One, two, three: How to produce interactions, space, particles, and calculate Lambda

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Time and constituents

I present a discrete, integer-based model that produces quantitative post-dictions of both particle properties and cosmology. The process of adding integers is endowed with the role of time. By assuming the simplest, constant metric, the vertices are added one by one to a regular unit-edge N-simplex. Edges kept constant, the distance from the simplex's face to its centroid shrinks following the harmonic series with each added dimension: 1/2 for a line segment, 1/3 for a triangle, 1/4 for a tetrahedron, and so on. These fractions 1/n are precisely the coefficients of the logarithmic series $\ln(1+x) = x - x^2/2 + x^3/3 - x^4/4 + \cdots$, and their partial sums converge to ln(N). Each added vertex thus contributes one term to a logarithmic series truncation whose parity — even or odd — determines its sign. This way integers first acquire topological meaning as vertices and then physical meaning as beables: even integers become pits (positive logarithmic poles) and odd integers become nits (negative logarithmic poles). This discrete model is named the Logarithmic Pole Model, or LPM.

The arithmetic foundation of a 4D arena

By Lagrange's four-square theorem, every positive integer decomposes into four squares, placing integers naturally along a 3-sphere, S^3, embedded in a 4D Euclidean space. The radius of S^3 is the square root of N, setting the scale of the Universe. Multiple decompositions of the same N are related by Hurwitz quaternion rotations preserving the norm — that's what promotes the four squares from arithmetic parameters to genuine coordinates (different observer frames, same norm). The Euclidean metric signature (++++) represents an unobservable simultaneity surface, while the Minkowski signature (+++−) refers to poles that once occupied a position contained within the past light-cone (an S^3 position when N was smaller). From any vertex on S^3, one can Hurwitz-rotate to other vertices, in either signature representation — neither is imposed; both arise from the arithmetic.

Pole aggregates and the speed of light

The following attraction and repulsion rules between poles produce physics. Pits attract other pits at all distances; nits repel other nits at all distances; and a pit-nit pair has a potential reaching a minimum of zero at unit distance. A natural consequence is a constant speed, a known feature in the logarithmic potential, as the propagation speed along S^3 of aggregates that consist of one pit and 1 to 3 nits: photon and neutrinos (see poster). Spin, electric charge, and relative masses of larger aggregates are derivable from Hurwitz quaternion arithmetic (see poster for a complete list, including a post-diction for Higgs at 123.9GeV, at 1% from actual value). At the other extreme, black holes are aggregates composed exclusively of pits, presenting the only manifestation of a long-range logarithmic potential, a candidate explanation for the flat galactic rotation curves.

The cosmological constant

Based on LPM, the derivation of the cosmological constant Λ follows from two contributions. The first is the total number N of poles in the Universe at approximately $8 \cdot 10^{89}$, twice the number of CMB photons which dominate the count. The radial curvature of the S^3 is then 1/N or $1.25 \cdot 10^{-89}$. The second contribution comes from the characteristic, tangential 3D extent of matter particles, defined by the ratio of the electroweak scale (based on Higgs mass 125GeV) to the Planck scale. The tangential curvature thus is the inverse of the ratio squared, around $1.05 \cdot 10^{-34}$. On LPM foundation, these two contributions are independent. The total curvature is hence their product, $\Lambda \approx 1.3 \cdot 10^{-123}$, within an order of magnitude from the observed value. This essentially resolves the 120-order-of-magnitude discrepancy between quantum field theory estimates and observation.

Supernova 1987A neutrino signal

When ordinary matter in a near-balance of pits and nits collapses into a black hole (a pure pit aggregate), all nits must be expelled. Neutrinos, with their nit-to-pit compositions running from 3:1 to 1:1 across three generations, are the vehicle for carrying away those nits. The collapse produces a predictable neutrino count with an even mix between generations; modifying the generational mix modulates the total number emitted. The post-predicted neutrino count agrees with observation to within an order of magnitude across fifty-eight orders of magnitude in absolute scale (see poster).

Conclusions

Beginning from integer arithmetic and a simple N-dimensional structure, LPM produces the foundational interaction, the dimensionality of space, two compatible metric signatures, particle characteristics, and the cosmological constant. Spacetime is not a pre-existing arena; it emerges from the same process of integer adding that produces particles.