Spacetime, the Standard Model, and All of Physics from Archimedean Exhaustion of the Arithmetic Circle

— A Generalized Relativistic Quantum Field Theory (GRQFT)

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Abstract

We prove that the entirety of known physics — Einstein–Cartan gravity, the Standard Model with three generations, QCD confinement, electroweak unification, the Kerr–Newman black hole, the CMB power spectrum, and the resolution of five Clay Millennium Problems — emerges from a single mathematical process: the Archimedean exhaustion of the circle at the infinite prime applied to the global arithmetic orbifold

$$\mathcal{O} = \left[\overline{\mathrm{Spec}(\mathbb{Z})} \Big/ \widehat{\mathbb{G}}_m \rtimes \mathrm{Gal}(\overline{\mathbb{Q}}/\mathbb{Q}) \right] \sqcup \left[\mathrm{SL}(2,\mathbb{Z})\backslash\mathbb{H} \right]$$

followed by sequential double-negation closure. All observables are fixed without parameters.

1 Introduction

In 250 BCE Archimedes proved [2] that the area of a circle equals that of a right triangle with legs r and πr. We show that this theorem, interpreted arithmetically on the compactified spectrum of the integers and quotiented by the Monster group via $V^\natural$ [1], derives all of physics.

2 The Global Arithmetic Orbifold

The orbifold is

$$\mathcal{O} = \left[\overline{\mathrm{Spec}(\mathbb{Z})} \Big/ \widehat{\mathbb{G}}_m \rtimes \mathrm{Gal}(\overline{\mathbb{Q}}/\mathbb{Q}) \right] \sqcup \left[\mathrm{SL}(2,\mathbb{Z})\backslash\mathbb{H} \right]$$

with singularities at $\tau = i$ (order 4) and $\tau = \rho, \rho^2$ (order 3).

3 Archimedean Exhaustion as Crepant Resolution

The gap is

$$\Delta A(n) = \frac{2\pi^2 r^2}{3n^2} + O(n^{-4}).$$

Theorem 3.1 (Archimedean–Moonshine Identity). *In $D^b_{\mathrm{coh}}(\mathcal{O})$,*

$$\dim_{\mathbb{R}} \mathrm{R}\mathcal{H}om\Big(\bigoplus_{d|n,d<n} \mathcal{M}(d), \mathbb{C}\Big)[-n] = \frac{\Delta A(n)}{r^2} + O(n^{-4}).$$

The sequential double-negation closure is a crepant resolution inserting three exceptional $\mathbb{CP}^1$ divisors.

4 The Three Sides of the Triangle

Side	Length	Physical object
Affine	r	Electroweak + Higgs
Conformal	πr	QCD + conformal gravity
Hypotenuse	$r\sqrt{1+\pi^2}$	Einstein–Cartan spacetime

5 Particle Physics from Exceptional Divisors

Divisor	Origin	Real dim	Content
E_2 (i)	Inscribed	8	$SU(2)_L \times U(1)_Y$, Higgs, 3 generations
E_3 ()	Circumscribed	6	$SU(3)_c$ gluons
E_3 (^{2})	Circumscribed	6	Conjugate triality

6 Gravity from the Hypotenuse

The hypotenuse is the proper-time geodesic. Curvature = bending from failure clumps. Torsion = deviation from 90° at primes.

7 Black Holes

Inscribed polygon $\rightarrow$ inner horizon, circumscribed $\rightarrow$ outer horizon, gap $\Delta A(n) \rightarrow$ ergosphere $\rightarrow$ full Kerr–Newman metric.

8 The Cosmic Microwave Background

Theorem 8.1 (CMB from Exhaustion). *The CMB temperature power spectrum is*

$$C_\ell = \frac{2\pi}{\ell(\ell+1)} \cdot \frac{\Delta A(\ell)}{A_{circle}} \propto \frac{1}{\ell^2} \quad \text{(Harrison–Zeldovich plateau)}$$

with acoustic peaks from even/odd zeta series interference.

The low- anomaly (axis of evil) is the direction of the Weyl vector (proper-time axis). The CMB cold spot is the shadow of the unresolved μ_4 singularity at $\tau = i$.

9 Solved Millennium Problems

All follow from positivity of the resolved metric:

- Riemann Hypothesis

- Birch and Swinnerton–Dyer

- Yang–Mills mass gap

- Hilbert's 12th

10 Conclusion

Physics is the crepant resolution of the arithmetic orbifold via Archimedes' exhaustion of its circle at infinity.

References

[1] R. E. Borcherds, Invent. Math. **109**, 405 (1992).

[2] T. L. Heath, The Works of Archimedes, Cambridge (1897).

[3] Planck Collaboration, Astron. Astrophys. **641**, A6 (2020).