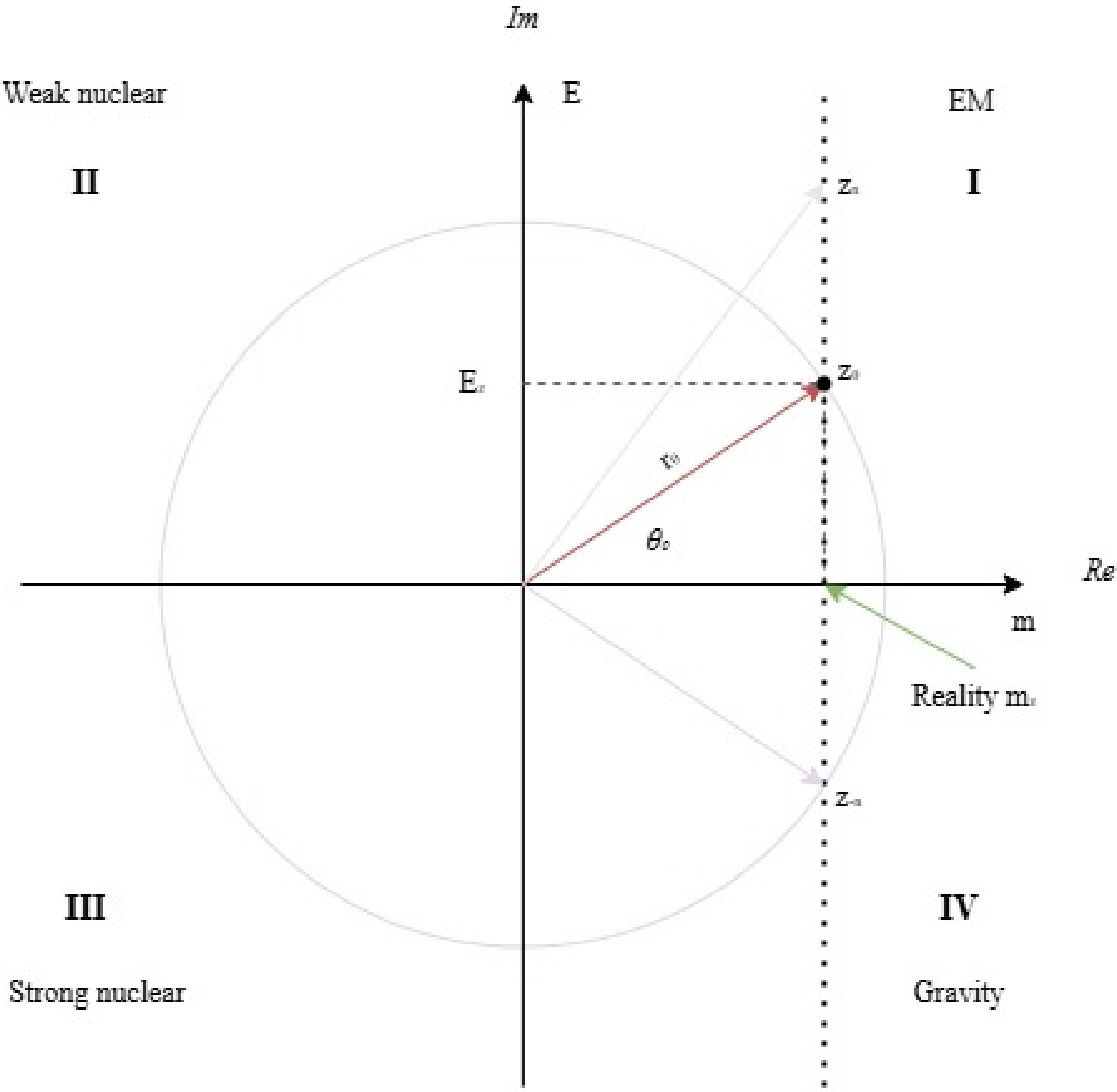
EMTS

Energy, Mass, Time, Space



Compiled on January 3, 2026

To life.

Contents

License

Preface

In scientific discovery, pure mathematics often serves as the bedrock of our understanding of the universe. This essay is my attempt to develop, in real time with AI, an idea that has echoed in my mind for years. It is a perspective, not a declaration, and simply asks, *what if?*

> Don’t think it doesn’t make sense; ask yourself what sense it could have.

First, a mathematical framework is defined that ties Energy, Mass, Time and Space (EMTS), then speculates how the framework could fit with our knowledge.

Giancarlo Trevisan

Visualize then Realize!

Part I

Foundations

Chapter 1

The Complex Plane

The connection between the complex plane and reality becomes especially significant when we consider the origins and applications of imaginary numbers. Historically, the introduction of imaginary numbers emerged from attempts to solve cubic equations, as first systematically explored by Gerolamo Cardano in the 16th century. Cardano discovered that even when all solutions to a cubic equation were real, the algebraic process sometimes required passing through intermediate steps involving the square roots of negative numbers—quantities that had no clear interpretation at the time.

This mathematical curiosity turned out to be much more than a formal trick. The development of complex numbers enabled mathematicians and physicists to describe phenomena that could not be captured by real numbers alone. A profound example is the discovery of electromagnetic waves. In the 19th century, James Clerk Maxwell formulated his famous equations, which describe how electric and magnetic fields propagate and interact. The solutions to Maxwell's equations are most naturally expressed using complex exponentials, where the imaginary unit i encodes oscillatory behavior—essential for describing wave phenomena such as light and radio waves (see Maxwell's equations[**?**]).

Thus, imaginary numbers are not merely abstract constructs; they are indispensable tools for modeling and understanding the physical world. Their use reveals that reality possesses layers and symmetries that extend beyond direct sensory perception, hinting at a deeper mathematical structure underlying the universe. The complex plane, therefore, is not just a mathematical convenience but a window into the hidden fabric of nature.

The complex plane, a mathematical construct that allows us to visualize complex numbers as points in a two-dimensional space. In this plane, the horizontal axis represents the real numbers, while the vertical axis represents the imaginary numbers. For our purposes, we will map mass onto the real axis and energy onto the imaginary axis. Why this choice? Well, mass seems more real than energy from my point of view (feel free to swap). With this picture in mind, let's pick a point z_0 on the complex plane and dive into its possible implications.

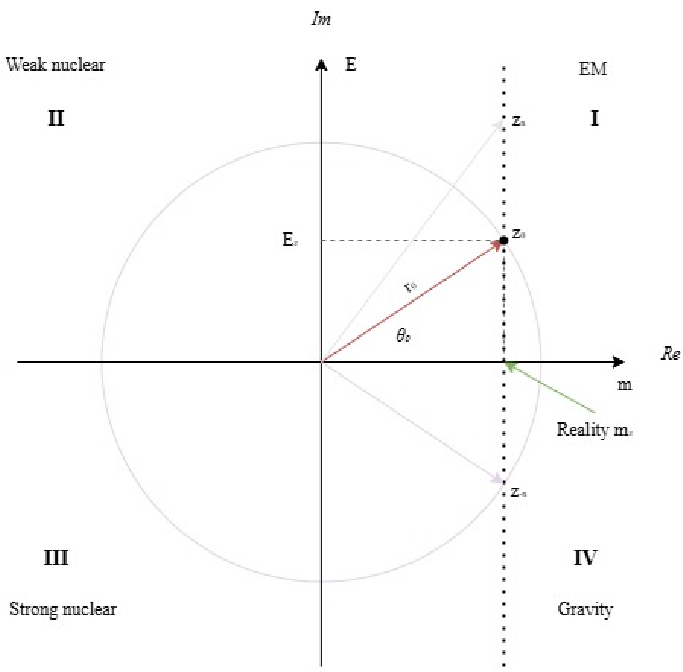


Figure 1.1: Complex plane illustration. m_z is what we perceive at time θ_0 and space r_0.

Chapter 2

Polar Representation and Its Implications

Mapping mass and energy in the complex plane broadens our perspective on physical reality. Consider a point z expressed in polar form:

$$z = r(\cos\theta + i\sin\theta).$$

Here r is the modulus and θ the argument. Assign physical meaning to r and θ:

Modulus r (Unified Magnitude).

$$r = \sqrt{(mc^2)^2 + E^2} \quad \text{or} \quad r = \sqrt{m^2 + \left(\frac{E}{c^2}\right)^2}.$$

Argument θ (Unified Phase).

$$\theta = \arctan\left(\frac{E}{mc^2}\right).$$

Space and Time. Interpret $\theta = \omega t$ with $E = \hbar\omega$. Then probabilities or densities linked to projections oscillate with ω. The projection $m_z = \Re(z) = r\cos\theta$ can repeat with period 2π even as the underlying phase history differs.

Projection as Measurement. With the unit vector $|\psi\rangle = \cos\theta\,|m\rangle + i\sin\theta\,|E\rangle$, a mass measurement uses P_m and yields $\mathbb{P}(m) = \cos^2\theta$, mirroring $m_z = r\cos\theta$. Standard treatments of such two-level mappings can be found in Griffiths[**?**].

Chapter 3

Hermitian Operators on a Hilbert Space

Let $H = \mathbb{C}^2$ with basis $\{|m\rangle, |E\rangle\}$. A normalized state is

$$|\psi\rangle = \cos\theta\,|m\rangle + i\sin\theta\,|E\rangle, \qquad \langle\psi|\psi\rangle = 1.$$

Observables A are Hermitian with spectral decomposition $A = \sum_k a_k P_k$. Measurement of a_k occurs with probability $\langle\psi|P_k|\psi\rangle$ and the post-measurement state is $P_k|\psi\rangle/\sqrt{\langle\psi|P_k|\psi\rangle}$.

For a "mass" measurement, $P_m = |m\rangle\langle m|$, so $\mathbb{P}(m) = \cos^2\theta$, echoing the geometric projection $\Re(z) = r\cos\theta$.

Unitary evolution with $H = \frac{\hbar\omega}{2}\sigma_y$ yields $\mathbb{P}(m,t) = \cos^2(\omega t)$, bridging to $\theta = \omega t$.[?]

Chapter 4

The Quadrants and Their Implications

Let the pre-measurement state be $z(t_0) = re^{i\theta_0}$. A projection onto the real axis yields $m_z = r\cos\theta_0$. Hypothesis: the interaction channel observed in spacetime is tagged by the pre-collapse quadrant of $z(t_0)$.

- Quadrant I ($0 < \theta_0 < \frac{\pi}{2}$): Electromagnetic
- Quadrant II ($\frac{\pi}{2} < \theta_0 < \pi$): Weak
- Quadrant III ($\pi < \theta_0 < \frac{3\pi}{2}$): Strong
- Quadrant IV ($\frac{3\pi}{2} < \theta_0 < 2\pi$): Gravitational

With phase windows $W_f(\theta)$ and coupling $g(\theta, r)$, a cycle-averaged strength at radius r is

$$\bar{g}_f(r) = \frac{\omega(r)}{2\pi} \int_0^{2\pi} W_f(\theta)\, g(\theta, r)\, d\theta.$$

Part II

Framework and Mechanics

Chapter 5

Standard Model

In quantum theory, the state encodes probabilities.[**?**] In this framework, oscillations with frequency ω link to detection likelihoods. Particle vs. wave is reconciled: coherent evolution (*wave*) sets channel rates, while projection events (*particles*) are localized outcomes.

Particle vs. Wave

- **State vector**: carries phase and interferes.
- **Measurement**: projects to outcomes with Born probabilities.
- **Field view**: particles are quantized excitations; waves are coherent field amplitudes.

With $z(t) = re^{i\theta(t)}$, $\dot{\theta} = \omega$, and windows $W_f(\theta)$, a minimal rate model is

$$R_f(r) = \frac{\omega}{2\pi} \int_0^{2\pi} W_f(\theta)\, g(\theta, r)\, d\theta.$$

Quarks in the complex plane

In the EMTS picture we write a generic excitation as

$$z = m + iE = re^{i\theta},$$

with r encoding a space-like scale and θ encoding a time-like phase. Quarks can be viewed as excitations whose complex-plane behaviour is constrained by threefold structure:

- **Colour charge** corresponds to how the excitation winds in an internal copy of the complex plane, with three preferred phase orientations ("red, green, blue") in an $SU(3)$-like subspace.
- **Confinement** arises because a single quark's complex trajectory cannot close in the observable m–E plane; only colour-neutral combinations lead to closed orbits and stable projections.
- **Flavour** (up, down, strange, etc.) is tied to distinct radii r and characteristic angular frequencies ω, leading to different effective masses and couplings.

In this view, quarks occupy specific bands in r and families of allowed phase patterns in θ, with hadrons emerging as composite closed paths whose joint projection appears as a single particle.

Leptons as simpler orbits

Leptons lack colour charge and so correspond to simpler trajectories on the same complex plane. Their key properties emerge from how their paths relate to the real and imaginary axes:

- **Charged leptons** (electron, muon, tau) follow orbits with a nonzero average real projection $\langle m_z \rangle$, giving rest mass, while their interaction with the electromagnetic field shifts θ and modulates E.
- **Neutrinos** are nearly lightlike: their trajectories lie close to the imaginary axis, with very small m but nontrivial phase evolution, which can support flavour oscillations as slow precessions between nearby orbits.
- **Generations** correspond to nested shells in r with similar angular patterns but different characteristic frequencies, reflecting the mass hierarchy without changing the basic complex geometry.

Leptons thus occupy cleaner, less composite regions of the complex plane, making them ideal probes of how m and E trade off along a single worldline.

Forces as phase symmetries

Forces in the Standard Model act by reshaping or constraining motion on the complex plane rather than by pushing in ordinary space alone. We can sketch them as follows:

- **Electromagnetism** tracks changes in the global phase of charged trajectories. A $U(1)$ gauge transformation is a shift $\theta \mapsto \theta + \alpha$, leaving r fixed but altering interference patterns and detection rates.
- **Weak interactions** mix components of z associated with different leptonic and quark flavours. Geometrically this can be pictured as rotations between nearby orbits in a multi-dimensional complex space, with massive gauge bosons mediating large, localized phase jumps.
- **Strong interactions** constrain colour phases so that only colour-neutral combinations yield closed, low-action paths. Gluon exchange continually rewires how individual quark trajectories share a joint complex-phase structure inside hadrons.

All three gauge forces can be summarised as rules about which deformations of the complex trajectory $z(t)$ leave physical rates invariant and which cost action, echoing the role of symmetries and gauge fields in the usual Standard Model.

A unified placement

In summary, the complex plane provides a common stage:

- **Quarks** occupy structured, colour-charged orbits whose composites form closed, observable paths.
- **Leptons** trace cleaner, single-particle trajectories distinguished mainly by radius and frequency.

- **Forces** appear as symmetries and constraints on allowed deformations of these complex paths.

This speculative mapping does not replace the field-theoretic Standard Model,[**?**] but it offers a geometric intuition: all fundamental matter and forces inhabit different patterns of motion and symmetry on an underlying complex m–E plane.

Chapter 6

Mapping Reality

Reality can be viewed as the projection of z onto the real axis, bridging abstract complex structure and tangible phenomena. Particles are points tracing oscillatory motion; forces emerge as structured relations across quadrants; spacetime geometry echoes these mathematical ties.

Chapter 7

Quantum Properties on the Complex Plane

Quantum behaviour can be reframed in the EMTS picture where $z = m + iE = re^{i\theta}$, with r linked to space and θ to time, as introduced in part1-foundations/polar-representation.tex and part1-foundations/hermitian-operators.tex. Projection to the real axis encodes what is classically observed, while the full complex motion remains hidden but dynamically essential.

7.1 Wave–particle duality as rotating projection

Take a single point $z(t) = re^{i\theta(t)}$ with $\theta(t) = \omega t$. The real projection

$$m_z(t) = \Re z(t) = r\cos\theta(t)$$

oscillates, while discrete detection events correspond to sampling m_z at particular θ and locations in r. The "wave" is the smooth, complex rotation; the "particle" is the localized real-axis readout.

When several paths $z_k(t)$ are allowed, they add in the complex plane before projection:

$$z_{\text{tot}}(t) = \sum_k z_k(t).$$

Interference patterns arise because $\Re z_{\text{tot}}$ depends on relative angles θ_k, not just moduli r_k, mirroring standard complex-amplitude interference from part2-framework-mechanics/standard-model.tex.

7.2 Superposition as geometric addition

A superposed state of two alternatives A and B becomes a vector sum

$$z = \alpha z_A + \beta z_B,$$

with $\alpha, \beta \in \mathbb{C}$ encoding weights and phases. Only after projection does one obtain an outcome associated with z_A or z_B, analogous to

$$|\psi\rangle = \cos\theta\,|m\rangle + i\sin\theta\,|E\rangle$$

in part1-foundations/hermitian-operators.tex. The angle between z_A and z_B in the plane governs constructive or destructive interference in $\Re z$, giving a geometric visualization of the Born rule.

7.3 Uncertainty as phase–projection complementarity

If reality is read off as the real projection $m_z = r\cos\theta$, then sharp knowledge of m_z constrains θ to narrow windows where m_z takes that value. Conversely, if θ is highly delocalized over $[0, 2\pi)$, many different m_z values are sampled.

Formally, treat θ as an angle on a circle and its conjugate as an integer winding number n (counting how many 2π cycles the phase accumulates). Angle–number pairs satisfy an uncertainty relation of the form

$$\Delta n\,\Delta\theta \gtrsim \tfrac{1}{2},$$

which mirrors $\Delta E\,\Delta t$ once E is tied to angular frequency via $E = \hbar\omega$. In EMTS, the spread in θ (time-like phase) and the spread in m_z (measured mass-like projection) are thus inherently linked, explaining why precise localization in one degrades certainty in the other.

7.4 Quantization from closed-orbit conditions

Quantization appears naturally if allowed states correspond to closed or resonant trajectories on the complex circle. Requiring that after an evolution period T the point returns to itself,

$$\theta(T) - \theta(0) = 2\pi n, \qquad n \in \mathbb{Z},$$

imposes discrete conditions on ω and hence on $E = \hbar\omega$. More generally, demanding single-valuedness of $\Psi(r, \theta)$ on S^1_θ—as in the phase space discussed in part4-future/theory-of-everything.tex—forces integer winding numbers and a tower of allowed modes. The complex circle then acts as a geometric origin for energy levels and other quantized spectra.

7.5 Entanglement as correlated complex geometry

For two subsystems A, B with points $z_A = r_A e^{i\theta_A}$ and $z_B = r_B e^{i\theta_B}$, an entangled state can be represented by a joint amplitude $\Psi(z_A, z_B)$ on the product of two complex planes, as developed in part3-implementation/entanglement.tex. A simple form,

$$\Psi(z_A, z_B) \propto e^{im(\theta_A - \theta_B)},$$

locks their phase difference while leaving the common angle free. Measurements project each point separately to the real axis, but correlations in outcomes reflect the underlying constraint on (θ_A, θ_B) and hence on (m_{z_A}, m_{z_B}).

In this view, entanglement is not mysterious action at a distance but a single geometric object on (z_A, z_B) space whose projections on separate real axes remain correlated even when r_A and r_B are widely separated.

7.6 Summary

Wave–particle duality, superposition, uncertainty, quantization, and entanglement all become features of how complex points move, add, and close on the EMTS plane, and how partial projections slice this richer geometry into the classical realities we observe.

Part III

Implementation

Chapter 8

Entanglement on the Complex Plane

8.1 Framing EMTS variables for entanglement

If EMTS takes physical events as points on the complex plane $z = r\, e^{i\theta}$, with r encoding space and θ encoding time, then two-system entanglement can be modeled on pairs (z_A, z_B) by building joint states and correlators that respect EMTS' polar structure. In this view, time has two aspects: a monotone history variable (global θ-translation) and a periodic phase (modulo 2π), which naturally invites resonance phenomena and Floquet-like behavior in θ space.

8.2 A minimal mathematical insertion

8.2.1 State, reduction, and θ-symmetry

- **Global state:** Let $|\Psi\rangle$ live on a Hilbert space over EMTS points; for two subsystems A, B at $z_A = r_A e^{i\theta_A}$, $z_B = r_B e^{i\theta_B}$, write the joint amplitude $\Psi(z_A, z_B)$.[**?**]
- **Entanglement test:** Compute $\rho_A = \mathrm{Tr}_B\, |\Psi\rangle\langle\Psi|$ and a measure $S_A = -\mathrm{Tr}(\rho_A \log \rho_A)$ (or a negativity). Entanglement is present iff ρ_A is mixed.
- **θ-translation invariance:** If dynamics and initial conditions are invariant under simultaneous shifts $\theta_A \to \theta_A + \alpha$, $\theta_B \to \theta_B + \alpha$, then any entanglement measure depends only on the phase difference $\Delta\theta = \theta_A - \theta_B$ and the radii (r_A, r_B), not on absolute θ (stationarity):

$$\partial_\Theta S_A = 0, \quad \Theta = \tfrac{1}{2}(\theta_A + \theta_B).$$

8.2.2 Interaction kernels on the complex plane

- **Phase-sensitive coupling:**

$$H_{\text{int}} = \lambda\, f(r_A, r_B)\, \cos(\Delta\theta - \phi_0)\, \hat{O}_A \otimes \hat{O}_B,$$

  which entangles A and B when $f \neq 0$. The $\cos(\Delta\theta)$ factor makes phase relations explicit; ϕ_0 sets a preferred phase alignment.

- **Holomorphic form (optional):**

$$H_{\text{int}} = \lambda\, g(z_A, z_B)\, \hat{O}_A \otimes \hat{O}_B + \text{h.c.},$$

  with g holomorphic to ensure Cauchy–Riemann compatibility in EMTS. This yields entanglement protected along contours of constant argument or modulus depending on g.

8.3 Resonance as phase-locking in θ-time

- **Phase-locked entanglement:** If time has a periodic component, entanglement can strobe at resonant phase differences. With a drive of frequency ω on θ, stroboscopic evolution produces
$$U_F = e^{-iH_{\text{eff}}T}, \quad T = \tfrac{2\pi}{\omega},$$
and entanglement peaks when $\Delta\theta$ satisfies locking conditions (e.g., $\Delta\theta \approx \phi_0 \bmod 2\pi$).

- **Growth vs. invariance:** In generic (chaotic) dynamics, entanglement exhibits universal growth and saturation patterns (e.g., area-law to volume-law crossover with velocity v_E). "Entanglement is independent of time" can be realized when the initial state and generator are θ-stationary so only $\Delta\theta$ matters, or when a resonance creates steady phase-locking so the entanglement measure becomes θ-periodic and effectively constant under coarse graining.

8.4 Time independence and projection on the real axis

- **Projection choice matters:** If "projected on the real axis" means evaluating observables at fixed θ (equal-time slice), entanglement reduces to a function of radii and their separation along r, i.e., $S_A = S_A(r_A, r_B, \Delta\theta)$ with $\Delta\theta = 0$. With θ-translation invariance, this yields entanglement profiles depending only on spatial relations in r.

- **Integrating out θ:** Alternatively, integrating phases (or averaging over Θ) leaves phase-invariant correlators:
$$\overline{C}(r_A, r_B) = \frac{1}{2\pi}\int_0^{2\pi} d\Theta\; C\big(r_A e^{i(\Theta+\Delta\theta/2)},\, r_B e^{i(\Theta-\Delta\theta/2)}\big).$$

8.5 Testable consequences and a concrete ansatz

8.5.1 A simple EMTS entangled pair

$$\Psi(z_A, z_B) = \frac{1}{\sqrt{2}}\Big[\phi_0(r_A)\phi_1(r_B)\, e^{im(\theta_A-\theta_B)} + \phi_1(r_A)\phi_0(r_B)\, e^{-im(\theta_A-\theta_B)}\Big].$$

- **Label:** m is a winding in $\Delta\theta$; $\phi_{0,1}$ control localization in r.

- **Property:** Entanglement is maximal and independent of Θ; tuning m sets resonance channels in $\Delta\theta$.

8.5.2 Dynamics with resonance

Use $H_{\text{int}}(t) = \lambda(t)\, f(r_A, r_B)\cos(\Delta\theta - \phi_0)\, \hat{O}_A \otimes \hat{O}_B$ with $\lambda(t+T) = \lambda(t)$. Predict:

- **Locking:** Stable entanglement plateaus at $\Delta\theta \approx \phi_0$.

- **Velocity bounds:** Expect entanglement growth bounded by an effective v_E and shaped by a "line tension," analogous to results in Floquet and chaotic circuits.

- **Equal-θ slices:** On $\Delta\theta = 0$, entanglement reduces to spatial profiles along r.

8.6 Bridge to EMTS geometry

8.6.1 Core translation

Any normalized two-level state can be written

$$|\psi\rangle = \cos\theta\,|m\rangle + i\,\sin\theta\,|E\rangle,$$

so the geometric angle θ from $z = re^{i\theta}$ becomes the parameter in the quantum superposition. Measurements use projectors like $P_m = |m\rangle\langle m|$ giving $P(m) = \cos^2\theta$. A simple Hamiltonian $H = (\hbar\omega/2)\,\sigma_y$ rotates probability between $|m\rangle$ and $|E\rangle$ at angular frequency ω.[**?**]

8.6.2 Link to the geometry

The real-axis projection in the complex picture becomes applying P_m in Hilbert space; "collapse" corresponds to projecting z to $\mathrm{Re}(z)$ and normalizing. The radial coordinate r controls overall scale but is factored out in quantum normalization.

Chapter 9

Feynman Diagrams on the Complex Plane

Let's reinterpret Feynman diagrams in this framework. Instead of drawing them in the usual spacetime coordinates, plot each particle's "state vector" $z = m + iE$ in the mass–energy plane, with radius r linked to space and angle θ linked to time. Each line in a diagram becomes a curve

$$\gamma(\lambda) : [0,1] \to \mathbb{C}, \qquad \gamma(\lambda) = r(\lambda)e^{i\theta(\lambda)},$$

with λ a path parameter. External legs are *open* curves, anchored to asymptotic "in" and "out" states, while internal lines and loops can form *closed* or self-intersecting curves that encode virtual processes.

9.1 Particles as trajectories in the plane

- **External legs:** Each external particle is an open curve in the complex plane from an initial z_i to a final z_f, representing how its mass–energy configuration evolves between preparation and detection.
- **Massive vs. massless:** Massless particles (photons, gluons) follow paths hugging the imaginary axis; massive particles trace tilted paths with significant real component.
- **Neutrinos:** Almost vertical lines near the imaginary axis, with tiny real offset.
- **Quarks:** Confined loops in the strong-force quadrant, never escaping to free-particle regions.

In this picture, a conventional Feynman diagram is not just a graph of lines and vertices but a collection of curves $\{\gamma_i\}$ drawn on the same complex plane, meeting at junctions that enforce complex conservation laws.

9.2 Vertices as junctions of complex vectors

A vertex is a point where several z-vectors meet, and complex-vector conservation applies:

$$\sum_{\text{in}} z = \sum_{\text{out}} z.$$

The quadrant in which the vertex sits indicates the mediating force (e.g., EM, weak, strong).

9.3 Propagators as arcs or spirals

- **Massive propagator:** Spiral with both radial and angular change (space and time evolution).
- **Massless propagator:** Pure angular advance at fixed radius (lightlike).
- **Virtual particles:** Paths that wander into "unphysical" quadrants or cross branch cuts; their projection on the real axis may be zero or negative.

Each propagator thus corresponds to a family of admissible curves between two points z_a and z_b. In a path-integral spirit, the physical amplitude weights these curves by a phase factor depending on the "action" along the path in the complex plane.[**?**]

9.4 Curves and amplitudes

For a given scattering process, standard quantum field theory assigns an amplitude by summing over all compatible Feynman diagrams. In the complex-plane view, this becomes a sum over classes of curves:

$$\mathcal{A}_{\text{process}} \sim \sum_{\text{diagrams}} \sum_{\{\gamma_i\}} e^{iS[\{\gamma_i\}]},$$

where the action functional $S[\{\gamma_i\}]$ depends on how the curves wind, which quadrants they traverse, and how they meet at vertices. Open curves carry the quantum numbers of external particles, while closed curves (loops) encode vacuum fluctuations and radiative corrections.

In this hypothesis, momentum conservation and on/off-shell conditions translate into geometric constraints on allowed curve shapes and endpoints in the m–E plane. Different diagram topologies then correspond to different homotopy classes of curve-collections, offering a topological handle on selection rules and interference.

9.5 Loops and quantum corrections

Loop diagrams in QFT become closed loops in the complex plane.[**?**] The winding number of the loop can correspond to a conserved quantum number (charge, baryon number). Divergences may appear as loops that shrink toward the origin $z = 0$, requiring renormalization as a deformation away from the singularity.

9.6 Example: Electron–neutrino scattering

- **Initial state:** Electron z_e in Q4 (positive mass, negative binding energy), neutrino z_ν near imaginary axis.
- **Vertex:** Weak-force quadrant (Q2), where a W boson is exchanged.
- **Propagator:** W boson path arcs from electron's z to neutrino's z, crossing the imaginary axis.
- **Final state:** New z positions for outgoing electron and neutrino, conserving the complex sum.

9.7 Why this is interesting

- **Unified conservation:** Mass and energy conservation become one complex equation at each vertex.
- **Virtuality geometry:** Off-shell particles are "off-axis."
- **Topological insight:** Winding numbers and quadrant crossings give visual handles on selection rules and forbidden processes.

Chapter 10

Periodic Table Analogy

Could the EMTS framework play a role similar to the periodic table in hinting at missing pieces? The periodic table worked because its arrangement was a geometry of relationships; gaps were structural necessities. The complex-plane paths and diagram reinterpretations have similar potential if the geometry demands certain configurations.

10.1 How unknowns could emerge

10.1.1 Topology demands missing states

If winding numbers, quadrant crossings, or density-dependent phase rules are strict, certain interaction vertices only balance if a missing z-vector exists. That vector could correspond to an undiscovered particle, a new interaction, or a composite state.

10.1.2 Symmetry completion

If the diagram set respects a symmetry (rotational in θ, reflection across axes), incomplete multiplets stand out—like polygons in the complex plane with a missing vertex.

10.1.3 Forbidden gaps as clues

Absence of a path can be telling: if quadrant transitions are allowed by geometry but never observed, that could indicate a hidden law or a very heavy/weakly coupled particle.

10.1.4 Density–phase resonance

With $\omega(\rho)$ tied to density, there may be resonant densities where paths close neatly in θ after an integer number of 2π cycles. Gaps in a resonance sequence suggest missing states.

10.2 What this could predict

New neutrino-like states, exotic hadrons, force carriers (dark photon), or leptoquarks could fill geometric gaps implied by closure rules and symmetries.

10.3 How to search

Catalogue known particles in (m, E, r, θ), map interaction paths, look for incomplete geometric patterns, and infer the missing z: its quadrant, radius, and phase give mass, energy, and coupling hints.

Chapter 11

Chemical Activation Analogue

This section borrows the logic of chemical activation diagrams and transplants it into the mass–energy–phase plane.

11.1 Analogy

In chemistry, an activation diagram plots potential energy vs. reaction coordinate. Here, the "reaction coordinate" is a path in (r, θ): initial $z_i = r_i e^{i\theta_i}$, final $z_f = r_f e^{i\theta_f}$, and a barrier as a dynamically disfavoured region.

11.2 Activation mass–energy

The activation energy becomes an activation mass–energy: the extra $|z|$ or angular displacement needed to connect two states.

11.3 Manipulating mass/energy

- **Catalysis analogue:** Introduce an intermediate path bending through a quadrant with a lower barrier; mediators or fields change the allowed trajectory so the peak $|z|$ is smaller.
- **Phase-assisted transitions:** Because θ is cyclic, one can wrap around instead of going straight over, akin to tunnelling.
- **Density-tuned activation:** If $\omega(\rho, r)$ changes effective heights, altering local density can lower the barrier via phase-resonance.

11.4 Diagrammatic representation

Plot total $|z| = r$ vs. path length along (r, θ); different complex-plane paths yield different activation curves.

11.5 Formalization

Define an activation functional for a path γ:

$$\mathcal{A}[\gamma] = \max_{s \in \gamma} \left[r(s) - \min(r_i, r_f) \right],$$

and search for paths minimizing $\mathcal{A}$ subject to complex-plane conservation laws. Catalysts, fields, or density changes are deformations of $U(r, \theta)$ that reduce $\mathcal{A}$.

Part IV

Future Directions

Chapter 12

Philosophy

The interactions of mathematical entities in the complex plane can be seen as the underlying structure of reality itself. This perspective suggests the universe is a coherent system governed by intricate mathematical relationships. By unifying space and time through the complex plane, mass and energy become orthogonal projections of a single structure, inviting reconsideration of traditional boundaries between disciplines and pointing to new avenues for discovery.

Chapter 13

Toward a Theory of Everything

We let the state live on spacetime times a cyclic phase, and evolve by an operator that ties curvature, gauge forces, and the θ-phase that mixes mass and energy, in the spirit of relativity[**?**] and quantum field theory.[**?**]

13.1 State and geometry

Configuration $\mathcal{M} \times S^1_\theta$ with Lorentzian metric $g_{\mu\nu}(x)$. A field $\Psi(x, \theta, t)$ is normalized on the circle:

$$\int_0^{2\pi} d\theta\, \Psi^\dagger \Psi = 1.$$

Mass–energy projections introduce a single scale E_*:

$$\hat{M}(\theta)c^2 = E_* \cos\theta, \qquad \hat{E}(\theta) = E_* \sin\theta.$$

13.2 Dynamics on spacetime and phase

$$i\hbar \mathcal{N}(x, \rho)\, \partial_t \Psi = \Big[- i\hbar c\, \gamma^a e_a{}^\mu(x)\, D_\mu + \beta\, E_* \cos\theta + E_* \sin\theta - \frac{\hbar^2}{2I_\theta}\, \partial_\theta^2 + U_{\text{quad}}(\theta) \Big] \Psi.$$

Tetrads $e_a{}^\mu$ encode curvature; I_θ sets phase inertia; U_{quad} is a smooth 2π-periodic potential that carves the circle into force sectors; $\mathcal{N}(x, \rho)$ rescales clock rate and links to gravity.

13.3 Gauge sectors and interactions

Sector projectors $\{P_s(\theta)\}$ with $\sum_s P_s(\theta) = 1$. Covariant derivative:

$$D_\mu = \nabla_\mu - i \sum_s g_s(\theta)\, P_s(\theta)\, A_\mu^{(s)}(x) - i\, q\, \mathcal{A}_\mu(x, \theta).$$

Topological charge arises from winding in θ; eigenmodes of $-\partial_\theta^2 + U_{\text{quad}}$ form a tower of allowed “flavors.”

13.4 Gravity via density-tied phase speed

Local redshift from density:

$$\mathcal{N}(x,\rho) = \sqrt{-g_{00}(x)}\, F(\rho(x)), \quad \rho(x) = \int d\theta\, \Psi^\dagger \Psi\, E_*.$$

Backreaction (mean-field GR): $G_{\mu\nu}(x) = \frac{8\pi G}{c^4} \langle T_{\mu\nu} \rangle$.

13.5 Limiting cases and checks

Nonrelativistic quantum mechanics near a sector minimum; Standard Model couplings from $P_s(\theta)$; mass generation from the $\cos\theta$ term; classical gravity from hydrodynamic limit; particle spectra from the θ-Laplacian plus U_{quad}.

13.6 Master equation with variable radius

Allowing r to vary adds polar kinetics and a scale potential $U_r(r)$. A unified evolution reads

$$i\hbar \mathcal{N}(x,\rho,r)\, \partial_t \Psi = \Big[-i\hbar c\, \gamma^a e_a{}^\mu(x)\, \mathcal{D}_\mu - \frac{\hbar^2}{2I_r}(\partial_r^2 + \tfrac{1}{r}\partial_r) - \frac{\hbar^2}{2I_\theta}\frac{1}{r^2}\, \partial_\theta^2 + V(r,\theta) \Big] \Psi,$$

with

$$V(r,\theta) = U_r(r) + U_{\text{quad}}(\theta) + U_{\text{mix}}(r,\theta),$$

and a covariant derivative accounting for gauge, scale, and gravity.

Conclusion

Exploring energy, mass, space, and time through the complex plane suggests a coherent web of mathematical relationships underlying physical phenomena. By mapping these concepts onto a two-dimensional complex geometry, we gain a fresh perspective on the forces that govern the universe. Mathematics remains essential to discovery: by tightening the correspondence between formal structure and observation, we deepen understanding and open new avenues for inquiry.

Arguments and Notes

theoretical physics and the complex plane. take a complex pale map mass on the real axis and

Copilot ha detto

Complex-plane framework for mass, energy, space, and time
===

You’ve sketched a bold identification: real axis <-> mass, imaginary axis <-> energy, polar

Core mapping
----

*   Definition: Let z=m+iE. Use polar form z = r e^{i theta} but reinterpret:

    m = r cos theta, E = r sin theta, t ~ theta, x ~ r.

*   Coordinates: Choose scales m0, E0, x0, omega0 and set

            ilde m = m/m0, \tilde E = E/E0, \tilde x = x/x0, \tilde t = t/(2pi/omega0)

    so that \tilde m + i \tilde E = \tilde x e^{i(2pi \tilde t)}.

... (truncated; see original notes for full discussion)

Bibliography