Anas Cosmogenesis Hypothesis v1.0:

Black Hole Genesis, Nuclear Triggering Beyond Iron, and the Parental Gravitational Imprint

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Abstract

This conceptual paper proposes a unified hypothesis for cosmic genesis that synthesizes (1) a *black hole genesis* scenario in which a parent black hole's catastrophic collapse and subsequent transition generates a child universe (the observed Big Bang), (2) a *nuclear-fusion-trigger* mechanism in which fusion beyond iron in an extreme hypermassive core materially influences the collapse dynamics and seeds baryonic/elemental content, and (3) the *parental gravitational imprint* conjecture, which posits that the child universe inherits a persistent gravitational field (a background metric imprint or gravitational-wave-like field) from the parent event that explains the universality and apparent weakness of gravity and its absence from the Standard Model as a gauge boson. This concept paper lays out definitions, qualitative mechanisms, mathematical placeholders, proposed tests, observational signatures, and an explicit program toward formalization and falsifiability. The goal is not to present a finished mathematical theory but to provide a rigorous and detailed roadmap that can be followed, developed, and eventually translated into formal models and testable predictions.

Contents

1 Introduction

The origin of our universe remains one of the deepest problems in physics. Standard cosmology describes the evolution of spacetime from an initial hot, dense state using the Friedmann–Lemaître–Robertson–Walker (FLRW) framework and the equations of General Relativity (GR). However, the *initial singularity* and the integration of gravity with quantum field theory remain unresolved. A variety of speculative models attempt to resolve the singularity and unify genesis scenarios: bounce cosmologies, inflationary mechanisms, and black hole cosmology proposals. This concept paper formalizes a new, composite hypothesis that: (i) extends black hole cosmology by explicitly including nuclear microphysics in the pre-collapse phase, (ii) posits a deterministic mechanism for matter/elemental seeding via extreme core processes, and (iii) proposes that gravity in the child universe is, in part, an *inherited permanent gravitational imprint* originating from the parent black hole's transition event.

2 Definitions and Notation

To avoid ambiguity, we define notation used throughout this paper.

- M_{parent}: Mass of the parent black hole (as measured in its parent universe).
- r_s: Schwarzschild radius of the parent black hole, $r_s = \dfrac{2GM_{\text{parent}}}{c^2}$.
- $\mathcal{H}_{\text{parent}}(t)$: Spacetime region interior dynamics of the parent black hole prior to transition.
- M_{core}: Mass of the collapsing stellar core in the parent universe that seeds the child universe (if model uses a collapsing progenitor star; in a more general model $M_{\text{core}} \sim M_{\text{parent}}$).
- M_{OV}: Oppenheimer–Volkoff limit for neutron-star stability (order of $\sim 2 - 3\,M_{\odot}$, model-dependent).
- $E_{\text{nuc}}(Z)$: Net nuclear energy change associated with fusing nuclei of atomic number Z to heavier species (positive if energy released, negative if energy absorbed).
- $\Phi^{(p)}_{\text{grav}}$: The parental gravitational imprint field (PGIF) hypothesized to be inherited by the child universe.
- $\rho(t)$, $p(t)$: Energy density and pressure in the child universe (as usual in cosmology).
- $a(t)$: Scale factor of the child universe in the FLRW metric.
- S_{BH}: Bekenstein–Hawking entropy of a black hole, $S_{BH} = \dfrac{k_B A}{4\,\ell_P^2}$.

3 Motivation: Conceptual Foundations

Three conceptual pillars motivate the hypothesis.

1. **Black Hole Interior ß Child Universe:** Several proposals in the literature suggest that the interior of a black hole could be isomorphic to an expanding universe (e.g., Einstein–Rosen bridge interpretations, models by Popławski). The gravitational collapse that creates the black hole may produce initial conditions suitable for a new cosmological expansion. Our hypothesis adopts this core intuition but modifies the causal mechanism and adds microphysical detail.

2. **Nuclear Physics as Dynamical Trigger:** In stellar astrophysics, fusion beyond iron is endothermic. If the collapsing core reaches states where nuclear processes continue to transform nuclei into heavier species (e.g., extreme neutron capture or exotic fusion into trans-iron elements under extreme pressure/density), then the sign and rate of E_{nuc} could materially influence pre-horizon dynamics and entropy distribution. We hypothesize a regime of hypermassive collapse where such processes amplify gravitational dominance and alter collapse outcomes.

3. **Parental Gravitational Imprint (PGI):** At the parent collapse event, a strong, non-transient gravitational-wave-like imprint may be laid down across the newly formed child spacetime. This PGI acts as a background field that sets the effective gravitational coupling and may explain why gravity is universal yet appears weak compared to other fundamental interactions.

4 High-Level Mechanism — A Stepwise Description

We present a conceptual timeline for the genesis event.

Step 1: **Hyper-Massive Progenitor Formation:** In the parent universe, gravitational dynamics assemble a hypermassive concentration (e.g., collapse of a supermassive star cluster or hierarchical black hole merger) whose effective core mass M_{core} exceeds typical thresholds.

Step 2: **Nuclear Evolution Beyond Iron:** As density and pressure grow in the core, nuclear pathways enable creation of trans-iron nuclei via extreme r-process, neutron-capture cascades, or exotic fusion channels. In this regime $E_{\mathrm{nuc}}(Z > 26) < 0$ (energy absorbed), increasing the net gravitational dominance.

Step 3: **Runaway Gravitational Collapse:** Degeneracy pressures (electron and neutron) fail; the system passes the Oppenheimer–Volkoff limit. Rather than forming a stable classical singularity in a simple sense, the combination of enormous mass, exotic equation of state, and quantum-gravity corrections induces a non-singular transition — a catastrophic reconfiguration of spacetime.

Step 4: **Burst / Transition Event (Parent "Bust"):** The parent black hole interior undergoes a violent transition: spacetime geometry and metric signature rapidly reconfigure, releasing a gravitational imprint (PGI) and dispersing matter/entropy into an inflating child spacetime. This event constitutes the Big Bang for the child universe.

Step 5: **Inheritance of PGI and Seeding of Matter Content:** The PGI establishes a background gravitational metric (or effective coupling) in the child universe. Meanwhile, matter/elemental remnants (or their information content) traverse the causal interface and seed the early universe with entropy and possibly heavy-element abundance anomalies.

Step 6: **Early Expansion and Thermalization:** The child universe undergoes rapid expansion and thermalization; standard nucleosynthesis and subsequent structure formation occur, but initial conditions may bear detectable imprints of the parent event.

5 Mathematical Placeholders and Minimal Equations

This section lists minimal equations and placeholders that will be replaced with rigorous derivations in future work. The goal is to show where formalism is required.

5.1 Geometry and Matching Conditions

We consider a parent metric $g^{(p)}_{\mu\nu}$ that describes the black hole exterior/interior and a child metric $g^{(c)}_{\alpha\beta}$ approximated by FLRW after transition. A matching condition across a spacelike or null hypersurface Σ is required. Formally, using Israel junction conditions:

$$[h_{ij}]_\Sigma = 0, \tag{1}$$

$$[K_{ij}]_\Sigma = -8\pi G \left(S_{ij} - \tfrac{1}{2}h_{ij}S\right), \tag{2}$$

where h_{ij} is the induced metric on Σ, K_{ij} the extrinsic curvature, and S_{ij} the surface stress-energy.

5.2 Parental Gravitational Imprint Field (PGIF) Ansatz

We introduce an effective background field $\Phi^{(p)}_{\text{grav}}$ modeled as a tensorial scalar imprint on the child metric. At leading order we write:

$$g^{(c)}_{\mu\nu}(x) = \bar{g}_{\mu\nu}(x) + \epsilon\, \Phi^{(p)}_{\mu\nu}(x), \tag{3}$$

where $\bar{g}_{\mu\nu}$ is the standard FLRW metric and ϵ is a dimensionless parameter characterizing imprint strength. The imprint tensor $\Phi^{(p)}_{\mu\nu}$ must satisfy constraints:

$$\nabla^{\bar{g}}_{\mu}\Phi^{(p)\mu}{}_{\nu} = 0 + \mathcal{O}(\epsilon), \tag{4}$$

$$\Phi^{(p)\mu}{}_{\mu} = 0 + \mathcal{O}(\epsilon)\ \text{(trace-free ansatz – optional)}. \tag{5}$$

5.3 Effective Field Equation with PGIF

A heuristic effective field equation in the child universe incorporating PGIF:

$$G_{\mu\nu}[g^{(c)}] + \Lambda g^{(c)}_{\mu\nu} = 8\pi G \left(T^{\text{matter}}_{\mu\nu} + T^{\text{PGI}}_{\mu\nu} \right), \tag{6}$$

where $T^{\text{PGI}}_{\mu\nu}$ encodes energy-momentum associated with the imprint. To leading order:

$$T^{\text{PGI}}_{\mu\nu} \approx \frac{1}{8\pi G} \left(\mathcal{L}_\Phi g^{(c)}_{\mu\nu} - \frac{\delta \mathcal{L}_\Phi}{\delta g^{\mu\nu}} \right), \tag{7}$$

with $\mathcal{L}_\Phi$ a phenomenological Lagrangian density for the imprint field.

5.4 Nuclear Microphysics Placeholder: Energy Budget

Let X_Z represent the fractional abundance of nuclei of atomic number Z in the collapsing core. The net nuclear energy density contribution is:

$$\rho_{\text{nuc}} = \sum_Z X_Z n_b E_{\text{nuc}}(Z), \tag{8}$$

where n_b is baryon number density. In regimes where fusion proceeds toward heavier Z with $E_{\text{nuc}}(Z) < 0$, ρ_{nuc} becomes negative in the sense of energy release rate (i.e., absorption), accelerating collapse.

5.5 Entropy and Information Transfer

Make explicit the connection between black-hole entropy and child-universe degrees of freedom. If S_{BH} is the parent horizon entropy, and $S_{child}(t_0)$ the initial entropy in the child universe, hypothesize a mapping function $\mathcal{M}$:

$$S_{child}(t_0) = \mathcal{M}\left(S_{BH}, \{\alpha_i\}\right), \tag{9}$$

where $\{\alpha_i\}$ are parameters encoding the microphysics of transfer (e.g., imprint coupling, quantum tunneling rates). A consistency condition: $S_{child}(t_0) \leq S_{BH}$ (information non-creation), though the mapping can scramble information.

5.6 Toy Model: Spherically Symmetric Transition

Consider a spherically symmetric metric for the parent interior (generalized Vaidya or Oppenheimer–Snyder type) and match to an FLRW patch. A minimal toy analytic approach: begin with a spherically symmetric line element

$$ds^2 = -f(r,t)\, dt^2 + \frac{1}{g(r,t)}\, dr^2 + r^2 d\Omega^2. \tag{10}$$

Specify physically motivated ansatz for f and g that allow a non-singular bounce (e.g., $f(r,t) \sim 1 - \frac{2G\mathcal{M}(r,t)}{r} +$ quantum corrections) and then solve junction conditions at $r = r_\Sigma(t)$.

6 Observational Signatures and Testability

A crucial requirement for scientific utility is falsifiability. We propose candidate observational signatures that may distinguish this hypothesis.

6.1 Primordial Gravitational Wave Background (PGWB) Anomalies

If the PGI exists, it may leave an imprint on the primordial gravitational-wave spectrum distinct from standard inflationary predictions. Possible signatures:

- Non-scale-invariant features or "line"-like spectral components reflecting parent-horizon modes.
- Directional anisotropies in the stochastic background (a residual preferred frame inherited from parent geometry).

These could be searched for in future space-based gravitational wave detectors (e.g., deci-Hz to nHz bands) and via CMB B-mode polarization anomalies correlated with gravitational-wave modes.

6.2 Heavy-Element Anomalies in Early Universe Abundances

If matter from the parent event seeds the child universe with non-thermal or non-standard heavy-element distributions, this could alter primordial nucleosynthesis (BBN) yields or early metal enrichment. Observable consequences might include:

- Localized overabundances of trans-iron isotopes in low-metallicity ancient stars (very challenging to detect but conceptually possible).
- Deviations from standard light-element abundances if early heavy-element recycling affects neutron-to-proton ratios in localized patches.

6.3 Entropy Bounds and Cosmic Information Tests

The relationship $S_{child}(t_0) \leq S_{BH}$ places constraints on initial conditions. If the observed entropy in our visible patch is inconsistent with plausible parent-horizon entropies, the hypothesis faces challenges. Conversely, a consistent mapping strengthens plausibility.

6.4 Cosmic Microwave Background (CMB) Signatures

Possible signatures in the CMB include:

- Large-angle anomalies or preferred-axis effects originating from anisotropic imprint of PGI.
- Non-Gaussian statistics in primordial perturbations seeded by parent-horizon irregularities.

7 Differentiation from Existing Models

We explicitly contrast features that distinguish this hypothesis from well-known alternatives.

1. **Vs. Popławski's Einstein–Cartan bounce:** Popławski uses torsion to avoid singularities and suggests universes inside black holes. Our hypothesis introduces nuclear microphysics as a dynamical trigger and adds the PGI field as an inheritable imprint — a combined mechanism not present in prior works.
2. **Vs. Inflationary cosmology:** Inflation explains horizon/flatness/perturbations via a scalar inflaton field. Our model may reproduce effective inflationary expansion through the dynamics of the transition event and PGI-driven early expansion; however, inflationary predictions (spectral index, tensor-to-scalar ratio) must be recovered or distinctively altered — this is a primary test.
3. **Vs. Cyclic / ekpyrotic models:** Cyclic models involve collisions of branes or repeated bounces. Our model is singular-event oriented (parent-to-child transfer) and predicts specific cross-universe information mapping.

8 Theoretical Challenges and Open Problems

We document the major theoretical obstacles that must be addressed in follow-up work.

1. **Junction conditions and global hyperbolicity:** Formulating a mathematically consistent and causal matching between parent interior and child FLRW requires careful analysis of hypersurface choice (spacelike vs null) and the handling of horizons.
2. **Quantum gravity regime:** The transition occurs in a strongly quantum-gravitational domain; without a consistent theory of quantum gravity we must rely on effective field theories and phenomenological ansatzes.
3. **Energy, conservation, and locality:** Explaining where energy resides during the transfer and how local conservation laws are respected across the causal interface.
4. **Microphysical plausibility of trans-iron fusion in core conditions:** Nuclear physics at extreme densities and high neutron flux is highly uncertain. Robust nuclear reaction network modeling under extreme degeneracy is required.

5. **Observational degeneracy:** Many signatures (e.g., PGWB deviations) may be degenerate with other exotic early-universe models. Distinguishing features need precise predictions.

9 Roadmap to Formalization

A staged program to convert this concept into a rigorous theoretical framework.

1. **Mathematical toy models:** Construct simplified spherically symmetric toy models (analytic or numeric) to study matching conditions and imprint formation.
2. **Equation of state studies:** Model extreme equations of state (EoS) including hyperonization, quark deconfinement, and trans-iron nuclear networks for hypermassive cores.
3. **Numerical relativity simulations:** Use (or adapt) numerical relativity codes to simulate collapse with phenomenological EoS and track metric response; incorporate semi-classical corrections.
4. **PGI field modeling:** Propose candidate Lagrangians for $\mathcal{L}_\Phi$ and study linearized perturbations to derive PGWB signatures.
5. **Prediction generation:** Calculate CMB, PGWB, and BBN implications and produce falsifiable observables and parameter ranges.
6. **Publication and peer review:** Write incremental papers: (i) conceptual overview (this document), (ii) toy-model analytic work, (iii) numerical simulations, (iv) observational constraints.

10 Suggested Experiments and Observational Campaigns

- High-sensitivity stochastic gravitational wave background observations (LISA, DECIGO, pulsar-timing arrays) focusing on non-standard spectral features.
- Precision large-angle CMB polarization surveys to seek PGI anisotropies.
- Spectroscopic surveys of Population II/III metal-poor stars searching for anomalous trans-iron isotope ratios.
- Comparative entropy accounting across cosmic horizons using refined measurements of black-hole demographics and large-scale entropy inventories.

11 Appendices

11.1 Appendix A: Useful Formulae

$$r_s = \frac{2GM}{c^2}, \tag{11}$$

$$S_{BH} = \frac{k_B A}{4\ell_P^2} = \frac{k_B 4\pi r_s^2}{4\ell_P^2} = \frac{\pi k_B r_s^2}{\ell_P^2}, \tag{12}$$

$$T_H = \frac{\hbar c^3}{8\pi G k_B M} \quad \text{(Hawking temperature)}. \tag{13}$$

11.2 Appendix B: Suggested Bibliography (Starter)

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12 Concluding Remarks

This document sets forth a broad, detailed conceptual framework for a new cosmogenesis hypothesis that unites black hole cosmology, nuclear microphysics in hypermassive cores, and a parental gravitational imprint mechanism. The path from concept to predictive theory requires substantial mathematical and computational development; however, the pieces here identify where new physics could appear and suggest concrete observational handles. If developed further and supported by analytic and numerical work, this hypothesis could supply a novel resolution to information paradox concerns and offer new perspectives on the origin and character of gravity.

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References