Chapter 1

Conjecture on the cosmological constant as a local variable scalar mass field operator

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Using the mechanism from Valentine, we conjecture that the cosmological constant, the lambda of the Lambda-CDM theory, is a consequence of matter-antimatter asymmetry, in terms of the time and space dilation effect when oscillators collapse, due to mass as an on-shell phase operator. This is induced qualitatively, with some constraints.

1. Introduction

Since 2012,[1] our papers have started with six rules (A.1), based on information theory,[5] which we have described as necessary for physics to emerge.

There are some emergent features of this mechanism that have physical effects, and the following conjecture attempts to link our phase operator to the lambda that is the cosmological constant. Our other work does not require a cosmological constant, so this is an exercise in reconciling a feature of standard cosmology with a satisfactory explanation in our terms.

2. Conjecture

> The cosmological constant is equivalent to the net effect of the scalar mass phase operator on the macro geometry of matter in the universe, where the phase operator has opposite sign for matter and anti-matter and correspondingly the reverse dilation or curvature effect.

Although both positive and negative modulations are active prior to the weak interaction radius, and change over the weak interaction, they are present throughout propagation in superposition until collapsed.[1,3]

In the following, we characterize the effect of a positive modulation and a negative modulation. Neither positive nor negative modulations happen without the other being present, active or excluded. However, one may become locally dominant over the other with respect to the fermions we observe as matter, and it may over time polarize high-mass A to matter fermions, and low-mass B to anti-fermions as the vacuum interaction.

2.1. *Positive modulation case*

When a positively-signed modulation (Rules 4, 5) applies to radiating shells (Rule 2) from matter, they may collapse (Rule 6) slightly earlier than for a zero-mass shell, assuming a quantum of environmental vacuum flux is equally available at that earlier time.

However, we should be careful to frame this change correctly, because the test occurs only when shells touch. Modulation does not allow the event time to shift earlier, but it does permit the collapse of shells that would not have otherwise collapsed.

For example, with positively-signed modulation, shells that were slightly too close to coincide with the Planck quantization of the condition may collapse. Thus:

(1) Shells can collapse at a smaller radius when modulated by the positive mass of another shell. It looks like a [space, time] [dilation, curvature][1,4] where composites and classical accumulations become smaller, like a decreasing Compton or Rydberg radius.
(2) Phase-modulated shells may select a different subset of environmental or structural shells.

We've proposed this as a possible origin for a tiny redshift, alongside a larger redshift caused by vacuum flux density, given a proposed structure for photons in this mechanism.[2] There, we also proposed that the observer could interpret this as distant objects retreating, if the measurement remained unable to resolve Planck-resolution quantizations that provide an absolute reference.

2.2. *Negative modulation case*

For the negatively-signed–mass oscillators on a shell, the waves collapse later than for zero-mass oscillators, so the interaction is later, and more distant from the source, or retarded. This also looks like dilation or curvature.

In the expansion scenario, it results in less dense matter, less dense vacuum flux, and consequently, a less dense gravitational field. Re-applying this to the interactions, in the manner of a chaotic and self-interacting field, this scenario converges to the massless scenario where lambda is zero, rather than being a runaway scenario where lambda results in limitless acceleration.

2.3. *Inherently thermodynamic geodesic*

Because the propagation in this mechanism is inherently thermodynamic, with the null-geodesic of 'no effort' being radial propagation at light speed, we require an *infinite* universe to avoid the scenario of rarification. Such an infinite universe imposes a positive vacuum pressure for infinite space, supporting the vacuum, and preventing evaporation at the boundary of matter in flat space.

A *finite* universe would evaporate in a distillation process, as a black hole would.[3] Confined composites would mostly remain confined, and their probability of decay is decreased with lower vacuum flux to interrupt their reconstitution sequences. Once decayed, their shells are less likely to interact with anything else, remaining as part of the vacuum flux itself, radiating away into the outer void zone of zero matter density.

The final picture of such a finite universe is a non-interacting sparse hollow shell many times the radius of the current observable universe, with the shell thickness corresponding to the time the universe was radiating its individual shells. Some matter may remain within, but its meaningful interactions will be limited, at risk of also evaporating.

This again is different from a universe where a constant lambda causes a controversially paradoxical acceleration that takes matter beyond the speed of light, and also different from where a negative lambda with increasing magnitude eventually causes all matter to evaporate and deconstitute.

Purely confined composites remain unaffected, but these would only be measurable on annihilation or decay. Given the cosmological constant is concerned with the spaces in rarified matter, we think confined composites can be ignored unless they are short-lived.

2.4. *A note on gravitation*

Incidentally, we model the gravitational force as the statistical directional deflection of second-order vacuum interactions: the collapse of vacuum flux with accountable origin from a massive classical body that itself re-radiated the environmental vacuum flux.[3]

3. Quantifying the effects

There are two differences between matter and anti-matter, in terms of their collapse radius:

- The 0.5-cycle phase difference between waves having positive and negative phase modulation (3.1).
- A tiny dilation effect due directly to the phase modulation of one oscillator on the shell of another (3.2).

3.1. *Wave phase*

An oscillator has two waves, separated by $0.25 + \rho$ cycles:[2,4]

- For **matter**, partner waves *lag* by ≈ 0.25 cycles.
- For **antimatter**, partner waves *lead* by ≈ 0.25 cycles.

Treating this as an oscillator, the collapse-triggering wave is the reference wave, with the partner wave as the order term. This determines the sign of both its phase modulation and angular momentum.

Because the waves having $\phi = 0$ are excluded after the fermion event, its first oscillator may collapse with opposite-signed mass and modulation direction. This typically leads to a repeating sequence of alternating matter and antimatter, noting that antimatter-matter-... sequences are an equally valid perspective.

$$\mathbf{A} \to \mathbf{BC} \to (\mathbf{D} = \mathbf{A}), \tag{1}$$

Mass ρ (eq.A.2) modulates the phases of other overlapping waves (rule 5), allowing an oscillator with mass to collapse other oscillators having non-excluded waves with a phase between $-\rho$ and 0 at the point oscillators overlap. We call this a **phase window**.

Positive and negative mass therefore have access to different phase windows of vacuum energy or confined flux. After a weak interaction[2,4] on a shell, both waves of the remaining oscillator are non-excluded, so it carries both signs of phase modulation, for a phase window twice as wide as a single non-excluded wave. This availability enables vacuum flux to flow through fermion networks without the need for intermediate fermions of opposite sign.

3.2. *Modulating dilation*

The absolute dilation effect is straightforwardly the value A or B depending on the mass, in units of l_P, Planck length, with constraints,[3]

$$\begin{aligned} A &\lessapprox 4.0 \times 10^{-18} \\ B &\lessapprox 2.9 \times 10^{-37} \end{aligned} \tag{2}$$

3.3. *Scales and factors*

We can quantify the effect caused by modulations from the mass values of the phase operators A and B as a proportion of interaction radius (Table 1), with the caveat that it's unlikely that any shell can remain uncollapsed for a significant distance in vacuum flux.

Table 1. 0.5 l_P offset and dilations A and B as a proportion of interaction radius.

Scale of interaction	0.5 l_P	Dilation factor A	Dilation factor B
0.25 l_P	2	1.6×10^{-17}	1.6×10^{-36}
0.75 l_P	2/3	5.3×10^{-18}	3.9×10^{-37}
l_P, Planck length	1/2	4.0×10^{-18}	2.9×10^{-37}
1.0×10^{-17}m	8.0×10^{-19}	6.5×10^{-36}	4.7×10^{-55}
1.0×10^{-14}m	8.0×10^{-22}	6.5×10^{-39}	4.7×10^{-58}
1 metre	8.0×10^{-36}	6.2×10^{-53}	4.7×10^{-72}
Galactic	9.8×10^{-57}	7.9×10^{-74}	5.7×10^{-93}
Observable universe	2.9×10^{-63}	2.3×10^{-80}	1.7×10^{-99}

The dilations are small effect, even if we consider the smallest possible scale of interaction.[4] In flat space, it cannot create a runaway acceleration, because the dilations are, at most, 18 orders of magnitude smaller than the next quantization opportunity, so there is no prospect of successive reductions, unless other influences change the spatial configuration in another segment of the cycle. Assuming that phase modulation does not 'write' on collapse, these dilations cannot accumulate as a first or second order change.

4. Further work

(1) Establish the polarity of the mass against matter and antimatter (3.1), and confirm the polarity of phase modulation (Rule 5), to align with the Standard Model and bring the matter/anti-matter asymmetry into more worked scenarios.[2]

(2) Calculate the net macro effect of the modulation, where we know some constraints for the free parameters representing the only necessary mass values of the phase operators (Eq.2).

(3) To complete the previous step, we need to quantify the matter and vacuum environment in terms of the distribution and composition of A and B masses in shells, in the ontological framework of the Standard Model. This is nontrivial, unless we can find a shortcut at a fundamental level, to obtain the net effect that applies macroscopically.

4.1. *Benefits and aims*

(1) Find a reasonable fundamental explanation for the cosmological constant and whether it is a required adjustment.

(2) Use this understanding, along with the mechanism's description of variable vacuum flux, to conjecture more about the evolution of the universe in different local scenarios.

(3) Take this forward as an inflationary influence, to explore the early universe: For example, the 'hot big bang', matter-antimatter polarization, and fermiogenesis.

(4) The matter-antimatter asymmetry outlined in our mechanism should be further explored for measurable effects.

4.2. *Grounds for falsification*

Falsification means disproving a direct connection between the mass phase operator from the lambda term that is the cosmological constant, rather than falsifying our mechanism.

We foresee the following grounds for falsification of this conjecture:

- The requirement for constant vacuum energy density
- No fixed Plank-scale quantization reference with respect to varying measurements corresponding to redshift.

4.2.1. *Requirement for constant vacuum energy density*

Against this conjecture is the requirement for constant vacuum energy density, from standard cosmology. In our mechanism, the vacuum flux is variable, depending on matter density on or behind the world line, because our vacuum comprises solely the flux of uncollapsed radiation shells from earlier fermion events.

Perhaps our mechanism does not require the constraint of constant vacuum energy density, but that would be a bold departure from standard cosmology.

4.2.2. *Availability of Plank-scale quantization reference*

Falsifying the redshift idea[2] requires proving that local measurements do not shrink over cosmological time, against a background of a constant Planck-scale quantization.

A.1. Deterministic rules

The six rules[1] are as follows:

(1) Waves are bound in pairs as oscillators or qubits.

(2) Waves propagate radially, as light speed bosons, having first-order equivalence of phase, distance, and time:

$$d\phi = ds = dt \tag{A.1}$$

(3) Nonunique waves, having the same phase and source, are excluded from interactions.

(4) An oscillator's mass is its elliptical skew:

$$\rho = e^{-i(\phi_B - \phi_A)} \tag{A.2}$$

(5) ρ modulates phase ϕ of other overlapping waves.

(6) Two waves, from different fermions, with $\phi = 0$ at a unique point, collapse their oscillators into a **fermion**.

References

1. J. S. Valentine, Deterministic Impulsive Vacuum Foundations For Quantum-Mechanical Wavefunctions, *The Physics of Reality* 326-335, World Scientific, (2012), `https://doi.org/10.1142/9789814504782_0035`.

2. J. S. Valentine, Minimal Deterministic Physicality Applied to Cosmology, *Unified Field Mechanics* 477-492, World Scientific, (2014), https://doi.org/10.1142/9789814719063_0048.
3. J. S. Valentine, Emergent Vacuum, Gravitation, and Standard Model Structure from Deterministic Mechanics, (2024), https://johnvalentine.co.uk/po8/Valentine-2024-sim.pdf.
4. J. S. Valentine, Planck-scale materials from Modified Deterministic Qubit Mechanics, (2025), https://johnvalentine.co.uk/po8/Valentine-2025-qubit-planck.pdf.
5. J. S. Valentine, Foundations of Physicality with Modified Deterministic Qubit Mechanics, (2026), https://johnvalentine.co.uk/po8/jv2026-physicality.pdf.