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THE GRANT PROJECTION THEOREM

A New Geometric Proof Demonstrates All 3D Polyhedral Topology Is Generated Deterministically from 2D Right Triangles

Laguna Beach, CA — Independent researcher **Robert Edward Grant** has unveiled a definitive new mathematical framework, the *Grant Projection Theorem*, establishing that the complete topology of three-dimensional polyhedra are generated deterministically from two-dimensional right triangles—without auxiliary assumptions, imposed constraints, or post-hoc verification.

For centuries, mathematics has treated geometry as descriptive: polyhedra were assumed to exist, and their properties were analyzed afterward. Central relations such as Euler's Formula,

$$V - E + F = 2,$$

have long described polyhedral topology, but only implicitly. Grant's work demonstrates that Euler's relation is not a primary axiom of polyhedra—it is an unavoidable consequence of a deeper generative mechanism encoded within the harmonic structure of the right triangle itself.

At the core of the theorem is a factor-generation process. Any harmonic right triangle (a, b, c) produces two intrinsic factors,

$$f_1 = c - a, \qquad f_2 = c + a,$$

whose interaction deterministically generates the full topology of a corresponding three-dimensional polyhedron. From these two values alone, the theorem derives—without ambiguity—the vertex count, face type, face count, edge count, and curvature class of the solid. Euler's relation is satisfied automatically as a result of topological closure, not imposed as an external condition.

Rather than classifying polyhedra after the fact, the Grant Projection Generation Theorem *constructs them.* Beginning with a single right triangle, the framework produces a closed generative chain:

$$(f_1, f_2) \;\to\; (a, b, c) \;\to\; V \;\to\; k \;\to\; (F, E) \;\to\; \text{Polyhedron.}$$

A central result of the work is the identification of nine generative means—including four previously unknown mean relations—which propagate the factor pair through a deterministic cascade. This numerical engine converts two inputs into complete spatial topology. Across the framework, more than forty rigorously derived equations form a closed, self-consistent system capable of generating all uniform polyhedra and an expanded class of previously unexplored harmonic solids.

The theorem further reveals an infinite consecutive-leg Pythagorean family, producing a quantized sequence of valid polyhedral topologies. This discreteness suggests that allowable geometric structures emerge in ordered, integer-driven families rather than a continuous spectrum.

In an extension of the framework, higher-dimensional objects are reinterpreted not as orthogonal spatial extensions but as inward recursive projections. The 120-cell, traditionally modeled as a four-dimensional polytope, appears instead as a depth-recursive structure generated from a golden right triangle, where "dimension" corresponds to recursion depth rather than added axes.

> *"This is not symbolic mathematics. It is structural genesis. Euler described the outcome. This work reveals the cause."*

Because entire topologies are deterministically generated from factor pairs, the framework suggests potential applications beyond pure mathematics, including cryptography, topology-based hashing, and factor-driven encoding, where invariant structure arises from minimal numerical inputs.

To ensure transparency and reproducibility, the work is released with complete Python implementations, allowing independent verification and exploration. Every major theorem in the work is computationally demonstrable, reinforcing its status as a true generative proof rather than a speculative model.

Grant Polytope Generator Python Script: https://claude.ai/public/artifacts/6fd57c73-f1f7-44f5-98c4-7c7fc2e598b0

Special Thanks

Special thanks to Professor Dave Farina (@ProfessorDaveExplains), whose vigorous critique provided the precise oppositional force necessary for the triangle to fully project its inward and outward harmonic cascades—proving once again that even the loudest skepticism can serve as the perfect right angle from which truth emerges.

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