

Chapter 1

Scalar Mass Phase Operator from Modified Qubits in Deterministic Physicality

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Using the mechanism from Valentine, which has phase-critical deterministic conditions for collapsing fermions, we examine the effects of the mass phase operator on physical systems. Two expressions are identified: matter-antimatter asymmetry and direct dilations from the phase operator. We approach possible expressions of Lambda-CDM, and the place of gravitation in the unified mechanism with quantum mechanics.

1. Introduction

Since 2012,¹ our papers have started with six rules (A.1), based on information theory,⁵ which we described as necessary for physics to emerge, including the ontology of the Standard Model and an emergent mechanism for gravitation.

Aside from these more obvious effects of this mechanism, there are also emergent features that have small physical effects of:

$$\begin{aligned} & [0.25, 0.75] \pm \rho l_P \\ & \lesssim 4.0 \times 10^{-18} l_P \\ & \lesssim 2.9 \times 10^{-37} l_P \end{aligned} \tag{1}$$

which offer helpful insights in special conditions, of interest to the study of quantum cosmology.

2. Mass as a phase modulator

Rule 2 defines intrinsic mass as an elliptical skew of a qubit-like oscillator,

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

A massless oscillator would have a circular phase picture, where waves of the oscillator are exactly a quarter-cycle apart. The phase spectrum we

proposed to achieve the Standard Model has two free parameters, A and B as the only masses, which give a slight elliptical skew to all oscillators, which have a mass of either A or B . These values have upper constraints as follows, and may be much lower depending on configuration of the vacuum:³

$$\begin{aligned} A &\lesssim 4.0 \times 10^{-18} \\ B &\lesssim 2.9 \times 10^{-37} \end{aligned} \tag{3}$$

2.1. Collapse mechanism

Rules 5 and 6 describe the phase modulation interaction between oscillators and the collapse condition.

- (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**.

Rule 5 implies that the mass of one oscillator shifts the phase of another overlapping oscillator, as a local perturbation at the overlap, and the resulting value is tested in Rule 6.

If the oscillators have nearby but not identical phase, then mass discriminates whether any given pairing of interacting oscillators will collapse. Large masses collapse a wider range of phases in other oscillators. This is a deterministic way of achieving quantum effects such as the excitation of fields into new particles, chaotic self-interaction in systems, or the correspondingly opposite effect, annihilation and decay, or failure to satisfy the collapse condition, which manifests as radiation.

2.2. Mass as a radius, energy, or deconstituting flux

We express the resulting fundamental Standard Model fermion ontology (Table 1), which forms the basis of composite structures, and their masses equivalent to the radius of collapse or flux required to deconstitute the composite.^{2,3}

W and Z bosons, and Higgs/Goldstone bosons we attribute to subsets of oscillators from a fermion event,² and the weak interaction as any collapse that takes an oscillator from a shell, leaving at least one other oscillator uncollapsed, changing the available phase modulations, and therefore the potential of the shell.

Table 1. Properties for fermion generations 1, 2, and 3, using pairs of oscillators to constitute fermions (Rule 6).

Entity	Generation:	3rd	2nd	1st
Quark (A, A)		b, t	s, c	d, u
Lepton (B, A), (A, B)		τ	μ	e
Neutrino (B, B)		ν_τ	ν_μ	ν_e
Collapses oscillators ^a		4	3	2
Collapses non-excluded waves ^a		4–8	3–6	2–4
Collapses oscillators of shell 1 ^a		2	2	1
Collapses oscillators of shell 2 ^a		2	1	1
Collapses weak-broken oscillators ^a		0	1–2	0–2

^a“Collapses...” numbers are counts.

2.3. Vacuum

We describe vacuum as the radiation of past fermion events. This means that the constituents of matter are the same as the constituents of vacuum. Whether an oscillator is currently a fermion or a boson depends on the configuration of the parts and how their elements are unique or common in the system (Table 2), with the fermion state being only an instantaneous condition satisfied by Rule 6. At all times, all oscillators are parts of shells that are bosonic, but only at the collapse event are those waves fermionic.

Table 2. Uniqueness-related properties before, during, and after fermion solutions.

Property	Bosons to collapse	Fermion	Emitted Waves
Position	Ambiguous (many shells)	Unique	Ambiguous (on-shell)
Origin	Multiple points	Collapse point	Common point
Wave phase (collapsing)	Proximate	Identical	Excluded
Wave phase (partner)	Distinct	Unique	Available
Entanglement	Not entangled	Coupled	Entangled

This picture also offers a description of cold dark matter (CDM), as the B mass oscillators, that create an increased vacuum flux around matter. In our ontology, two B mass oscillators may collapse into a neutrino.²

2.4. Modulation effect

In the following, we characterize the effect of a positive modulation and a negative modulation.

2.4.1. 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, implying a smaller collapse radius, 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, selecting a different shell to collapse.

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.

2.4.2. Negative modulation case

For the negatively-signed-mass oscillators on a shell, the modulation sign is the opposite of the positively-signed case. 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.

If this negatively-signed modulation is active for radiating matter, then the matter will have a smaller interaction radius, and as a composite, the

matter will be less dense. If this modulation is active for vacuum, then the vacuum flux will be less dense, and consequently at a statistical level, the vacuum has lower pressure. It also implies a slightly 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 λ is zero, rather than being a runaway scenario where λ results in limitless acceleration.

3. Quantum cosmology

3.1. *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 if we are 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.

These evaporative or distillation effects are evident in our model for black holes,² and also apply for the coherence of particles and composites.

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 λ causes a controversially paradoxical acceleration that takes matter beyond the speed of light, and also different from where a negative λ 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.

3.2. Gravitation

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 (fig.1).²

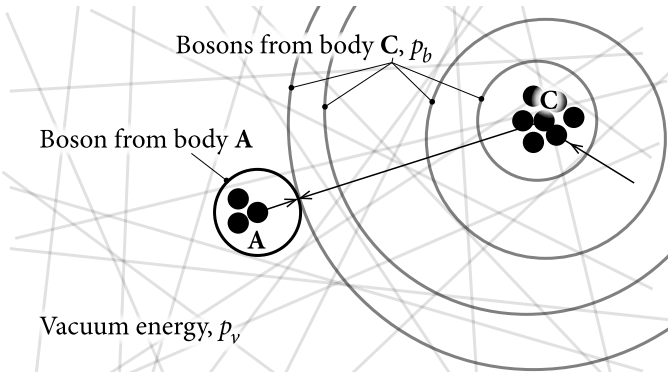


Fig. 1. Directional collapse between two classical sources.

This accounts for gravitation's relative weakness compared to electric, strong, and weak interactions, because it is a directional attribution to redirected vacuum flux from classical bodies of matter.

The gravitational field is equivalent to the flux gradient of the vacuum, and gravitational deflection is a directional statistical bias of collapse events, depending on where the vacuum flux is radiating from.

Because oscillator collapse occurs at the meeting of oscillator shells, both signs of phase modulation still result in gravitational attraction, and negative mass values do not imply repulsion.

Another difference of our mechanism when compared to Newtonian gravitation, is that with some compromises that lose phase in order to create a statistical measure, our function of gravitation with radius has no asymptotes, instead relying on interaction area which diminishes to zero as the radius tends to zero. Accounting again for phase dependence gives us a comb-quantized wavefunction at multiples of Planck length (fig.2).

We therefore approach unification of gravitation and quantum mechanics not as a unified field theory, but as a unified mechanism that is neither,

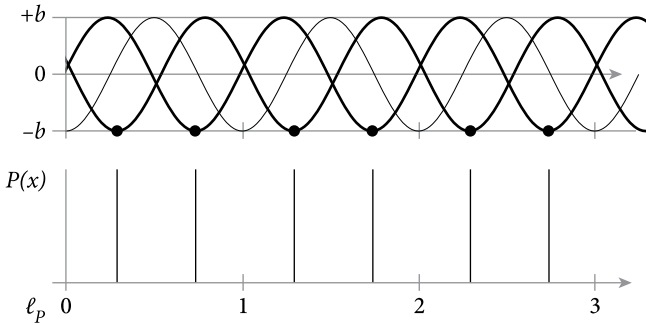


Fig. 2. With two active waves, opportunities interleave, and repeat every cycle.

but can encode both. Because gravitation is an attribution of the same interactions that also collapse quanta and generate the Standard Model ontology and processes, the **unification energy** is simply whatever radius the oscillators can collapse, which is $([0.25, 0.75] \pm \rho + n) l_P$.⁴

3.3. Black holes

This picture models black holes as such collections of matter. Near black holes, flux effects are extreme but are not a singularity, and escape is improbable rather than impossible.

Such a gravitational flux may be screened by the black hole itself, and the nearby vacuum can have lower flux (energy) than the vacuum of ordinary space.² We also find accretion bands, and processes for distillation and evaporation, agreeing with information-theoretic ideals of conserving information but not structure.

In our case, we separate fermions into their constituent oscillators, conserving information as oscillators while not conserving the identities and constitutions of the fermions.² This is possible because our fermions are not fundamental, but comprise oscillators in special coupling and uniqueness configurations. An oscillator and its waves are the fundamental conserved units.

4. The size of phase 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 neg-

ative phase modulation (4.1).

- A tiny dilation effect due directly to the phase modulation of one oscillator on the shell of another (4.2).

4.1. 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 (fig.3, eq.4), noting that antimatter-matter-... sequences are an equally valid perspective.

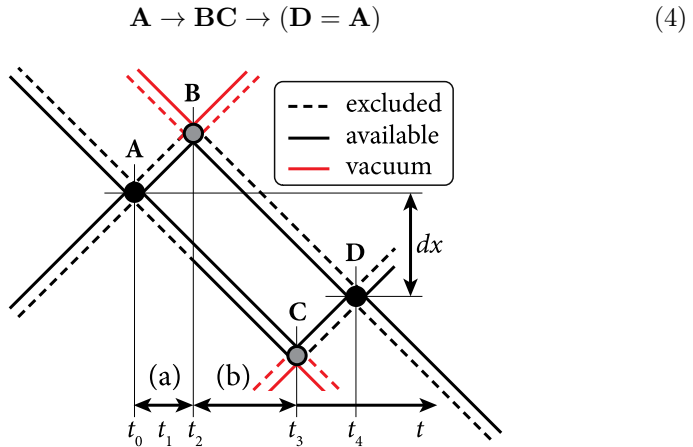


Fig. 3. The propagation of a conserved fermion from **A** to **D**. Each line is a wave; each pair of lines is an oscillator, as a boson.

Mass ρ (eq.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.

4.2. Modulating dilation

The absolute dilation effect is straightforwardly the value A or B depending on the mass.

4.3. 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 3), with the caveat that it's unlikely that any shell can remain uncollapsed for a significant distance in vacuum flux.

Table 3. $0.5 l_P$ 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 a relatively 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.

5. Phase spectra of vacuum flux

Because the phase is critical to fermion collapse, quantifying the effect of modulation relies on knowing the availability of waves at any given phase: the more flux at that phase, the greater the probability of collapse. We have yet to determine the phase spectrum of vacuum relative to nominal matter oscillators.

From the perspective of a fermion event, its phases are trivial:

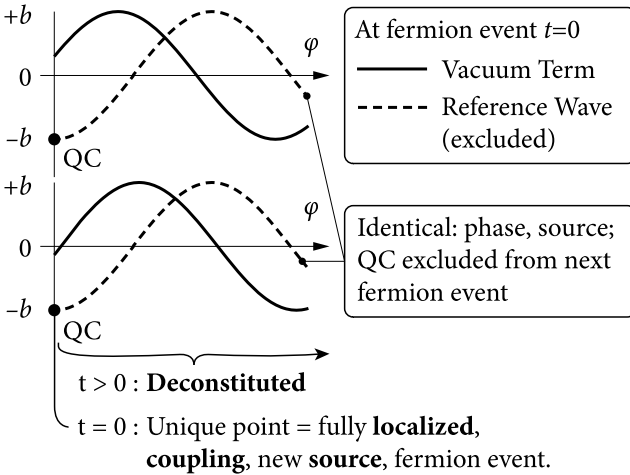


Fig. 4. M.

- Two reference waves from different oscillators, with a phase value of 0. This comes with a small assumption that the modulated phase becomes 0 at the fermion event, when it was non-zero pre-modulation.
- A partner waves, from each of the oscillators that collapsed. These each have a unique value from $\pm[A, B]$, because A and B are the only available mass values.
- There may be more waves for higher-generation fermions.²

As the shell propagates, it meets other oscillators. It will collapse at the first meeting point where the quantization condition is met. The shells at that point collapse, and that new fermion radiates from the new point.

To meet the quantization condition, both shells need to have wave that passes $\phi = 0$ with a modulation from the other shell.

To create a phase-critical function of the probability of collapse, we need to know how much vacuum flux there is at a particular phase.

5.1. Profiles for vacuum

We have not yet profiled the phase spectrum of our local vacuum. Initial options are as follows, or a profile we haven't yet thought of:

Table 4. Considered vacuum profiles.

Name	Phases
Matter exact	$[-0.25, 0, +0.25]$
Matter spread	$[-0.25, 0, +0.25] \pm s$
Matter ring	$[-0.25, 0, +0.25, +0.5]$
Matter ring spread	$[-0.25, 0, +0.25, +0.5] \pm s$
Homogeneous	$[-0.5...0.5]$

5.1.1. Matter exact (eliminated)

All matter waves are synchronous, with matter fermions only at phase 0, and partner waves at -0.25 and $+0.25$ phase.

We discount this scenario, because our rules need a spread of phases for there to be slightly out-of-phase waves available when mass modulates them into the collapse condition, for mass to have a measurably different behavior.

5.1.2. Matter spread

Wave phases are clumped around phases 0, -0.25 , and $+0.25$, with some spread, so that modulation collapses oscillators that a zero-mass oscillator could not. For this scenario, we would need justification for the distribution, likely a modification to the phase 'written' at a fermion on modulation.

5.1.3. Matter ring

Wave phases also include 0.5, and waves can interact in phase rings, which implies that oscillators with waves at phase 0 can directly access only two of the four phases available, and only those two phases can access the fourth phase. All parts of the cycle are as fundamental as the other, and we'd need to quantify how those other phases manifest.

In this picture, as well as the matter at phase 0, matter exists also at phase 0.5, mediated by the antimatter at -0.25 and 0.25 .

5.1.4. *Homogeneous*

Wave phases are homogeneous through the phase cycle. This implies that there is much more matter and vacuum flux in parallel phases that we cannot access directly, by a factor of $1/A$ and $1/B$. For example, for the quark-like A masses, there are maximally 2.5×10^{17} unipolar layers, or 1.25×10^{17} bipolar layers, mediated by interleaving layers.

To validate this profile requires us to find evidence of hidden structure in adjacent layers and infer the deeper layers.

5.2. *Modulation functions*

In earlier work, we identified open design parameters, concerning whether phase modulation remains a temporary and local operator, or whether the modulated value is committed to the collapsed fermion event.

This affects how particles may migrate through phase to leave a system, or return. While away, these particles will be unable to directly interact with the reference system. Such a scenario presents challenges observationally proving the existence of matter that cannot be directly observed.

Committed modulation also affects exclusion, in cases where the collapse condition is met from both positive and negative modulations, such that the reference waves are not at identical phase, and therefore waves are not excluded, changing the weak interaction into one of eliminating phases rather than replacing phases due to a removal of oscillators and lack of exclusion.

6. Further work

- (1) Establish the polarity of the mass against matter and antimatter (4.1), 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.3).
- (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) Eliminate the design parameters around committing phase modulation to the fermion event, and explore the resulting universe in terms of observable and unobservable content.
- (5) Propose a modified process for the distillation and evaporation of black holes,² based on the probabilities caused by phase modulation. This should show a matter/antimatter asymmetry in the ordering of evaporated oscillators, with a bias towards negative-modulated oscillators escaping before positive-modulated oscillators.

6.1. *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.

6.2. *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.

6.2.1. *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.

6.2.2. Availability of Planck-scale quantization reference

Falsifying the redshift idea² 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 rules¹ 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**.

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