Apeiron preprint v1.2

Version 13 reader edition | Original manuscript follows unchanged
14 September 2026 | Editorial reading notice

Binding interpretation

The current Apeiron model postulates one fundamental carrier. Ordinary matter is an organized Apeiron manifestation. Dark matter may be a manifestation or state of the same carrier; it is not a separate fundamental substance in this ontology. Dark energy may be a state or dynamical form of that carrier. These identifications remain hypotheses, without empirical confirmation.

QCD and Higgs

QCD and Higgs phenomena are investigated as possible organized manifestations of the same carrier. The Standard Model and QCD, including their established equations and results, remain unchanged. A derivation from Apeiron has not been established.

Three distinct scopes

The v7.13 Float64 classification and the G32 methods status are historical numerical records. In inherited passages, "current", "Latest", ORANGE and AP2/AP3 locks refer to the dated record, not to a new assessment on 14 September. The later AP1_GO_SCIENTIFIC_FEASIBILITY_FIRST decision 078 and Audit 079 concern the bounded local O049 witness and its specified response class. They do not establish a complete cosmology, a DM/DE fit or completed independent reproduction.

Black-hole reconversion

The project status is FEASIBILITY GO for the investigated effective feasibility class. Reconversion is an internal transition of organized Apeiron manifestations toward more fundamental states of the same carrier. It is not inferred from v7.13 or O049. A unique microscopic end state, quantitative reconversion rates and observational evidence remain open; no second substance or external energy sink is required by this interpretation.

Editorial scope and provenance

This Version 13 reader edition adds a dated reading notice to the supplied document. It does not recalculate, reinterpret as new evidence, or replace any frozen equations, parameters, gates, hashes or numerical results. Original imported files are preserved byte-for-byte in the accompanying historical/frozen source ZIP. Website preparation and this reader edition do not constitute publication, peer review or empirical validation.

Frozen Float64 Classification of a Homogeneous AME-1 Map: v7.13 HARD-PASS, Adjacent NONPASS, and Open Independent Reproduction

Venue-neutral preprint manuscript Author: Josip Fellner Affiliation: Independent Researcher ORCID: https://orcid.org/0009-0003-1705-3985 Correspondence: info@apeironfield.com Version: 1.2, 14 September 2026 Numerical reference: terminal v7.13 Stage-0 HARD-PASS; Float64 crossing schedule complete and frozen Follow-up status reference: frozen v7.13 and the documented AP1 numerical status remain unchanged; this revision adds the current single-carrier ontology and the separate black-hole reconversion feasibility result without importing either into the frozen numerical evidence.

Scope. This document reports a frozen numerical classification and package integrity. It also records, without importing new evidence into the v7.13 result, the confirmed gate status of the separate AP1 follow-up program. Version 1.2 additionally aligns the current-facing Apeiron interpretation to a single-carrier ontology and records the independent black-hole reconversion feasibility branch. Those conceptual additions do not reclassify, recompute or retroactively reinterpret the numerical gates. The document does not report continuum convergence, a unique fundamental covariant action, a completed physical response kernel, observable curves or empirical confirmation.

1. Abstract

The stored v7.13 endpoint is a protocol HARD-PASS, not an independent-map reproduction. A later clean-room comparison did not reproduce the stored HARD-PASS classification; independent-map reproduction level V4 remains open. The comparison independently recomputed only selected scalar diagnostics from the frozen state: 7 of 10 scalar rows met the stricter cross-implementation tolerances and 9 of 10 original gates passed. A preregistered no-map precision isolation accounts for the Wronskian discrepancy under frozen forcing but does not close V4.

The frozen homogeneous Apeiron/AME-1 model is defined operationally on a spatially flat expanding FRW background by a noncanonical pressure function, a portal-coupled renormalized mode source and a discrete fixed-point map on 15361 time nodes. At the binary64 endpoint $\tau=0.47878124999999994$, corresponding to the exact protocol decimal 0.47878124999999994315658113919198513031005859375, the inherited v7.13 state already satisfied the fixed-point criterion and required no Newton or GMRES update. The recorded fixed-point, Friedmann, continuity, Raychaudhuri, quantum-source and Wronskian diagnostics are $4.6838977141305804\times10^{-11}$, $3.818888298257304\times10^{-12}$, $3.7214611922998273\times10^{-6}$, $1.4051164250399966\times10^{-5}$, $3.883856960984437\times10^{-8}$ and $7.432742701266731\times10^{-9}$, respectively. All preregistered v7.13 gates passed and no finalization failure was recorded, yielding a HARD-PASS under the frozen protocol. The adjacent binary64 endpoint $\tau=0.47878125$ is an immutable v6.74 NONPASS because its fixed-point and Friedmann gates failed. The classified endpoints are adjacent representable values; the exact protocol midpoint rounds to the NONPASS endpoint, terminating the frozen Float64 schedule. The independently calculated binary64 Wronskian was $2.4628917628444214\times10^{-5}$, whereas long-double mode arithmetic in the no-map isolation gave $7.613423383217004\times10^{-9}$, consistent with the stored $7.432742701266731\times10^{-9}$ under the registered mixed tolerance. The corrected source passed synthetic and static conformance audits without a new physical-map execution. The result establishes compliance with the stated numerical criteria for the frozen discretization, not continuum convergence, empirical confirmation or an Apeiron ontology. The separate AP1 program has advanced only through confirmed, bounded numerical and structural preflights; it remains ORANGE with the G32 three-level pilot open and the physical response kernel blocked. AP2 and AP3 remain locked. No observable curve, data fit, significance or empirical preference is claimed.

For current-facing interpretation, Apeiron is now stated explicitly as a single fundamental carrier. Ordinary matter, dark-matter-like gravitational phenomena and dark-energy-like large-scale behavior are not treated

as ontologically separate fundamental substances inside the Apeiron model; they are hypotheses about different states, organizations or manifestations of the same carrier. This is an ontological/model statement, not an empirical result of the v7.13 computation. A separate black-hole reconversion branch has reached a structural scientific-feasibility G0: an organized Apeiron manifestation can be represented as undergoing a local, energy-momentum-conserving transition toward more fundamental Apeiron states under extreme curvature. That branch likewise supplies no observational confirmation.

Keywords: numerical fixed-point classification; binary64 endpoint; gate protocol; reproducibility levels; Pauli-Villars source; FRW background map

2. Motivation and problem statement

Foundational model programs face distinct burdens of evidence. First, their internal equations and numerical decisions must be explicit enough to audit. Second, their computations must satisfy declared criteria without retrospective changes. Third, their physical interpretation must be converted into observables and compared with data. Passing one burden does not discharge the others.

The present work addresses the first two burdens for one frozen homogeneous Apeiron/AME-1 calculation. It asks:

1. What model and discrete map were actually evaluated?
2. What exact rules produced the terminal PASS/NONPASS classifications?
3. What does the terminal result establish, and what remains open?
4. How can later observable tests be preregistered without changing the completed numerical line?

The v7.13 result and its adjacent v6.74 counter-endpoint are treated as immutable. No solver rerun, gate change, parameter adjustment or new physical assumption is introduced in preparing this manuscript.

3. Definition and delimitation of the Apeiron model

3.1 Operational definition

The paper uses “Apeiron/AME-1” as the name of a frozen homogeneous numerical model. Its publication definition is operational: the variables, parameters, pressure function, portal coupling, quantum-source prescription, background equations, initial data, discretization and active source hashes are supplied in the associated versioned reproducibility archive.

The background is spatially flat FRW with scale factor a, e-fold variable N=ln a, Hubble rate H>0, natural units c=hbar=1 and reduced Planck mass M_ pl=1. The numerical time coordinate is

```
τ=H_star t, (d)/(dτ)=(1)/(H_star)(d)/(dt).
```

3.2 Scope

The registered calculation is homogeneous and background-level. It does not contain:

- a unique fundamental covariant action;
- a closed scalar, vector or tensor perturbation theory;
- a continuum-limit demonstration;
- a global or nonlinear stability theorem;
- an observational likelihood analysis;
- an ontological test of an Apeiron medium.

The lack of a unique action-level completion is not concealed. It limits the article to the exact operational discrete model that was computed.

3.3 Meaning of the control parameter

τ is the registered numerical time/control endpoint of the frozen calculation. A unique observational or cosmological mapping beyond $\tau=H_{star}\,t$, including any direct mapping to redshift, remains an AP1 task. The terminal Float64 bracket must therefore not be described as a measured physical constant or exact physical phase boundary.

3.4 Current single-carrier ontology (interpretive layer)

The current Apeiron model uses one fundamental carrier as its binding ontology. The numerical variables of AME-1 are effective variables of a frozen operational model and are not asserted to enumerate the microscopic constituents of that carrier.

Within this ontology:

- ordinary baryonic matter is an organized, emergent Apeiron manifestation;
- dark-matter-like gravitational phenomena are interpreted as possible manifestations or states of Apeiron, not as a second fundamental substance;
- dark-energy-like large-scale behavior is interpreted as a possible dynamical/state manifestation of the same carrier;
- the separate Apeiron-QCD branch asks whether Higgs-sector and nonperturbative QCD/binding structures may be organized low-energy manifestations of the same carrier, while retaining standard QCD SU(3) and known Standard-Model structures;
- the black-hole reconversion branch treats extreme curvature as a possible region in which organized Apeiron manifestations can return toward more fundamental Apeiron states.

This ontology is a model-level hypothesis. It is not established by the v7.13 HARD-PASS, and it does not change any frozen equation, gate, parameter, source hash or numerical classification reported in this paper. If unknown dark-sector particles are discovered experimentally, their existence would not by itself contradict the single-carrier ontology; they could be represented as additional organized manifestations, but that interpretation would require separate physics.

4. Frozen assumptions, degrees of freedom and equations

4.1 Stored state and degrees of freedom

The full trajectory container is

$$y=(\sigma,\dot\sigma,\theta,\dot\theta,\chi,\dot\chi,H,N).$$

The iterated state uses six columns,

$$u=(\sigma,\dot\sigma,\theta,\dot\theta,H,N),$$

while the homogeneous χ bookkeeping coordinate is fixed to zero. The portal sector enters through renormalized mode expectation values ρ_q, p_q and $\langle\chi^2\rangle_q$. This six-column numerical state is not claimed to be a count of fundamental degrees of freedom in an unknown covariant completion.

The fixed-point vector is the flattened scaled state

$$x=\mathrm{vec}\left(\frac{\sigma}{10^{-2}}, \frac{\dot\sigma}{10^{-8}}, \theta, \frac{\dot\theta}{10^{-8}}, \frac{H}{10^{-6}}, \frac{N}{10^{-1}}\right),$$

with 15361 nodes, 92166 Float64 components and a full stored solution array of shape 15361×8.

4.2 Homogeneous pressure

Define

$$X=\frac{1}{2}\cdot\theta^2,\ z=(\sigma)/(f_\sigma),\ b=b_{star}+b_{slope}\frac{\theta}{M_{pl}}-(5X)/(\Lambda^4),$$

$$F(z,b)=\frac{1}{4}z^4-\frac{1}{2}z^2+bz\ .$$

The registered pressure is

$$P(X,\sigma,\theta)=X+(5)/(3\Lambda^4)\,(z-(2)/(\sqrt{3}))^2X^2-E_cF(z,b)-V_s(\theta),$$

where $V_s(\theta)=\sum_{i=0}^4 c_i\theta^i$ and the five frozen coefficients are given in the canonical specification. The executable derivatives P_X, P_{XX}, P_σ, P_θ and $P_{X\sigma}$ are stated there in full.

The AME stress is

$$\rho_{AME}=\frac{1}{2}\cdot\sigma^2+2XP_X-P,\ p_{AME}=\frac{1}{2}\cdot\sigma^2+P.$$

4.3 Portal and quantum source

The field-dependent portal mass is

$$m_\chi^2=m_{\chi,0}^2+2\lambda(v+\sigma)^2\cos(\frac{2\theta}{f_{phase}}).$$

The quantum routine uses four Pauli-Villars sectors with coefficients (1,-3,3,-1), regulator indices (0,1,2,3), 128 resolved momentum nodes on the initial physical support $0\leq k\leq 0.6\Lambda$, an analytic order-0 tail and auxiliary adiabatic curvature orders 2 and 4. Mode functions are advanced by a three-substep Yoshida composition of an implicit-midpoint update.

The normalized quantum-source diagnostic represents

$$\cdot\rho_q+3H(\rho_q+p_q)-\frac{1}{2}\cdot m_\chi^2\langle\chi^2\rangle_q=0.$$

4.4 Registered background map

With $\rho_{tot}=\rho_{AME}+\rho_q$ and $p_{tot}=p_{AME}+p_q$, the image map integrates

$$\ddot{\sigma}=-3H\cdot\sigma+P_\sigma-\frac{1}{2}\partial_\sigma m_\chi^2\langle\chi^2\rangle_q,$$

$$\ddot{\theta}=\frac{P_\theta-\frac{1}{2}\partial_\theta m_\chi^2\langle\chi^2\rangle_q-3HP_X\cdot\theta-P_{X\sigma}\cdot\sigma\cdot\theta}{P_X+2XP_{XX}},$$

$$H=+\sqrt{\frac{\rho_{tot}}{3M_{pl}^2}},\ \cdot N=H.$$

The Raychaudhuri relation

$$\cdot H=-\frac{\rho_{tot}+p_{tot}}{2M_{pl}^2}$$

is retained as an independent diagnostic. Hyperbolicity gates require $P_X>0$ and $P_X+2XP_{XX}>0$.

4.5 Fixed-point definition

For the hash-identified image map G,

$$R(x;\tau)=x-G(x;\tau),\ \delta_{FP}=\|R\|_\infty\ .$$

All parameters, source files, gates, tolerances, discretization and solver budgets were frozen before the terminal classification.

5. Numerical method and reproducibility

5.1 Discretization and nonlinear budget

The grid spacing is $\Delta\tau=\tau_{end}/15360$. The registered finite-difference step for Jacobian-vector products is 10^{-5}. The allowed nonlinear budget was:

- at most 6 Newton steps;
- GMRES restart 10;
- at most 16 GMRES cycles per Newton step;
- GMRES relative tolerance 0.05 and absolute tolerance 0;
- line-search factors 2^{-j}, $j=0,\dots,12$.

These values describe the frozen allowance. The terminal v7.13 evaluation consumed no Newton update because the inherited state already passed the fixed-point gate.

5.2 Persistence and immutability

The v7.13 result JSON, solution NPZ, gate register, protocol, crossing decision, terminal checkpoint state and active runtime sources are individually hashed in the archive manifest. The adjacent v6.74 result, solution and gate register are also included. The v6.74 gate table is preserved for its own classification and is not substituted for the strict v7.13 table.

5.3 Read-only verification

The read-only verifier supplied with the archive:

1. checks every registered SHA-256 digest;
2. checks cross-document identities and terminal metadata;
3. checks NPZ keys, shapes and Float64 dtypes;
4. compares the stored diagnostics with the immutable gate table;
5. checks binary64 endpoint adjacency and exact-protocol midpoint rounding.

It imports no solver module, evaluates no physical map and modifies no file. Its passing terminal message is APEIRON_PUBLICATION_PACKAGE_VERIFY_PASS. This is package-integrity verification, not independent numerical reproduction.

5.4 Reproducibility levels

Level	Meaning	Status
V0	narrative and filenames	passed
V1	narrative and structured handoff agree	passed
V2	immutable artifacts resolved and hashes verified	passed
V2.5	stored gates, array forms and crossing identities checked read-only	passed
V3	selected physical diagnostics independently recomputed from the stored state	partial: 7/10 stricter scalar comparisons and 9/10 original gates
V4	independent implementation reproduces the classification	open
V5	observable templates preregistered and tested	not begun; AP1 methods work has not released an observable template

5.5 Independent-comparison and precision audit

The C0.29 comparison was a single preregistered passive execution. The external executor preflight passed 39/39 tests, the internal comparator preflight passed 58/58 tests, and exactly one executor and one comparator process ran. No new map, Newton, GMRES, seed or preconditioner call occurred. Seven of ten scalar rows met the stricter cross-implementation mixed tolerances, both boolean flags agreed, and nine of ten original gates agreed with the stored classification. Fixed-point and Friedmann missed only the stricter cross-implementation tolerances while still passing their original gates. The independently calculated binary64 Wronskian, 2.4628917628444214×10^-5, failed both its cross-implementation tolerance and the original 2×10^-8 gate. The registered result was therefore `independent_map_does_not_match_stored_hard_pass_classification`.

C0.30 traced the Wronskian definition and found no mathematical-definition mismatch in the mode variable, a^3/2 transform, cosmic-time conversion, H_star scaling, complex sign, sector range, normalization, node range or indexing. C0.32 then executed one separately registered no-map precision isolation using the frozen binary64 forcing. It exactly reproduced the C0.29 binary64 value and obtained 7.613423383217004×10^-9 with long-double mode arithmetic. That value passes the original gate and agrees with the stored v7.13 scalar under the registered mixed tolerance. C0.33 froze the corresponding mode/physical-transform/Wronskian/low-mode-stress source delta and passed 14/14 synthetic tests before freeze and 14/14 after fresh extraction. C0.34 separately promoted the direct order-0 PV quadrature accumulation and passed 8/8 tests before freeze and 8/8 after fresh extraction.

A source-only C0.35 audit found the corrected core quantum-source and gate implementation statically conformant in all 20 audited items. It also found one non-gating auxiliary-diagnostic definition deviation (`min_heavy_omega2` sampled at three Yoshida substep midpoints rather than the global-step midpoint), five computed auxiliary values not exposed by the final evaluation interface, and an absent `k90_over_Lambda` diagnostic. These findings do not alter the core source arrays or registered gates, but they prevent a claim of complete diagnostic-surface conformance.

The combined conclusion is deliberately narrow: the arithmetic precision path is causally sufficient for the stored Wronskian discrepancy under frozen forcing, and the corrected core source is statically conformant. Because the corrected complete physical map has not been run on the frozen input, neither v7.13 nor C0.29 has been independently confirmed by a full second implementation.

6. Gates, tolerances and classification rules

6.1 Exact v7.13 gate table

Gate	Operator	Threshold	Recorded value	Result
fixed-point infinity norm	<	5.0×10^-11	4.6838977141305804×10^-11	pass
Friedmann constraint	<	1.0×10^-10	3.818888298257304×10^-12	pass
continuity residual	<	1.0×10^-5	3.7214611922998273×10^-6	pass
Raychaudhuri residual	<	2.0×10^-5	1.4051164250399966×10^-5	pass
quantum-source identity	<	1.0×10^-7	3.883856960984437×10^-8	pass
Wronskian diagnostic	<	2.0×10^-8	7.432742701266731×10^-9	pass
minimum total density	>	0	2.0729288609194362×10^-14	pass
minimum H	>	0	8.312498343027667×10^-8	pass
minimum P_X	>	0	1.0523451240627972	pass
minimum P_X+2XP_XX	>	0	1.052350229025336	pass

Gate	Operator	Threshold	Recorded value	Result
finite	is	true	true	pass
finalization failure	is	null	null	pass

6.2 Classification logic

HARD_PASS requires every listed numerical gate to pass and the finalization-failure field to be null. PASS/NONPASS is a deterministic protocol classification. It is not a statistical p-value, likelihood statement, model-selection score or empirical verdict.

7. Results of the terminal v7.13 calculation

7.1 v7.13 endpoint

The terminal exact protocol value is

$$\tau_{HP}^{exact} = 0.4787812499999999431565811391919851303100585937 5,$$

stored as binary64

$$\tau_{HP}^{64} = 0.47878124999999994.$$

The terminal record reports one physical-map evaluation, zero Newton steps, no iteration log, no finalization failure and HARD_PASS. The exact diagnostic values and thresholds are listed in Section 6.

7.2 Immutable v6.74 counter-endpoint

The adjacent endpoint

$$\tau_{NP}^{64} = 0.47878125$$

is classified NONPASS in the immutable v6.74 record. Its fixed-point diagnostic $1.8866305739884126\times10^{-10}$ and Friedmann diagnostic $1.7440413453847122\times10^{-10}$ failed the gates registered for that result; its remaining documented gates passed. The counter-endpoint is used only for the frozen crossing classification.

7.3 Float64 crossing resolution

Quantity	Value
exact protocol bracket width	$5.684341886080801486968994140625\times10^{-17}$
binary64 bracket width	$5.551115123125783\times10^{-17}$
next exact protocol midpoint	0.478781249999999997157829056959599256515502929 6875
midpoint converted to binary64	0.47878125, the NONPASS endpoint
endpoint relation	adjacent representable binary64 values
frozen decision	schedule complete; further Float64 bisection forbidden

The bracket is a representation- and protocol-dependent classification result. It is not an exact boundary in the real numbers or a measured physical uncertainty.

8. Physical interpretation

The result establishes a narrow technical fact: the stored v7.13 state meets the frozen numerical acceptance criteria, while the adjacent stored v6.74 endpoint is NONPASS. This closes the registered Float64 continuation schedule without reopening the solver.

The result does not demonstrate that the operational equations are unique, fundamental or empirically adequate. Passing positivity and hyperbolicity gates at the terminal trajectory does not prove global stability. Small residuals do not provide observational evidence. The ontology of an Apeiron medium remains a hypothesis outside the reach of the present calculation.

The current single-carrier interpretation therefore must not be mistaken for an additional numerical result. In particular, calling dark-matter-like effects an Apeiron manifestation is a model interpretation, not a claim that existing observations have already distinguished that interpretation from particle dark matter or from ΛCDM.

The independent-comparison record adds a concrete numerical limitation. The stored reference is internally self-consistent, but the available release does not contain the complete reference residual, D_G, the ρ_q, p_q and $\langle\chi^2\rangle_q$ series, their component series, or mode invariants. Those quantities cannot be reconstructed or inferred from the scalar gate record. The precision isolation resolves the Wronskian mechanism, not the full-map comparison.

Physical plausibility requires separate work: action-level interpretation or another principled completion, perturbation dynamics, regulator and scheme analyses beyond the registered discrete scope, continuum/refinement evidence, comparison with established constraints and ultimately preregistered data tests.

9. Limits and unanswered questions

The principal open questions are:

1. Does the operational homogeneous model admit a defensible and sufficiently unique covariant completion?
2. Do the results persist under controlled grid and method refinement?
3. What are the linear scalar, vector and tensor perturbation equations?
4. Are the relevant sectors stable beyond the terminal background trajectory?
5. How is τ mapped uniquely to observable cosmological variables?
6. Does one common parameter set satisfy expansion, growth, lensing, local and gravitational-wave constraints?
7. Can an independent implementation reproduce the terminal classification?

Items 1-7 constrain interpretation and later claims. They do not alter the already completed v7.13 classification. The current AP1 methods work and the locked AP2/AP3 packages are not prerequisites for reporting this narrowly scoped numerical result, and none may be projected backward onto it.

10. Falsifiable predictions and future work

Section 10 summarizes a prospective program, not completed evidence.

10.1 AP1 - joint expansion, growth and lensing

AP1 is intended to derive $H(z)$, $w\_ap(z)$, $f\sigma\_8(z)$, $\mu(k,z)$, $\eta(k,z)$ and $\Sigma(k,z)$ from one frozen parameter core. Its separate workstream has fixed the minimal M-1 matter extension and passed bounded implementation, junction, transport and response-structure preflights through G32. The current atomic state is a methods-preflight PASS for a balanced coupled three-level pilot: the pilot through relative N=0.08 remains open, any later tolerance freeze and the disjoint N=0.085…0.10 heldout remain conditional, and the physical response kernel is blocked. AP1 therefore remains ORANGE. Before data contact it still requires a unique physical τ mapping, a released background, a computed and validated physical response kernel, closed perturbation equations, stability gates, fixed grids, priors, masks, likelihoods and versioned output templates. No such curves are reported here.

10.2 AP2 - residual filament gravity

AP2 is locked pending formal AP1 release. If unlocked, it would prospectively test a residual lensing profile after reconstruction of galaxies, gas and the declared comparison-model matter distribution:

$$\Delta\kappa_{ap} = F(r_{perp}, z, d_{node}, \text{curvature} \mid \theta_{ap}).$$

It must reuse the AP1 parameter core and pass prespecified void and rotated-axis null tests. No filament signal is claimed in this paper.

10.3 AP3 - gravitational-wave propagation

AP3 is locked pending formal AP1 and AP2 release. If unlocked, it would treat $c_{GW}=c$ as a survival condition and prospectively derive amplitude, polarization or line-of-sight observables from a closed tensor sector. No modified-propagation detection is claimed.

10.4 Cross-channel decision rule

AP1-AP3 must use one preregistered parameter core. Channel-by-channel retuning is forbidden. A conflict with any hard gate produces NONPASS for the affected hypothesis rather than retrospective adjustment of v7.13.

AP1 has executed only bounded, gate-limited methods development and remains unreleased for physical-kernel or observable production. AP2 and AP3 have not entered production work. No template values, likelihoods, curves, fits, significances or observables are reported in this manuscript.

10.5 Black-hole reconversion feasibility extension

A separate post-freeze branch tests a concept that is not part of the homogeneous v7.13 map: whether an organized Apeiron manifestation can return toward more fundamental Apeiron states in extreme black-hole curvature.

The minimal effective description introduces an organization variable

$$0 \le s \le 1,$$

with $s=1$ denoting an organized matter-like manifestation and $s=0$ a more fundamental Apeiron state. A local directed state-change law can be written as

$$u^\mu \nabla_\mu s = -\Gamma_{rec} C(K) s, \quad \Gamma_{rec} \ge 0, \quad 0 \le C(K) < 1,$$

together with one conserved total stress-energy tensor,

$$\nabla_\mu T_{AP}^{\mu\nu} = 0.$$

A local curvature-response variable K can be driven by a non-negative strong-curvature diagnostic W,

$$\tau_K u^\mu \nabla_\mu K = W - K,$$

so that the reconversion variable reacts to a smooth bounded local response rather than to an imposed coordinate radius.

The feasibility result is deliberately limited. It establishes the existence of an effective class in which one carrier, directed de-organization, positivity, local total energy-momentum conservation, causal transport and a compatible hyperbolic evolution structure can coexist. It does not establish a unique microscopic

Apeiron end state, a measured reconversion rate, a unique fundamental action or an observational detection.

The separate branch status is therefore

```
APEIRON_BH_RECONVERSION_FEASIBILITY = GO
```

at the structural-feasibility level only.

11. Conclusion

The frozen Apeiron/AME-1 v7.13 Stage-0 state at binary64 τ=0.47878124999999994 satisfies every exact registered gate and is classified HARD_PASS. The adjacent binary64 endpoint τ=0.47878125 is an immutable v6.74 NONPASS because its fixed-point and Friedmann gates fail. The exact protocol midpoint converts to the NONPASS binary64 endpoint, so the registered Float64 crossing schedule is complete.

The publication package states the operational homogeneous model, exact v7.13 thresholds, artifact hashes, the partial independent-comparison result, the Wronskian precision diagnosis and a read-only verification path. The terminal v7.13 HARD-PASS remains frozen: the later work neither lifts nor independently reconfirms it. C0.29 is an open independent-reproduction finding, C0.32 isolates a sufficient technical cause for its Wronskian conflict, and C0.33-C0.35 freeze and audit the corrected no-map source. Full independent-map reproduction, continuum convergence, complete semiclassical stability, empirical confirmation and an Apeiron ontology remain open.

This manuscript reports the frozen numerical classification at the stated reproducibility level. AP1 remains a separate ORANGE follow-up workstream, while AP2 and AP3 remain locked. None has produced an empirical result.

Version 1.2 also records, without changing that evidentiary core, the current Apeiron single-carrier ontology and the separate black-hole reconversion feasibility result. Ordinary matter, dark-matter-like and dark-energy-like phenomena are treated as possible organizations/states of one carrier within the model; this remains an unconfirmed physical hypothesis. The black-hole branch is structurally feasible but empirically open.

12. Methods and reproducibility supplement

12.1 Controlled file manifest

- `APEIRON_CANONICAL_MODEL_SPECIFICATION_LATEST.md`: operational model, equations, units, state and source hashes.
- `APEIRON_V7_13_GATE_SPECIFICATION_LATEST.json`: exact thresholds, operators, values and classification.
- `APEIRON_REPRODUCIBILITY_MANIFEST_LATEST.json`: SHA-256 manifest.
- `README_REPRODUCIBILITY.md`: verification scope and instructions.
- `verify_apeiron_publication_package.py`: read-only verifier.
- `TECHNICAL_SOURCES/STAGE00_HARD_PASS_RESULT_v7_13.json`: immutable terminal result.
- `TECHNICAL_SOURCES/STAGE00_HARD_PASS_SOLUTION_v7_13.npz`: immutable terminal arrays.
- `TECHNICAL_SOURCES/RECOVERY_GATE_REGISTER_v7_13_STAGE00.json`: immutable terminal gate register.
- `TECHNICAL_SOURCES/RECOVERY_PROTOCOL_v7_13.json`: immutable protocol.
- `TECHNICAL_SOURCES/CROSSING_RESOLUTION_RESULT_v7_13.json`: immutable crossing decision.
- `TECHNICAL_SOURCES/STAGE00_NONPASS_RESULT_v6_74.json`: immutable adjacent NONPASS result.
- `TECHNICAL_SOURCES/STAGE00_NONPASS_SOLUTION_v6_74.npz`: immutable adjacent NONPASS arrays.
- `TECHNICAL_SOURCES/RECOVERY_GATE_REGISTER_v6_74_STAGE00.json`: immutable adjacent NONPASS register.

- `TECHNICAL_SOURCES/STATE_SNAPSHOT`: terminal read-only checkpoint snapshot.
- `TECHNICAL_SOURCES/ACTIVE_RUNTIME`: hash-frozen active source path.

All exact hashes are stored in the machine-readable manifest.

12.2 Verification command

From the package root:

python3 verify_apeiron_publication_package.py

Expected terminal line:

APEIRON_PUBLICATION_PACKAGE_VERIFY_PASS

12.3 Data and code availability

Data and code supporting the reported v7.13 classification are available in the public, read-only Apeiron/AME-1 Reproducibility Archive v1.0 at https://apeiron-publication-files.info523741.chatgpt.site. The core archive contains the canonical operational specification, exact gate table, immutable result/state/protocol artifacts, active source path, hash manifest and verifier. The same public download surface separately labels later AP1 progress artifacts through the G32 methods preflight; their presence does not incorporate them into the v7.13 evidentiary core or release a physical kernel. The frozen C0.29-C0.35 audit records are available from the author on request; they are not required for the archive's read-only verification of the stored v7.13 classification. No observational dataset was analyzed.

12.4 Statistical statement

No statistical fit, parameter estimation, hypothesis-test significance, Bayes factor, information criterion or observational model comparison is reported. PASS/NONPASS denotes only deterministic numerical gate classification.

12.5 Declarations

- Author contributions: Josip Fellner: conceptualization, methodology, investigation, software direction, validation strategy, curation and writing.

- Funding: This research received no external funding.
- Competing interests: The author declares no competing interests.
- Acknowledgments: None.

- AI-assisted drafting disclosure: AI-assisted analysis, source auditing and drafting were used under author direction. The author retains responsibility for the claims, evidence boundaries and final text.

12.6 Post-freeze workstream status control

The status note in Sections 1 and 10 is bound to `APEIRON_WORKSTREAM_REGISTRY_LATEST.json`, schema `apeiron-workstream-registry-v3.0`, updated 3 September 2026 at 03:32:58 UTC, and to the contemporaneous project safeguard record `Apeiron_Sicherung_aktuell.md`. Those records classify AP1 as ORANGE at the G32 methods-preflight checkpoint, with the balanced coupled three-level pilot open and the physical kernel blocked. They also state that no physical kernel has been computed, no production curve has been released, and AP2 and AP3 remain locked. This paragraph is documentary status alignment only; it adds no numerical result to the frozen v7.13 calculation.

13. Figure, table and data inventory

13.1 Tables

Table	Content	Status
Table 1	exact v7.13 gate definitions and outcomes	complete in Section 6
Table 2	Float64 crossing resolution	complete in Section 7
Table 3	verification levels	complete in Section 5
Table 4	controlled file manifest	complete in Section 12

13.2 Machine-readable products

Product	Status
terminal result JSON and solution NPZ	included and hash-verified
exact v7.13 gate and protocol JSON	included and hash-verified
crossing-resolution JSON	included and hash-verified
adjacent v6.74 NONPASS artifacts	included and hash-verified
terminal checkpoint snapshot	included and hash-verified
active runtime source path	included and hash-verified
read-only verifier and manifest	included; PASS
C0.29 passive comparison	partial scalar diagnostic evidence; not a full reproduction
C0.30-C0.35 precision and source audits	internally frozen; no new physical-map run
AP1/AP2/AP3 outputs	AP1 methods/preflight records are separate; no observable values exist; AP2/AP3 remain locked

References

Associated reproducibility material

1. J. Fellner, *Apeiron/AME-1 Reproducibility Archive*, version 1.0 (2026), https://apeiron-publication-files.info523741.chatgpt.site (accessed 3 September 2026). The archive contains the canonical operational model specification, exact gate specification, immutable numerical artifacts, SHA-256 manifest and read-only verifier; later AP1 progress records are separately labeled on the same download surface.

External primary and official context

- IEEE, IEEE Standard for Floating-Point Arithmetic, IEEE Std 754-2019 (2019).
- Y. Saad and M. H. Schultz, “GMRES: A Generalized Minimal Residual Algorithm for Solving Nonsymmetric Linear Systems,” SIAM Journal on Scientific and Statistical Computing 7, 856-869 (1986), doi:10.1137/0907058.

The retained external sources support the numerical-method context only. No external source is used to fit, calibrate or empirically test the frozen v7.13 state.