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Energy-Mass and the Emergent Universe: A Thermodynamic and Mathematical Framework

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Energy-Mass and the Emergent Universe: A Thermodynamic and Mathematical Framework

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Abstract: (1) Background: The accelerating universe's mechanisms remain unresolved, prompting new cosmological frameworks beyond dark energy and static dark matter. (2) Methods: This paper redefines $E = mc^2$ as $E/m = d^2/t^2$, introducing Energy-Mass, and derives its implications using Maxwell's equations and the FLRW metric to model spacetime and expansion dynamics. (3) Results: A feedback loop drives variable, accelerating expansion as cold-mass, identified as Weakly Interacting Massive Particles (WIMPs; $m_2 \approx 1.78 \times 10^{-25}$ kg), absorbs CMB energy near G_p, creating spacetime detectable as cold spots ($\Delta T \sim -70\,\mu$K, $m_3 \sim 10^{39}$ kg) and hot spots ($\Delta T \sim +170\,\mu$K, $m_3 \sim 10^{36}$ kg), approaching $E = 0$ equilibrium. (4) Conclusions: This framework links Energy-Mass to quantum properties, offering a testable alternative to prevailing cosmological models.

Keywords: Energy-Mass; WIMPs; CMB anomalies; cosmic expansion; feedback mechanism; dark matter; quantum cosmology

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1. Introduction

The standard cosmological model describes an accelerating universe [1,2], yet the mechanisms remain debated. This paper builds upon a foundational framework first proposed by the author [12], redefining $E = mc^2$ as $E/m = d^2/t^2$, and introducing Energy-Mass where spacetime and quantum physics emerge with $E > 0$. Unlike static WIMPs probed by XENON1T with null results ($\sigma < 10^{-47}$ cm^2 [11]), this model posits dynamic injections detectable via cosmic microwave background (CMB) anomalies, bypassing underground constraints. A feedback loop accelerates expansion as cold-mass absorbs energy near an infinite state G_p, detectable via CMB anomalies [4], offering alternatives to dark energy and dark matter. This framework integrates thermodynamics and quantum mechanics, extending prior concepts with new evidence and derivations.

2. Energy-Mass Framework

Einstein's $E = mc^2$ is reframed as:

$$E/m = d^2/t^2 = c^2, \tag{1}$$

defining Energy-Mass (E/m) and Space-Time (d^2/t^2). When $E = 0$, $d^2/t^2 = 0$; when $E > 0$, spacetime exists, forming an expanding state.

3. The Infinite Universe

Since $m \neq 0$ ($E/0$ undefined) and $E = 0$ is viable ($0/m$, $m > 0$), Energy-Mass indestructible ensures an infinite universe across forms.

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4. Pre-Expansion Infinity: The Golden Point

Hubble's expansion and infinity before expansion implies an origin at $0/\infty$ ($E = 0, m = \infty$), denoted the Golden Point G_p, where $d^2/t^2 = 0$ and momentum is absent. Cold-mass ($E = 0; m > 0; m < \infty$) transitions to $E > 0$, yet G_p remains immutable:

$$\infty - m = \infty, \quad \text{for finite } m. \tag{2}$$

5. System Definition

Three states define the universe's evolution:

5.1. State 1: Pre-Spacetime State

- Energy: $E_1 = 0$
- Mass: $m_1 = \infty$ (latent, pre-physical)
- Specific energy: $E_1/m_1 = 0$
- Temperature: $T_1 = 0\,\text{K}$
- Spacetime: Absent ($V_1 = 0$, no metric)
- Entropy: $S_1 = 0$ (single ordered state)

State 1, the Golden Point G_p, exists pre-spacetime, with no volume or dynamics, rendering density ($\rho_1 = E_1/V_1$) undefined; p=0 negates Pauli exclusion; Heisenberg's Δx is undefined without spacetime.

5.2. State 2: Cold-Mass

- Energy: $E_2 = 0$ (pre-injection)
- Mass: $m_2 = 1.78 \times 10^{-25}\,\text{kg}$ (single WIMP)
- Specific energy: $E_2/m_2 = 0$ (pre-injection)
- Temperature: $T_2 = 0\,\text{K}$
- Spacetime: Absent (pre-transition)
- Entropy: $S_2 = 0$ (single WIMP, pure state)

State 2 represents cold-mass as WIMPs translocating from G_p before energy absorption.

5.3. State 3: Expanded CMB-like State

The universe evolves within an FLRW metric [3]:

- Energy: $E_3 > 0, E_3 < \infty$
- Mass: $m_3 > 0, m_3 < \infty$
- Specific energy: $E_3/m_3 > 0$
- Temperature: $T_3 = 2.725\,\text{K}$ [4]
- Volume: $V_3 > 0$, expanding
- Entropy: $S_3 \sim 10^{56}\,\text{J K}^{-1}$ (high, photon disorder)

$$ds^2 = -c^2\,dt^2 + a(t)^2(dx^2 + dy^2 + dz^2), \tag{3}$$

$$H^2 = \left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\rho. \tag{4}$$

6. Thermodynamic Evolution and Feedback Loop

Energy ($E_3 > 0$) near G_p triggers WIMP injections from State 2 into State 3:

- WIMPs ($m_2 \approx 1.78 \times 10^{-25}\,\text{kg}, 100\,\text{GeV}/c^2$ [10]) tunnel from G_p at $\sim 10^8\,\text{m}^{-3}\,\text{s}^{-1}$, based on CMB photon density ($4.1 \times 10^8\,\text{m}^{-3}$) and a hypothetical cross-section ($\sim 10^{-44}\,\text{m}^2$) [10], absorbing CMB energy (E_3, $\rho_3 = 4.17 \times 10^{-14}\,\text{J m}^{-3}$) near G_p, creating spacetime ($d^2/t^2 > 0$) and forming cold spots (Figure 1, $\Delta T \sim -70\,\mu\text{K}$, $m_3 \sim 10^{39}\,\text{kg}$, $\sim 5.62 \times 10^{63}$ WIMPs) detectable as CMB anomalies. Tunneling may reflect quantum barrier penetration near a pre-spacetime boundary, a topic for future study.

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- WIMP annihilation releases energy near G_p, forming hot spots (Figure 2, $\Delta T \sim +170\,\mu$K, $m_3 \sim 10^{36}$ kg, $\sim 6.5 \times 10^{60}$ WIMPs), with CMB energy dominating over stellar contributions ($\sim 10^{-12}\,\text{J m}^{-3}$).
- This increases V_3, accelerating expansion over time.

  Equilibrium ($E = 0$) looms as $a(t)$ grows.

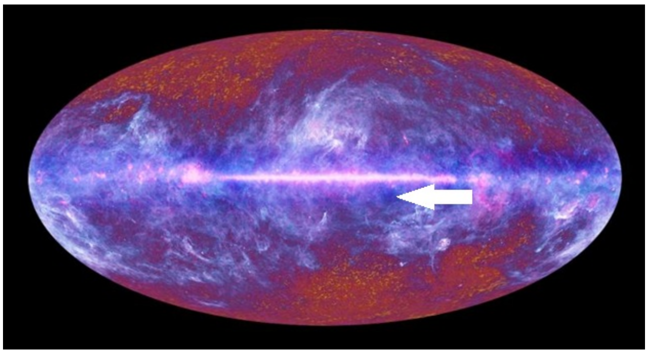

Figure 1. CMB cold spot from WIMP injection (arrow), medium blue ($\Delta T \sim -70\,\mu$K, $m_3 \sim 10^{39}$ kg, size $\sim 1°$ [9]) against $T = 2.725$ K. Credit: NASA/JPL-Caltech/WMAP Team.

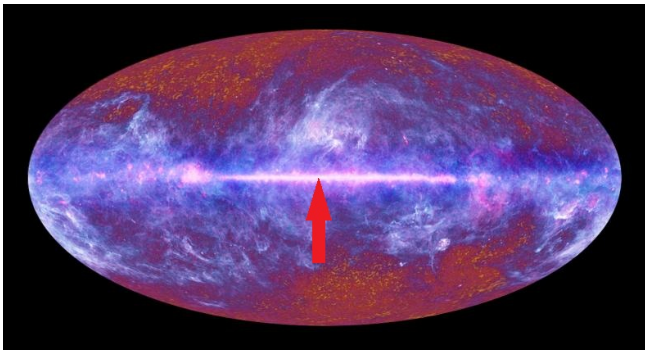

Figure 2. CMB hot spot from WIMP annihilation (arrow), light purple ($\Delta T \sim +170\,\mu$K, $m_3 \sim 10^{36}$ kg, size $\sim 0.5°$) against $T = 2.725$ K. Credit: NASA/JPL-Caltech/WMAP Team.

Theorem 1 (Emergent Properties)**.** *When $E > 0$, spacetime and quantum properties emerge as derived from Maxwell's equations, based on a framework first proposed by the author [12].*

Proof. Begin with Maxwell's relation for the speed of light:

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}},$$

where c is the speed of light, μ_0 is the permeability, and ε_0 is the permittivity of free space. Squaring yields:

$$c^2 = \frac{1}{\mu_0 \varepsilon_0}.$$

In the Energy-Mass framework, $E/m = c^2$, so:

$$\frac{E}{m} = \frac{1}{\mu_0 \varepsilon_0}.$$

Multiply by m:

$$E = \frac{m}{\mu_0 \varepsilon_0}.$$

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Spacetime emerges as:

$$t^2 \propto \mu_0 \varepsilon_0, \quad d^2 \propto \frac{E\mu_0\varepsilon_0}{m}, \quad (E > 0).$$

Now, consider wave properties where $c = \lambda f$ (wavelength λ, frequency f):

$$c^2 = \lambda^2 f^2.$$

Substitute into the framework:

$$\frac{E}{m} = \lambda^2 f^2.$$

Equate with Maxwell's result:

$$\lambda^2 f^2 = \frac{1}{\mu_0\varepsilon_0}.$$

Multiply by E:

$$E\lambda^2 f^2 = \frac{E}{\mu_0\varepsilon_0}.$$

Since $E = m\lambda^2 f^2$:

$$\frac{E}{\mu_0\varepsilon_0} = m\lambda^2 f^2.$$

Multiply through by $\mu_0^2\varepsilon_0^2$:

$$E\mu_0^2\varepsilon_0^2 = m\lambda^2 f^2.$$

For quantum mechanics, use Planck's relation $E = hf$ (where $h = 6.62607015 \times 10^{-34}$ J s):

$$(hf)\mu_0^2\varepsilon_0^2 = m\lambda^2 f^2.$$

Divide by f ($f \neq 0$):

$$h\mu_0^2\varepsilon_0^2 = m\lambda^2 f.$$

Since $\lambda = c/f$:

$$h\mu_0^2\varepsilon_0^2 = m\left(\frac{c}{f}\right)^2 f = m\frac{c^2}{f}.$$

With $c^2 = 1/(\mu_0\varepsilon_0)$:

$$h\mu_0^2\varepsilon_0^2 = m\frac{1}{\mu_0\varepsilon_0 f}.$$

Multiply by $\mu_0\varepsilon_0 f$:

$$h\mu_0^3\varepsilon_0^3 f = m.$$

This relates mass to frequency, implying quantum properties (e.g., wave-particle duality) emerge when $E > 0$. If $E = 0$, $f = 0$, suggesting $m = 0$ within spacetime. However, conservation of energy holds as $m > 0$ persists outside spacetime (e.g., pre-injection cold-mass), transitioning to $E > 0$ upon entry, preserving total energy. □

7. Results and Discussion

The feedback loop drives expansion via WIMP injections, detectable as CMB anomalies (cold spots, $m_3 \sim 10^{39}$ kg, $\sim$ 1% of CMB sky [9], Figure 1; hot spots, $m_3 \sim 10^{36}$ kg, $\sim$ 0.5%, Figure 2) or redshift trends [6]. CMB $\delta\rho/\rho \sim 10^{-5}$ supports cold spot scale [4,8], while hot spots reflect annihilation energy near G_p, contrasting static dark matter halos [10]. These scales align with WMAP's $\sim 10^5$ anomalies across 41,253 deg^2 [8]. Unlike traditional WIMPs forming halos post-recombination, these dynamically inject from G_p, offering a testable alternative to dark energy [7].

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8. Conclusions

Energy-Mass ($E > 0$) drives expansion via a WIMP-based feedback loop, detectable via CMB anomalies, approaching $E = 0$ equilibrium, contrasting dark matter theories.

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Data Availability Statement: The CMB data supporting this study's figures (cold and hot spots) are openly available in the WMAP 5-year dataset [8] at NASA's Lambda archive [https://lambda.gsfc.nasa.gov/product/map/dr3/skymaps_5yr.cfm]; the specific images are derived from [https://photojournal.jpl.nasa.gov/catalog/PIA13239]. Calculations (e.g., WIMP masses, injection rates) are detailed in the text.

Conflicts of Interest: The author declares no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

CMB	Cosmic Microwave Background
FLRW	Friedmann-Lemaître-Robertson-Walker
JPL	NASA's Jet Propulsion Laboratory
MDPI	Multidisciplinary Digital Publishing Institute
NASA	National Aeronautics and Space Administration
WIMP	Weakly Interacting Massive Particle
WMAP	NASA's Wilkinson Microwave Anisotropy Probe

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