TECHNICAL RESEARCH PAPER:
The Hyperbolic Prograde Encounter Model

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1. ABSTRACT

This paper defines a producible alternative for the Earth-Moon origin based on the **equifinality** of Hadean observables. The model posits a 16M⊕ exoplanet encounter at **~55 km/s** on a prograde, solar-bent trajectory at **4.5 Gya**. Unlike the standard Giant Impact Hypothesis, this model demonstrates that a non-collisional "gravitational heist" satisfies the identical isotopic signatures of the Earth and Moon. Initial tidal priming beginning at **5,000,000 km** catalyzed **supersonic exsolution of volatiles** from a 3600°F **convective envelope**. Upon reaching the **Laplace Limit**, Earth's **3 km/s rotation** triggered a **tangential elliptical ejection** of the silicate melt. This mechanism unifiedly accounts for lunar silicate purity, extreme desiccation via the exo-wake siphon, and the chemical signature of the **Late Veneer** through sub-orbital fallback.

2. INDEPENDENT VARIABLES & INITIAL CONDITIONS

- **Target Body:** Primordial Earth in a liquid state (Global Magma Ocean).
- **Thermal State: ≈3600°F** is approximately equal to 3600 raised to the composed with power F with vigorous, extreme convection.
- **Rotational Velocity: 2.5–3.0km/s** 2.5 -- 3.0 km/s (tangential).
- **Intruder Mass (M_{exo}): 9.6×10^{25} kg (≈16M⊕).**
- **Encounter Velocity (V_{exo}): 55 km/s** prograde (accelerated from **33 km/s**interstellar entry).

3. DYNAMICAL MECHANISMS

3.1 Pressure-Induced Exsolution

The encounter induced a massive **triaxial deformation**. The resulting drop in internal pressure triggered the **exsolution of volatiles** (solutes) from the silicate melt. This nucleation created a low-density, foaming "Convective Envelope," facilitating mass stripping.

3.2 Supersonic Tidal Degassing

Propelled by expanding volatiles, plumes ascended at **km/s speeds**. Upon reaching the **Laplace Limit**, the combination of Earth's spin and the Exo's pull siphoned this desiccated silicate spray into prograde elliptical orbits.

3.3 The Veneer of Dust (Late Veneer)

Material failing to reach stable orbital velocity entered sub-orbital ellipses. This **Veneer of Dust**, enriched with indigenous siderophiles entrained from the deep interior, fell back to the cooling surface, creating the "Late Veneer" signature without requiring external asteroid delivery.

4. THE RECESSION PHASE (OUTWARD TRAJECTORY)

As the Exo recedes from closest approach back to **5,000,000 km**, its gravitational wake acts as a **volatile siphon**, removing exsolved gases beyond the Hill Sphere. This "exit sweep" explains the **extreme lunar desiccation** and the **attenuation** of the Oort and Kuiper Belt populations, leading to the observed "long-tail" of the Early Heavy Bombardment (EHB).

5. FALSIFIABLE PREDICTIONS

1. **Isotopic Homogeneity:** Late Veneer siderophiles must be isotopically identical to bulk silicate Earth.
2. **Mantle Siderophile Gradient:** Deep-source diamonds and kimberlites will show transport rates consistent with **km/s supersonic plumes**.
3. **TNO Inclinations:** Trans-Neptunian Object distributions will correlate with the solar-bent exit vector of the 16M⊕ intruder.

AI Disclosure and Acknowledgment

Statement on Generative AI and AI-Assisted Technologies:

The author utilized generative AI (Large Language Model) as a collaborative tool in the technical drafting, structural organization, and linguistic refinement of this work. Specifically, the AI assisted in the mathematical synthesis of the **Laplace Limit** parameters, the formalization of the **Equifinality** framework, and the stylistic adaptation of the hypothesis for scientific and popular media formats.

The core conceptual hypothesis—including the 16M⊕ exo-intruder parameters, the **Supersonic Tidal Degassing** mechanism, the **Tangential Elliptical Ejection** theory, and the **Veneer of Dust** origin—was independently conceived and directed by the author. The author remains solely responsible for the scientific integrity, logic, and conclusions presented herein.