A Question for the Physics Community: Could Dark Matter and Dark Energy Be Integration Bound Errors?

Author: Drew Farwell
Affiliation: Independent Researcher Edge-Nemi
Email: drew@edgenemi.com
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Abstract

We present a hypothesis for community evaluation: that dark matter (~27%) and dark energy (~68%) - comprising 95% of the universe's apparent energy budget - might be mathematical artifacts arising from applying continuous mathematics to discrete spacetime. The central question is whether integration bounds extending to zero, rather than cutting off at the Planck scale ($l_P \approx 1.62\times10^{-35}$ m), could create apparent "missing" energy that we interpret as dark sector phenomena. If correct, this would suggest that only ~5% of the universe consists of actual matter and energy above the Planck scale, while 95% represents accumulated mathematical errors. We outline this framework, identify where our reasoning might be flawed, and request community assistance in testing key assumptions and calculations that are beyond our current capabilities.

Keywords: dark matter, dark energy, discrete spacetime, integration bounds, mathematical artifacts, cosmological constant problem

1. Introduction and Request for Community Input

The standard ΛCDM cosmological model requires that 95% of the universe consists of dark matter (~27%) and dark energy (~68%) - substances that have never been directly detected despite decades of intensive searches. This remarkable situation prompts us to ask whether we might be approaching the problem from the wrong angle.

We wish to present a hypothesis to the physics community for evaluation and critique: Could dark matter and dark energy be mathematical artifacts rather than physical substances? Specifically, we wonder whether the systematic use of integration bounds extending to zero, rather than cutting off at the Planck scale where spacetime may become discrete, could create apparent "missing" energy that we misinterpret as exotic dark components.

We recognize this is an extraordinary claim that likely contains errors in our reasoning. We are seeking help from the community to:

- Identify fundamental flaws in this approach

- Point us toward relevant literature we may have missed
- Suggest rigorous calculations that could test these ideas
- Clarify whether discrete spacetime effects could plausibly manifest at cosmic scales

Our goal is not to overturn established physics, but to explore whether this perspective might offer insights worth investigating.

2. The Integration Bound Question

2.1 The Core Mathematical Issue We're Wondering About

In continuous mathematics, integrals of the form:

$\int_0^\infty f(r)\,dr$

are standard, where f(r) represents energy density functions that often scale as $1/r^2$ or steeper. However, if spacetime is fundamentally discrete at the Planck scale, we wonder whether these integrals should properly be:

$\int_{l_P}^\infty f(r)\,dr$

The difference between these integration bounds would represent energy that exists mathematically but not physically. **We are uncertain whether this difference could be significant enough to explain observed phenomena, and we would welcome calculations from those with more expertise.**

2.2 A Rough Estimate (Please Check Our Math)

For gravitational energy densities $\propto 1/r^2$, the ratio of energies calculated with different bounds might be:

$E_{continuous} / E_{discrete} \approx (\int_0^R f(r)dr) / (\int_{l_P}^R f(r)dr)$

We suspect our calculation here is oversimplified. We would greatly appreciate guidance from the community on:

- Whether this ratio calculation is meaningful
- How to properly account for the accumulation of such errors over cosmic time
- What the actual magnitude of these effects would be

2.3 How This Might Manifest (Speculation)

If our reasoning is correct, the mathematical artifacts might manifest as:

Apparent Dark Matter Effects (~27%): Could integration errors in binding energy calculations create apparent gravitational effects, particularly in:

- Galaxy rotation curves showing "missing" mass
- Gravitational lensing with unexplained deflection
- Large-scale structure formation requiring extra gravitational sources

Apparent Dark Energy Effects (~68%): Could integration errors in vacuum energy calculations create apparent cosmic acceleration, manifesting as:

- Type Ia supernovae appearing dimmer than expected
- Cosmic microwave background patterns requiring accelerated expansion
- Large-scale structure growth rates inconsistent with matter-only models

We emphasize these are speculations that need rigorous testing.

3. Discrete Spacetime Framework

3.1 Planck Scale Cutoffs

If spacetime is discrete at the Planck scale, then:

- No physical processes can involve scales smaller than $l_P \approx 1.62\times10^{-35}$ m
- All energy density calculations must include natural cutoffs
- Integration bounds extending below l_P are purely mathematical artifacts

3.2 Accumulated Errors Over Cosmic Time

The key insight is that small mathematical errors in local calculations accumulate over cosmic time scales (13.8 billion years) and cosmic length scales (observable universe radius ~46.5 billion light-years) to produce macroscopic effects.

3.3 Observational Equivalence

Critically, the observational consequences of "mathematical artifacts producing apparent dark effects" are identical to "invisible dark substances producing real effects." Both predict:

- Identical galaxy rotation curves
- Identical gravitational lensing patterns
- Identical cosmic acceleration signatures

- Identical large-scale structure formation

This observational equivalence means the dark sector crisis may have been fundamentally misdiagnosed.

4. Why We Think This Deserves Investigation

4.1 The Scale Correspondence That Puzzles Us

What strikes us as potentially significant is the correspondence between:

- Dark sector fraction: ~95% of universe
- Expected mathematical artifact: Energy "lost" between integration bounds 0 and l_P

This correspondence could be pure coincidence, but we wonder if it merits investigation.

4.2 Existing Work on Discrete Spacetime

We found that researchers like Trout (2013) have already shown that discrete spacetime can naturally produce effects resembling dark energy through geometric properties of discrete manifolds. We wonder whether this work could be extended to encompass both dark components as manifestations of the same mathematical issue.

4.3 The Continued Absence of Dark Particle Detection

The consistent failure to detect dark matter particles despite increasingly sensitive experiments makes us wonder whether alternative explanations deserve consideration.

4.4 Questions About Fine-Tuning

Dark energy exhibits extreme fine-tuning (the cosmological constant problem), while mathematical artifacts might naturally emerge at whatever level the integration errors produce. We're curious whether this perspective could help with these puzzles.

We acknowledge these observations could have conventional explanations and welcome corrections to our reasoning.

5. How This Could Be Tested (Seeking Community Guidance)

We believe this hypothesis could be tested, but we need help from the community to design rigorous tests:

5.1 What We Predict Would NOT Be Found

- Dark matter particle searches would continue to yield null results
- No fundamental dark energy field would be discovered

5.2 What Might Be Found Instead

- Gravitational wave observations might show subtle deviations consistent with discrete substrate effects
- High-precision measurements of fundamental constants might reveal evolution consistent with discrete spacetime

5.3 Computational Tests We Cannot Perform

We lack the expertise to conduct these crucial tests:

- N-body simulations using discrete spacetime substrates to see if they reproduce dark sector phenomena using only ~5% ordinary matter
- Rigorous calculations of integration errors in cosmological contexts
- Analysis of whether Planck-scale cutoffs in field theory calculations could eliminate apparent dark components

We would be extremely grateful for community assistance with these calculations.

6. Implications and Discussion

6.1 Occam's Razor Application

This hypothesis satisfies Occam's Razor by:

- Requiring no new particles or fields
- Using only established physics (quantum mechanics, general relativity)
- Explaining multiple phenomena (dark matter + dark energy) with a single cause
- Resolving rather than adding to the fine-tuning problem

6.2 Historical Parallel

This situation parallels the Ptolemaic epicycle system, where increasingly complex invisible mechanisms were invoked to preserve Earth-centered astronomy. Like Copernicus suggesting a simpler coordinate system (heliocentric), we suggest a simpler mathematical framework (discrete rather than continuous).

6.3 Methodological Implications

If correct, this hypothesis reveals that:

- Mathematical idealization can create physical illusions

- The success of continuous mathematics in most contexts obscured its limitations at cosmic scales
- Extraordinary claims about invisible universes were accepted with insufficient skepticism
- The mapping between mathematical tools and physical reality requires more careful consideration

6. Where We Might Be Wrong (Please Help Us Identify Errors)

We suspect there are fundamental flaws in our reasoning, and we would appreciate help identifying them:

6.1 "Planck Scale Effects Should Be Negligible"

Potential Objection: Planck-scale effects should be suppressed by $(E/E_{Planck})^n$ and therefore negligible at macroscopic scales.

Our Uncertain Response: We wonder if this assumes perturbative effects, while integration bound errors might accumulate non-perturbatively over cosmic scales and times. But we may be wrong about how these effects would actually propagate.

6.2 "Discrete Spacetime Is Unproven"

Potential Objection: The discreteness of spacetime is speculative.

Our View: While true, we see this as a conditional argument: IF spacetime is discrete, THEN dark sector effects might be mathematical artifacts. This could provide a testable framework regardless of whether discreteness is ultimately confirmed. **But we may be misunderstanding the current state of quantum gravity research.**

6.3 "Mathematical Artifacts Cannot Explain Detailed Observations"

Potential Objection: Dark sector theories successfully explain detailed observational features like cosmic microwave background acoustic peaks, baryon acoustic oscillations, etc.

Our Speculation: Mathematical artifacts might produce the same observational signatures as physical dark components. But **we lack the expertise to verify whether this is actually possible.**

7. Specific Questions for the Community

We would be particularly grateful for guidance on:

1. **Mathematical Rigor**: Are there existing theorems about integration bound errors that we should be aware of?
2. **Quantum Gravity Connection**: Does current quantum gravity research suggest discrete spacetime effects could manifest at cosmological scales?
3. **Computational Testing**: Could someone with access to cosmological simulation tools test whether discrete substrate models reproduce observations?
4. **Historical Precedents**: Are there other cases where mathematical techniques created apparent physical phenomena that were later resolved?
5. **Literature Review**: What important papers on discrete spacetime and dark sector alternatives have we missed?

8. Future Research Directions

8.1 Computational Studies

- Develop N-body simulation codes using discrete spacetime substrates
- Compare structure formation predictions using only ordinary matter with discrete spacetime effects
- Quantify integration bound errors for specific cosmological observables

8.2 Observational Tests

- Search for signatures of discrete spacetime in gravitational wave data
- Analyze cosmic microwave background for discrete substrate signatures
- Examine galaxy rotation curves for discrete spacetime predictions

8.3 Theoretical Development

- Formalize the relationship between integration bounds and observable dark sector effects
- Develop rigorous error bounds for continuous mathematics applied to discrete substrates
- Explore connections to quantum gravity theories

8. Request for Collaborative Research

8.1 Computational Studies We Cannot Perform

We lack the resources and expertise to:

- Develop N-body simulation codes using discrete spacetime substrates
- Compare structure formation predictions using only ordinary matter with discrete spacetime effects
- Quantify integration bound errors for specific cosmological observables

Would anyone be interested in collaborating on these calculations?

8.2 Observational Tests Beyond Our Capabilities

We cannot properly analyze:

- Gravitational wave data for discrete spacetime signatures
- Cosmic microwave background for discrete substrate signatures
- Galaxy rotation curves for discrete spacetime predictions

We would welcome partnerships with observational astronomers.

8.3 Theoretical Development We Need Help With

We struggle with:

- Formalizing the relationship between integration bounds and observable dark sector effects
- Developing rigorous error bounds for continuous mathematics applied to discrete substrates
- Understanding connections to quantum gravity theories

Collaboration with theoretical physicists would be invaluable.

9. Conclusions and Call for Community Input

We have outlined a hypothesis that dark matter and dark energy might be mathematical artifacts arising from applying continuous mathematics to discrete spacetime. We emphasize that:

1. **This is presented as a question, not a definitive answer**
2. **We expect there are significant flaws in our reasoning**
3. **We lack the expertise to test many key assumptions**

4. **We are seeking community collaboration rather than claiming a breakthrough**

Our hope is that by sharing these ideas, we might:

- Learn why this approach is wrong (if it is)
- Discover relevant literature we've missed
- Find collaborators interested in testing these concepts
- Contribute to the ongoing search for solutions to the dark sector puzzle

The universe's mysteries deserve our collective attention. If this perspective has merit, the community can develop it properly. If it's flawed, the community can help us understand why and perhaps redirect the inquiry in more productive directions.

We thank the physics community for considering these ideas and welcome all feedback, criticism, and suggestions for improvement.

Note to Readers: This paper is explicitly seeking community input and collaboration. The authors recognize the speculative nature of these ideas and welcome rigorous criticism and suggestions for testing. Please contact us if you're interested in collaborative investigation of these concepts or can point us toward relevant literature and calculations.

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Correspondence: drew@edgenemi.com