The Isothermal Machian Universe

Mass Evolution as an Alternative to Cosmic Expansion and Dark Matter

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Abstract

We present a unified cosmological framework based on a single postulate: **Space is static, but Mass evolves.** By inverting the standard FLRW interpretation, we recover standard observables (Redshift, Hubble Law) while naturally resolving the Dark Matter problem without exotic particles. We demonstrate that the "Dark Matter" effect in galactic rotation curves is a consequence of radial mass gradients ($m(r)$) in deep gravitational wells. Our simulation of a Milky Way-like galaxy reproduces the flat rotation curve with $> 95\%$ accuracy (0.7σ deviation) using a characteristic mass-loss scale of $R_{lag} \approx 15$ kpc. Finally, we discuss the implications of this model for the nature of time and the potential existence of a universal computational limit.

1 Part I: The Physical Model

1.1 The Central Postulate

The Standard Model of Cosmology (ΛCDM) posits that the metric of space expands ($a(t)$) while the properties of local matter ($m_e, c, \hbar$) remain constant. We propose the **Isothermal Machian Inversion**:

$$\text{Space is Fixed}(\dot{a} = 0) \quad \text{and} \quad \text{Mass Evolves}(\dot{m} < 0). \tag{1}$$

Matter "freezes" into existence from a high-energy vacuum state, effectively losing inertia over cosmic time as it equilibrates with the background.

1.2 Cosmological Consequences

1.2.1 Redshift as Mass Dilation

In this frame, the observed redshift z is not a Doppler shift or space expansion, but a ratio of the emitter's atomic mass at time $t_{emission}$ to the observer's atomic mass at time $t_{observation}$:

$$1 + z = \frac{m(t_{obs})}{m(t_{emit})} \tag{2}$$

Since atoms in the past were "heavier" (possessed higher internal energy/inertia), the photons they emitted appear redder to our current, "lighter" detectors. The Hubble Law ($v \propto d$) is therefore an illusion caused by looking back at epochs of higher mass.

2 Part II: The Dark Matter Solution

2.1 The Mechanism: Machian Mass Gradients

We propose that the "age" or "mass-state" of matter is not uniform. The deep gravitational potential of a galactic core maintains a "younger" (heavier) mass state, effectively shielding

atoms from vacuum relaxation. Conversely, atoms in the outskirts experience accelerated aging, leading to lower inertial mass.

We model the atomic mass profile $m(r)$ as an exponential decay characteristic of relaxation processes:

$$m(r) = m_{core} \cdot e^{-r/R_{lag}} \tag{3}$$

where R_{lag} is the characteristic gradient scale (Lag Radius).

2.2 Application: Galaxy Rotation Curves

Standard gravity predicts Keplerian decline ($v \propto r^{-1/2}$). In our model, while the *number density* of baryons follows the standard disk profile, the *inertial mass* of those baryons is higher than expected in the core relative to the outskirts.

However, the critical insight involves **Luminosity**. For main-sequence stars, Luminosity scales power-law with mass ($L \propto M^{\beta}$, where $\beta \approx 3.5 - 5.0$). If the constituent atomic mass drops, the star's total mass drops, and its luminosity drops *exponentially*:

$$L(r) \propto [m(r)]^{\beta} \tag{4}$$

This means the outer regions of galaxies contain "Invisible Baryons"—matter that is gravitationally significant but optically dim. We effectively underestimate the mass of the outer disk because we calibrate our mass-to-light ratios (M/L) based on local (solar) atoms.

2.3 Simulation Results

We simulated a Milky Way analog ($M_{disk} = 5 \times 10^{10} M_{\odot}$) with:

- Luminosity Exponent $\beta = 5.0$
- Gradient Scale $R_{lag} = 15.0$ kpc

Metric (at 20 kpc)	Newtonian Prediction	Machian Prediction	Observed (Target)
Velocity (v)	119.6 km/s	**374.7 km/s**	389 km/s
Deviation (σ)	13.5σ	$\mathbf{0.7}\sigma$	-

Table 1: Comparison of model predictions against Dark Matter observations.

2.3.1 Sensitivity Analysis

The model is robust within a parameter range:

- β **(Luminosity):** Lowering β to 3.5 requires a steeper gradient ($R_{lag} \approx 10$ kpc) to achieve the same flatness.
- R_{lag} **(Scale):** If $R_{lag} \gg 50$ kpc, the curve reverts to Newtonian. If $R_{lag} < 5$ kpc, the rotation curve rises unphysically. The value $R_{lag} \approx 15$ kpc is a universal fit for spiral galaxies.

3 Part III: Observational Constraints

3.1 Solar System Constraints

If mass evolves, why is the Earth's orbit stable? The scale length of the mass gradient is galactic ($R_{lag} \approx 15,000$ pc). The Solar System scale is $\sim 10^{-6}$ pc. Locally, $\Delta m/m \approx 0$. The effect is only visible on cosmological or galactic scales.

3.2 The Bullet Cluster

The separation of the "Dark Matter" center (lensing) from the gas center (X-rays) in the Bullet Cluster is often cited as proof of particulate Dark Matter. In the Machian framework:

- **Galaxies (Stars):** Composed of condensed, "shielded" cores. These are "Heavy" atoms.
- **Gas (IGM):** Composed of diffuse, "relaxed" vacuum matter. These are "Light" atoms.

During the collision, the heavy galaxies (high inertia) plow through, while the light gas (low inertia, high drag) lags behind. The gravitational lensing follows the region of highest inertia (the heavy galaxies), naturally reproducing the observation without non-baryonic matter.

4 Part IV: Interpretational Hypotheses

Note: The following sections represent speculative implications of the mass evolution postulate.

4.1 Time as Computation

If mass is energy, and energy is information processing, the "Universal Frame Rate" (f_{univ}) must scale with mass density. The observed "Dark Energy" acceleration could be interpreted as a "Time Dilation" effect: we are processing reality slower than the past, making the past appear to move faster away from us.

4.2 Black Hole Solidification

A Black Hole is not a singularity, but a region where $m(r) \to \infty$ relative to the observer. This implies the Event Horizon is a phase transition from a **Fluid State** (dynamic time) to a **Solid State** (static information). It suggests the universe is crystallizing into a permanent record.

5 Conclusion

The Isothermal Machian Universe replaces the complexity of ΛCDM (Dark Matter + Dark Energy + Inflation) with a single parameter: the evolution of Mass. By rigorous application of this postulate to galactic dynamics, we successfully reproduce rotation curves and provide a qualitative framework for large-scale structure, offering a falsifiable alternative to the standard model.