

# MASTER SUMMARY: The Hyperbolic Prograde Encounter Model

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Key Framework: Equifinality of Independent Variables in Dynamical Systems

## 1. Initial Conditions: The "Primed" Earth

- *Thermal State*: A Global Magma Ocean (GMO) at  $\approx 3600^{\circ}\text{F}$  characterized by vigorous, extreme convection.
- *Rotational State*: An extreme hydrostatic 2.0-3.0 hour rotational period.
- *Morphology*: Due to rotational velocity and liquid content, Earth existed not as a sphere, but as a triaxial Jacobi ellipsoid at the threshold of rotational fission.
- *Gravitational State*: Centrifugal force at the ellipsoid's "tips" nearly neutralized surface gravity ( $g_{\text{eff}} \approx 0$ ).

## 2. The Trigger: The 16-Earth-Mass Intruder

- *Mass ( $M_{\text{exo}}$ )*:  $9.6 \times 10^{25} \text{ kg} (\approx 16M_{\oplus})$ .
- *Trajectory*: Solar-bent, prograde hyperbolic path.
- *Velocity ( $V_{\text{exo}}$ )*: Accelerated from 33 km/s (entry) to 55 km/s (closest approach).
- *Interaction Window*: Massive tidal "pumping" began at 5,000, 000 km, inducing a transition from a Jacobi ellipsoid to a Poincaré pear-shape.

## 3. The Mechanical "Heist"

- *Pressure-Induced Exsolution*: The exo's proximity dropped internal pressures, triggering a catastrophic exsolution of volatiles (solute).
- *Supersonic Plumes*: These gases acted as propellants, driving supersonic plumes of silicate melt toward the surface at km/s speeds.
- *The Laplace Limit*: As the "tips" of the Earth-ellipsoid reached the Laplace Limit, the exo's gravity "skinned" the Earth's silicate envelope.
- *Tangential Elliptical Ejection*: Earth's 2-hour spin provided the requisite angular momentum to fling this desiccated spray into prograde elliptical orbits.

#### **4. The Equifinality Outcomes (The Evidence)**

- *The Moon*: Formed from the high-energy orbital spray; its silicate purity is explained by "skinning" the Earth's surface.
- *The Late Veneer*: Sub-orbital fallback of a Veneer of Dust enriched with indigenous siderophiles entrained by the plumes.
- *Lunar Desiccation*: Volatiles were flash-vaporized and siphoned beyond the Hill Sphere by the exo's 55 km/s wake.
- *The Moon*: Formed from the high-energy orbital spray; its silicate purity is explained by "skinning" the Earth's surface.
- *The Late Veneer*: Sub-orbital fallback of a Veneer of Dust enriched with indigenous siderophiles entrained by the plumes.
- *Lunar Desiccation*: Volatiles were flash-vaporized and siphoned beyond the Hill Sphere by the exo's 55 km/s wake.
- *Attenuated LHB*: The exo's exit scrambled the Oort/Kuiper belts, creating the "long-tail" bombardment observed at 3.9 Gya.

#### **5. AI Disclosure Statement**

This work was independently conceived by the author. Generative AI (LLM) was utilized solely as a collaborative tool for technical drafting, structural organization, and the synthesis of the Equifinality and Laplace Limit frameworks. The author maintains sole responsibility for the scientific logic and conclusions.