to observe or infer logarithmic time through astrophysical measurements.
3. Compatibility with CMB: The model must reproduce the spectral characteristics and anisotropies of the cosmic microwave background.
4. Laboratory Testability: If valid, the effects should be detectable in precision interferometry or Earth-based metrology experiments.

Conclusion

This hypothesis of matter expanding in scale and time slowing down offers an alternative to the concept of cosmic acceleration driven by dark energy. It preserves the observational framework but changes the interpretation—and must now be rigorously tested across all physical domains.

Extension: On Dark Matter and Galactic Rotation Curves

In classical Newtonian gravity, the orbital velocity $v(r)$ of a star at radius r from the galactic center is given by:

$$v(r) = \sqrt{G * M(r) / r}$$

Where:

- $M(r)$ is the mass enclosed within radius r,
- G is the gravitational constant,
- v is the orbital velocity.

In the scale expansion hypothesis, if the entire galaxy expands homogeneously over time by a scale factor $S(t)$,

then both mass and radius grow as:

$$M(t) \sim S(t)^3, \quad r(t) \sim S(t)$$

Substituting into the velocity formula:

$$v(r) \sim \sqrt{G * M(t) / r(t)} \sim \sqrt{G * S(t)^3 / S(t)} = \sqrt{G * S(t)^2}$$

But for an internal observer, where all scales (including time) grow proportionally, this results in no observable change in velocity.

Thus, the rotation curves remain flat not because of hidden mass, but due to the dynamics of uniform scale growth.


Scale Factor and Derived Quantities
S(t) - Scale Factor
r(t) ~ S(t)
m(t) ~ S(t)^3
1.0
1.5
2.0
2.5
3.0
0
2
4
6
8
10
Gravitational Force and Acceleration
F(t) ~ S(t)^4
a(t) ~ S(t)
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
0
2
4
6
8
10
Rotational Velocity Over Time
v(t) ~ S(t)
1.0
1.1
1.2
1.3
1.4
1.5
0
2
4
6
8
10