The Geometric Limit: Deriving the Fine-Structure Constant and the Structural Failure of the Periodic Table

Darius Puzinas
Lead Theorist, Universal Space Theory

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Abstract

This paper provides a purely mechanical derivation of the fine-structure constant ($\alpha \approx 1/137$) within the Universal Shell Theory (UST) framework. We redefine α as a geometric coupling ratio between a 3D pressurized vessel and the 2D manifold substrate. Furthermore, we demonstrate that the structural integrity of the 3D skin (the atomic shell) is subject to a manifold resolution limit. This limit dictates a maximum achievable atomic number ($Z \approx 118$), identifying the end of the periodic table not as a nuclear decay limit, but as a mechanical failure of the manifold to maintain 3D curvature.

1 The Mechanical Origin of Alpha

In UST, α is the ratio of the energy contained in a single manifold surface vibration (Roughness) to the total potential energy of the wrapped 3D vessel. This is identified as the **Geometric Impedance** of the 2D energy sheets.

Using the manifold's elasticity (E_{vac}) and the observed skin tension (γ), α is derived as the efficiency of energy transfer from the internal primordial pressure to external transverse oscillation:

$$\alpha = \frac{e^2}{4\pi\epsilon_0\hbar c} \rightarrow \text{Ratio of Surface Work to Manifold Tension} \tag{1}$$

The value $1/137.036$ represents the maximum stable "interlock" density of 1D manifold strings on a 3D spherical boundary.

2 The m_p/m_e Ratio as a Vibrational Period

We establish that the electron is not an independent particle but the mass-equivalent of one full vibrational period of the proton's 3D skin. The ratio of the vibration period ($T = h/Q$) to the light-crossing time of the vessel ($t_w = r/c$) yields:

$$\frac{T}{t_w} = \frac{hc}{Qr} \approx 1836 \tag{2}$$

This confirms that the electron's mass is a direct function of the manifold's restorative force.

3 The Structural Limit of the Periodic Table

As the atomic number (Z) increases, the internal pressure (P_{int}) of the vessel increases to accommodate higher nucleon density. According to the Young-Laplace relationship, there is a point where the required skin tension exceeds the manifold's breaking stress.

At $Z \approx 118$ (Oganesson), the 3D skin reaches the **Manifold Resolution Limit**. Beyond this point, the 2D manifold can no longer resolve the high-curvature required to maintain a closed 3D vessel, leading to immediate dimensional reversion. This provides a mechanical explanation for the observed instability of transactinide elements.

4 Conclusion

The fine-structure constant and the limits of chemistry are governed by the mechanical properties of the vacuum substrate. By acknowledging the manifold as a high-tension material, we unify subatomic ratios with structural engineering limits. The periodic table is finite because the medium that hosts it has a finite resolution.

Darius Puzinas
Lead Theorist, UST