APEIRON / AME-1 / PUBLICATION MILESTONE

Controlled Publication Master Dossier

Claims register, venue-neutral manuscript, gap audit, canonical operational model specification, and read-only reproducibility guide

v7.13 FROZEN	R1-R3 CLOSED	NO SOLVER RERUN

Scope statement

The terminal v7.13 result is reported only as a numerical gate classification of the frozen homogeneous model. The package now exposes its operational equations, exact gates, immutable artifacts, and read-only verification route. This does not claim empirical confirmation, independent numerical reproduction, a fundamental covariant action, or ontological proof. AP1-AP3 remain a prospective falsification program.

30 August 2026 / venue-neutral controlled draft

Dossier manifest

This milestone PDF is generated from the authoritative publication-latest source files. The numerical state and recovery files were not modified.

Document	Role	SHA-256
APEIRON_PUBLICATION_CLAIMS_REGISTER_LATEST.md	German internal claims audit	ef17d6be90ff1a59de7fbe7a6172c4115a142601512302acf7bd9bf44076ccf6
APEIRON_MANUSCRIPT_LATEST.md	English scientific master manuscript	4559aa3ee8cffae41407290024084bf706667275b1387a56ee48d7bb727eccc9
APEIRON_PUBLICATION_GAP_REPORT_LATEST.md	German publication gap report	d9f9307bcae733444aefafb53144b0c0f0d6a850acea32685903b62a2bfa9909
APEIRON_CANONICAL_MODEL_SPECIFICATION_LATEST.md	Canonical operational model specification	9f9fa5454e7e298c7344a240db6672644335302f8459fb59c74c30bb82c897e4
README_REPRODUCIBILITY.md	Read-only reproducibility guide	ffbbbd3cc38a04c1ffaa223f35d9a9b4e097c5847f720ba4c80652b52b2e7530
APEIRON_V7_13_GATE_SPECIFICATION_LATEST.json	Machine-readable exact v7.13 gate table	64e44a228e856814b66c129ce7fe741797b8cbe75756b684c582827bd72f71de
APEIRON_REPRODUCIBILITY_MANIFEST_LATEST.json	Machine-readable SHA-256 manifest	eb5475e0f327d340b8f33d1b4b3ea00af9a779a9a4a241a20f886184d44cdec1
APEIRON_PUBLICATION_REPRODUCIBILITY_PACKAGE_LATEST.zip	Tested reproducibility ZIP	801f19dc26808184ccf4dfa33dd5429831c42fdba0b2048d16fd7c50b6ae0ac2

Reading order

Part I fixes the publication claim ceiling. Part II is the venue-neutral manuscript. Part III records remaining gaps. Part IV states the canonical operational model. Part V gives the read-only verification instructions.

Part I - Controlled claims register

German internal audit and publication-language ceiling

Apeiron - Publikations-Claims-Register (Latest)

Version: 1.1-red-blockers-closed Stand: 30. August 2026 Sprache: interne Auditdokumentation Deutsch Status: Claims-Freeze aktualisiert; R1-R3 dokumentarisch geschlossen; numerische Linie unverändert

1. Zweck und Geltungsbereich

Dieses Register begrenzt die erste venue-neutrale Grundlagenpublikation auf den nachweisbaren Stand. Der terminale v7.13-HARD-PASS, der v6.74-NONPASS-Gegenendpunkt und die Float64-Crossing-Klassifikation bleiben eingefroren. Es wurde kein Solver gestartet, kein Diagnosewert aus den Feldgleichungen neu berechnet und keine Klassifikation wiederholt.

Die neu aufgenommenen technischen Quellen schließen die bisherigen Dokumentationslücken zu operationalen Gleichungen, Freiheitsgraden, Einheiten, v7.13-Gates und Artefaktintegrität. Sie liefern keine fundamentale Wirkung, keine Kontinuumsanalyse, keine Störungstheorie und keine empirische Bestätigung. Anlage A bleibt ein zukünftiges Forschungsprogramm.

2. Autoritative Evidenzbasis

Kürzel	Quelle	Verwendbarer Nachweis	Integrität / Status
H1	START_HERE_APEIRON_LATEST.md, Eingangsstand dieses Arbeitsblocks	terminaler Stand, Verbote, Resume-Punkt	Eingangs-SHA-256 81d93733e869e17166e177f88aba9224729c16265ab33d7d6ea58edb9085c35e
H2	CURRENT_PROJECT_STATE_LATEST.json, Eingangsstand dieses Arbeitsblocks	strukturierte Werte, Klassifikationen und Freeze-Regeln	Eingangs-SHA-256 50224e7714752eda017406cd6465de09b4f0e1a68e87e4613a2b511cfbd91da3
A1	Apeiron_Anlage_A_Falsifizierbare_Vorhersagen_v1.0_2026-08-30.pdf	Abgrenzung und Prospektivstatus AP1-AP3	SHA-256 145ed65884c63d65c0e6fd042266cbb01e4d2babcdd370ac43745695ae62c532
S1	APEIRON_CANONICAL_MODEL_SPECIFICATION_LATEST.md	operationale homogene Gleichungen, Einheiten, Parameter, Freiheitsgrade, diskrete Abbildung	Version 1.0; aktiver Quellpfad hashgebunden
G1	APEIRON_V7_13_GATE_SPECIFICATION_LATEST.json	exakte v7.13-Schwellen, Operatoren, beobachtete Werte und Klassifikationsregel	Version 1.0; auf Protokoll, Gate-Register und Resultat gehasht
M1	APEIRON_REPRODUCIBILITY_MANIFEST_LATEST.json	SHA-256-Verzeichnis der Resultate, Zustände, Protokolle und aktiven Quellen	Version 1.0
V1	verify_apeiron_publication_package.py	read-only Hash-, Identitäts-, Form-, Gate- und Crossing-Prüfung	PASS; keine Solverimporte und keine Auswertung der physikalischen Abbildung
U1	STAGE00_HARD_PASS_RESULT_v7_13.json	terminale Werte, Klassifikation, Evaluationsanzahl	SHA-256 030f83d808d00cafbe2eba9d80385ce9dde7b7b6193ebe46f87000a748411c5f
U2	STAGE00_HARD_PASS_SOLUTION_v7_13.npz	gespeicherte Arrays t, y, x, tau	SHA-256 72c01e17d8416d84264fa8ab8f33980f8ffd770203ace2f8078b86a42d4c3b53
U3	RECOVERY_GATE_REGISTER_v7_13_STAGE00.json	v7.13-Gates und HARD_PASS	SHA-256 1cd8d5008f0a6d599dadc81e36fb32ca86a81dec34576e8935269f1781267245
U4	RECOVERY_PROTOCOL_v7_13.json	strikte Schwellen, Dimension, Solverbudget, Protokoll-tau	SHA-256 25697b2dc6e15cfac4ca1393ea5521b31ca120f54710308c370057da98137129
U5	CROSSING_RESOLUTION_RESULT_v7_13.json	Float64-Nachbarschaft und Abbruchregel	SHA-256 87f899702f5d46abb2cf26affad67946a6fd8140b67402b2f23bf984afba098f
U6	v6.74 NONPASS-Resultat, -Solution und Gate-Register	unveränderlicher Gegenendpunkt und seine eigene Klassifikation	Hashes in M1
U7	CURRENT_STATE_LATEST.npz, MASTER_RECOVERY_STATE_LATEST.json, CURRENT_META_LATEST.json	terminale Checkpointidentität, Arrays und Evaluation-Meta	Hashes in M1; nur gelesen
U8	aktive Laufzeitquellen aus dem Latest-Runtime-Capsule	exakte operationale Implementierung	Einzelhashes in S1 und M1

Evidenzregel: Resultatwerte stammen aus U1/U3/U5 beziehungsweise U6. Schwellen stammen aus U3/U4/G1 und niemals aus einer Schätzung anhand der Resultatwerte. Gleichungen stammen nur aus dem aktiven, in U8 identifizierten Ausführungspfad. S1 macht diesen Pfad publikationslesbar, erhebt ihn aber nicht nachträglich zu einer fundamentalen Wirkung.

3. Klassifikationsvokabular

Klasse	Bedeutung
Modellpostulat	gesetzte physikalische oder ontologische Ausgangsannahme
mathematisch innerhalb des Modells hergeleitet	folgt aus den angegebenen operationalen Gleichungen oder aus IEEE-754-Arithmetik
numerisch demonstriert	im eingefrorenen diskreten Lauf berechnet und gespeichert
durch Gates oder Klassifikation bestätigt	erfüllt die vorregistrierte numerische Entscheidungsregel
wissenschaftliche Interpretation	vorsichtige Bedeutungsaussage jenseits des Zahlenwerts
offene Hypothese	noch nicht hergeleitete oder gemessene physikalische Aussage
zukünftige messbare Vorhersage	prospektiver Observable- oder Nulltest aus Anlage A
unzulässige oder noch nicht gedeckte Überaussage	wird durch den Evidenzsatz nicht getragen

4. Zentrale Claims

4.1 Modell, Gleichungen und diskrete Definition

ID	Aussage	Klasse	Exakter Nachweis	Maximal zulässige Publikationsformulierung	Unzulässige stärkere Formulierung
C-001	Untersucht wird ein eingefrorenes homogenes Apeiron/AME-1-FRW-Modell.	Modellpostulat / dokumentierte Struktur	S1 Abs. 1-3; U8	“We study a frozen homogeneous FRW numerical model, operationally denoted Apeiron/AME-1.”	“Apeiron is established as the fundamental substrate of nature.”
C-002	Natürliche Einheiten, $M_{pl} = 1$, $\tau = H_{star}\, t$, flaches FRW und $H > 0$ definieren den operationalen Rahmen.	Modellpostulat	S1 Abs. 2	“The registered implementation uses the units, time coordinate and expanding flat-FRW branch stated in the supplement.”	“These conventions are uniquely required by nature.”
C-003	Die aktive diskrete Zustandsvariable umfasst sechs Trajektorienspalten; der Vollcontainer umfasst acht.	Modellpostulat / dokumentierte Struktur	S1 Abs. 3; U2; U7	“The fixed-point vector stores six scaled trajectory columns; the released solution container stores eight columns.”	“The theory has exactly six fundamental degrees of freedom.”
C-004	Homogenes χ wird nicht iteriert; der χ-Sektor tritt über ρ_q, p_q und $\langle\chi^2\rangle_q$ ein.	Modellpostulat / operational definiert	S1 Abs. 3 und 6; U8	“The registered homogeneous map couples the portal sector through renormalized mode expectation values rather than an iterated homogeneous χ coordinate.”	“All possible χ dynamics have been solved.”
C-005	Die Druckfunktion P, ihre Ableitungen, der Portalterm und die homogenen Gleichungen sind operational angegeben.	mathematisch innerhalb des Modells definiert	S1 Abs. 5-7; U8-Hashes	“The supplement provides the defining homogeneous pressure, derivatives, portal terms and evolution map used by v7.13.”	“A unique fundamental covariant action has been derived.”
C-006	Die positive Friedmann-Wurzel schließt H in der Bildabbildung; Raychaudhuri bleibt ein unabhängiger Diagnoseweg.	mathematisch innerhalb des Modells definiert	S1 Abs. 7 und 9; rb23-Hash in U8	“The image map imposes the positive Friedmann branch and audits the Raychaudhuri relation independently.”	“General covariance is thereby proven.”
C-007	Das diskrete Gitter besitzt 15361 Knoten und der Float64-Vektor 92166 Komponenten.	Modellpostulat / numerische Methode	S1 Abs. 3 und 9; U2; U4	“The frozen discretization contains 15361 nodes and a 92166-component Float64 fixed-point vector.”	“The continuum solution is established.”
C-008	Die aktive Laufzeitquelle ist durch Einzelhashes gebunden.	Dokumentationsnachweis	S1 Abs. 10; M1	“The operational definition is tied to the hash-identified active runtime sources.”	“The implementation is independently certified as bug-free.”
C-009	Eine eindeutige fundamentale Wirkung ist nicht Bestandteil des Belegsatzes.	offene wissenschaftliche Lücke	S1 Abs. 1 und 11	“The present paper defines the homogeneous model operationally and does not claim a unique fundamental covariant action.”	Jede Behauptung, eine fundamentale Wirkung sei bewiesen oder eindeutig.

4.2 v7.13-Methode, Gates und Ergebnis

ID	Aussage	Klasse	Exakter Nachweis	Maximal zulässige Publikationsformulierung	Unzulässige stärkere Formulierung
C-010	v7.13 Stage 0 verwendet binär τ = 0.47878124999999994 und den dokumentierten exakten Protokollwert.	numerisch demonstriert	U1, U3, U4, G1	“The terminal Stage-0 evaluation used the stated binary64 endpoint and exact protocol decimal.”	“τ is a measured constant of nature.”
C-011	v7.13 wurde einmal aus dem hashverifizierten v7.12-HARD-PASS initialisiert.	Dokumentationsnachweis	H1/H2; U4	“The persistent protocol records one initialization from the immutable v7.12 HARD-PASS state.”	“The entire history was independently rerun.”
C-012	Der geerbte Zustand erfüllte bereits das Fixed-Point-Gate; v7.13 führte null Newton-Schritte aus.	numerisch demonstriert / klassifiziert	U1, U3, U7; G1	“The inherited v7.13 state passed the fixed-point criterion before any Newton update; zero Newton steps were executed.”	“The solver converges without iteration for arbitrary states.”
C-013	Fixed-Point und Friedmann betragen 4.6838977141305804e-11 und 3.818888298257304e-12.	numerisch demonstriert	U1, U3, G1	“The recorded fixed-point and Friedmann diagnostics are the stated values.”	“Both equations are exact.”
C-014	Kontinuität, Raychaudhuri, Quantensource und Wronskian haben die gespeicherten Werte.	numerisch demonstriert	U1, U3, G1	“The recorded terminal diagnostics are 3.7214611922998273e-06, 1.4051164250399966e-05, 3.883856960984437e-08 and 7.432742701266731e-09, respectively.”	“Their smallness confirms physical reality.”
C-015	Die Positivitäts- und Hyperbolizitätsminima sind positiv und Endlichkeit ist wahr.	numerisch demonstriert / durch Gates bestätigt	G1: min ρ = 2.0729288609194362e-14; min H = 8.312498343027667e-08; min P_X = 1.0523451240627972; min kinetischer Nenner = 1.0523502290253336	“The recorded positivity, hyperbolicity and finiteness gates pass at the terminal state.”	“Global stability and causality are proven.”
C-016	Die strikten Schwellen sind FP < 5e-11, Friedmann < 1e-10, Kontinuität < 1e-5, Raychaudhuri < 2e-5, Quantensource < 1e-7 und Wronskian < 2e-8.	Modellpostulat / registrierte Klassifikationsregel	U3, U4, G1	“The terminal classification uses the exact strict thresholds listed in the released gate specification.”	Schwellen aus den beobachteten Werten herleiten oder nachträglich lockern.
C-017	Weitere Gates verlangen ρ > 0, H > 0, P_X > 0, kinetischen Nenner > 0, Endlichkeit wahr und keinen Finalisierungsfehler.	registrierte Klassifikationsregel	U3, U4, G1	“The remaining gates impose the listed positivity, hyperbolicity, finiteness and finalization conditions.”	“Passing these local gates proves full theoretical consistency.”
C-018	Alle v7.13-Gates bestanden; die Klassifikation lautet HARD_PASS.	durch Gates oder Klassifikation bestätigt	U1, U3, G1	“Under the frozen v7.13 protocol, Stage 0 satisfies every registered gate and is classified HARD_PASS.”	“Apeiron is empirically confirmed.”
C-019	Das registrierte Budget umfasst maximal 6 Newton-Schritte, GMRES restart 10, höchstens 16 Zyklen, rtol 0.05, JVP-Schritt 1e-5 und 13 Halbierungs-Alphas.	Modellpostulat / reproduzierbare Methode	U4, G1	“The released protocol records the stated nonlinear-solver budget, although v7.13 consumed no Newton update.”	“These settings are universally optimal.”
C-020	Die v7.13-Solution enthält t, y, x und tau in den registrierten Formen und Float64.	Dokumentationsnachweis	U2; V1 PASS	“The released solution arrays have the registered keys, shapes and Float64 dtypes.”	“The stored trajectory was independently recomputed.”

4.3 Gegenendpunkt, Crossing und Reproduzierbarkeit

ID	Aussage	Klasse	Exakter Nachweis	Maximal zulässige Publikationsformulierung	Unzulässige stärkere Formulierung
C-021	v6.74 bei $\tau = 0.47878125$ ist NONPASS; Fixed Point und Friedmann verfehlten seine registrierten Gates.	numerisch demonstriert / klassifiziert	U6; H1/H2	“The immutable v6.74 endpoint is NONPASS because its fixed-point and Friedmann gates fail.”	“Nature is unstable above this value.”
C-022	Die v6.74-Toleranzen dürfen nicht als v7.13-Schwellen verwendet werden.	Klassifikationsregel	G1; U3/U4 versus U6	“The historical v6.74 gate table is not substituted for the strict v7.13 table.”	Gate-Tabellen vermischen.
C-023	v7.13-HARD-PASS und v6.74-NONPASS sind benachbarte Float64-Werte.	mathematisch innerhalb IEEE-754 / dokumentiert	U5; V1 PASS	“The two classified binary64 endpoints are adjacent representable values.”	“The exact physical transition has been located.”
C-024	Der exakte Protokollmittelpunkt rundet auf den NONPASS-Binärwert; weitere Float64-Bisektion ist verboten.	mathematisch innerhalb des Protokolls / Klassifikationsregel	U5; V1 PASS mit Decimal- und nextafter-Prüfung	“The exact protocol midpoint maps to the recorded NONPASS binary64 endpoint; the frozen Float64 schedule therefore terminates.”	“No intermediate real number exists.”
C-025	Der read-only Verifier bestätigt Hashes, Identitäten, Formen, gespeicherte Gatevergleiche und Crossing-Regeln.	Dokumentationsnachweis	M1; V1 PASS	“A read-only verifier confirms package integrity and documentary consistency.”	“The physical calculation was independently reproduced.”
C-026	Im Publikationsaudit wurde weder der Solver noch die physikalische Abbildung ausgeführt.	wissenschaftliche Abgrenzung	V1 Quelltext; Meta; Prozessprotokoll	“The audit performed no solver rerun and recomputed no physical diagnostic.”	“The v7.13 result has been independently numerically reproduced.”
C-027	Das Paket ist bis zur read-only Integritätsstufe reproduzierbar; unabhängige Implementierungsreproduktion bleibt offen.	wissenschaftliche Interpretation	README_REPRODUCIBILITY.md; M1; V1	“The release supports file-level and documentary verification; independent implementation-level reproduction remains future work.”	“Complete independent reproducibility has been achieved.”

4.4 Physik, Empirie und Ontologie

ID	Aussage	Klasse	Exakter Nachweis	Maximal zulässige Publikationsformulierung	Unzulässige stärkere Formulierung
C-030	Der HARD_PASS belegt technische Gate-Erfüllung für diesen diskreten Zustand.	wissenschaftliche Interpretation	C-010-C-020	“The HARD-PASS establishes compliance with the registered numerical criteria for the frozen discretization.”	“The whole theory is correct.”
C-031	Der HARD_PASS ist keine Kontinuumskonvergenz oder globale Stabilitätsaussage.	Abgrenzung	S1 Abs. 9; keine entsprechende Evidenz	“No continuum-convergence or global-stability claim is made.”	“The continuum theory is stable.”
C-032	Der HARD_PASS ist keine empirische Bestätigung.	Abgrenzung	A1; keine Datenanalyse	“No observational comparison is reported; empirical support remains open.”	“Observations confirm Apeiron.”
C-033	Der HARD_PASS ist keine ontologische Bestätigung eines Apeiron-Mediums.	Abgrenzung	S1 Abs. 1; A1	“The calculation does not establish an Apeiron ontology.”	“The medium has been detected.”
C-034	Physikalische Plausibilität ist von technischer Korrektheit zu trennen.	wissenschaftliche Interpretation	S1; Lückenbericht	“Internal numerical consistency is necessary but insufficient for physical plausibility.”	“Numerical consistency makes the model physically true.”
C-035	Ein eindeutiges physikalisches Mapping von τ ist offen.	offene Hypothese / Grenze	A1 AP1	“The physical mapping of τ is deferred to AP1.”	“τ already equals redshift, time or scale factor in a unique way.”
C-036	Lineare Störungen und etablierte Beobachtungsgrenzen sind nicht im v7.13-Ergebnis enthalten.	offene wissenschaftliche Lücke	A1; S1 Abs. 1	“Perturbations and observational consistency require separate follow-up analysis.”	“v7.13 passes cosmological observations.”

4.5 Zukünftige falsifizierbare Vorhersagen

ID	Aussage	Klasse	Exakter Nachweis	Maximal zulässige Publikationsformulierung	Unzulässige stärkere Formulierung
C-040	AP1 soll Expansion, Wachstum und Lensing mit einem gemeinsamen Parametersatz ableiten.	zukünftige messbare Vorhersage	A1 S. 3-4	“AP1 prospectively targets a jointly parameterized expansion-growth-lensing observable vector.”	“The curves are already predicted.”
C-041	AP1 setzt eindeutiges τ-Mapping, geschlossene Störungen und Stabilitätsgates vor Datenkontakt voraus.	zukünftiges methodisches Gate	A1 S. 4 und 9	“AP1 proceeds only after the physical map, perturbations and preregistered stability checks are fixed.”	“These prerequisites are already fulfilled.”
C-042	AP2 definiert einen zukünftigen Filament-Residual test mit Materierekonstruktion und Nulltests.	offene Hypothese / zukünftige Vorhersage	A1 S. 5, 7-8	“AP2 will test a preregistered residual filament-lensing profile after matter reconstruction and null tests.”	“Filaments already show Apeiron gravity.”
C-043	AP3 behandelt c_GW = c als Überlebensbedingung und soll mögliche Propagationsobservablen ableiten.	offene Hypothese / zukünftige Vorhersage	A1 S. 6	“AP3 is a prospective tensor-sector test constrained by the gravitational-wave speed condition.”	“Apeiron causes measured GW damping or polarization.”
C-044	AP1-AP3 müssen einen gemeinsamen eingefrorenen Parameterkern verwenden.	Modellpostulat für zukünftige Falsifikation	A1 S. 1, 3, 7-8	“The program forbids independent channel-by-channel retuning.”	“Three separate fits jointly confirm Apeiron.”
C-045	Anlage A ist kein empirischer Nachweis und kein Teil des HARD_PASS.	Abgrenzung	A1 S. 1-2 und 9	“Appendix A is a prospective falsification roadmap, separate from v7.13.”	“AP1-AP3 were validated by v7.13.”
C-046	Es existieren keine freigegebenen Vorhersagekurven, Messwerte oder empirischen PASS-Ergebnisse.	Abgrenzung	A1; Publikationspaket	“No observable template, fitted curve or empirical PASS is claimed.”	Erfundene Kurven, Signifikanzen oder Best-fit-Werte.

4.6 Publikationsstatus und ausgeschlossene Motive

ID	Aussage	Klasse	Exakter Nachweis	Maximal zulässige Publikationsformulierung	Unzulässige stärkere Formulierung
C-050	Der wissenschaftlich-technische Kern kann nun als kontrollierter Preprintentwurf paketiert werden.	Dokumentierter Status	S1, G1, M1, V1 PASS; Manuskript; Lückenbericht	“The controlled technical core is documented for preprint packaging, subject to editorial and administrative completion.”	“The work is peer-reviewed, accepted or empirically validated.”
C-051	Eine Journaleinreichung benötigt weiterhin Autorenangaben, Deklarationen, Venue-Format und finale Archiv-/Lizenzangaben.	redaktionelle Grenze	Manuskriptplatzhalter; Publikationsmeta	“Venue-specific submission preparation remains outstanding.”	“The journal submission package is complete.”
C-052	Genesis, ewiger Kreislauf, reale Apeiron-Filamente und Schwarze Löcher als Apeiron-Fenster sind im aktuellen Ergebnisscope nicht belegt.	unzulässige Überaussage	fehlen in H1/H2/A1/S1/G1	“These motifs are not results of the present numerical-foundations paper.”	“The calculation proves any of these motifs.”

5. Fünf strikt getrennte Aussageebenen

1. Technische Korrektheit des Rechenteils: Die eingefrorenen Resultat-, Zustands-, Protokoll- und Gate-Dateien sind hashverifiziert und dokumentarisch konsistent. V1 ist keine neue numerische Reproduktion.
2. Konsistenz des dokumentierten Modells: v7.13 erfüllt die exakten registrierten Gates des angegebenen homogenen diskreten Modells.
3. Physikalische Plausibilität: bleibt teilweise offen; insbesondere fehlen Kontinuumsnachweis, Störungen, globale Stabilität und vollständige externe Konsistenztests.
4. Empirische Bestätigung: nicht vorhanden; AP1-AP3 sind prospektiv.
5. Ontologische Interpretation: ein Apeiron-Medium bleibt Modellpostulat beziehungsweise offene Hypothese.

6. Kontrollierte Wortwahl

Ausdruck	Zulässig	Unzulässig
Beweis	elementare Float64-Nachbarschaft, ausdrücklich auf Repräsentation begrenzt	physikalische Existenz oder Wahrheit von Apeiron
Bestätigung	Bestätigung der gespeicherten Gate-Erfüllung oder Dateiintegrität	Bestätigung der Theorie oder empirische Bestätigung
Nachweis	Dokumentations- oder Integritätsnachweis mit genauer Quelle	Nachweis eines Mediums oder neuer Gravitation
stabil	nur bestandene lokale Hyperbolizitäts-/Positivitätsgates am angegebenen Zustand	globale, nichtlineare oder kosmologische Stabilität
Grenze	Float64-Klassifikationsklammer unter dem gefrorenen Protokoll	exakte physikalische Phasengrenze
reproduziert	nur bei echter unabhängiger Neuberechnung	für den read-only Dokumentationsprüfer

7. Claims-Freeze

Die Claims C-001 bis C-052 sind der aktualisierte interne Freeze. Externe Literatur darf Motivation, methodischen Kontext und Beobachtungsgrenzen ergänzen, aber weder die eingefrorene interne Modellabbildung ändern noch fehlende Physik ersetzen. Stärkere Aussagen als die Spalte “maximal zulässige Publikationsformulierung” sind ausgeschlossen.

Part II - Venue-neutral master manuscript

English scientific draft with numerical results, limitations, and future falsification program

Apeiron/AME-1: Terminal Numerical Classification of a Frozen Homogeneous Model and a Prospective Falsification Program

Venue-neutral master manuscript - controlled technical draft Author(s): [AUTHORSHIP TO BE PROVIDED] Affiliation(s): [AFFILIATION TO BE PROVIDED] Corresponding author: [TO BE PROVIDED] Status: technical core documented for preprint packaging; venue-specific and administrative completion outstanding Numerical reference: terminal v7.13 Stage-0 HARD-PASS; Float64 crossing schedule complete and frozen

1. Title and cautious abstract

Abstract

We report the terminal numerical classification of a frozen homogeneous Apeiron/AME-1 model and separate this result from physical, empirical and ontological claims. The 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 τ=0.47878124999999994, corresponding to the exact protocol decimal 0.4787812499999999431565811391919851303100585937 5, 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 4.6838977141305804×10^-11, 3.818888298257304×10^-12, 3.7214611922998273×10^-6, 1.4051164250399966×10^-5, 3.883856960984437×10^-8 and 7.432742701266731×10^-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 τ=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 release includes the operational equations, exact gate table, hash manifest, immutable artifacts and a read-only integrity verifier. This verifier does not rerun the solver or recompute physical diagnostics. The result therefore establishes compliance with the stated numerical criteria for this discretization, not continuum convergence, empirical confirmation or an Apeiron ontology. AP1-AP3 are presented only as a prospective falsification program; no observable curve, data fit or empirical preference is claimed.

Keywords: numerical cosmology; fixed-point residual; gate classification; binary64 boundary; reproducibility; falsifiability

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 authoritative publication definition is operational: the variables, parameters, pressure function, portal coupling, quantum-source prescription, background equations, initial data, discretization and active source hashes are stated in APEIRON_CANONICAL_MODEL_SPECIFICATION_LATEST.md.

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,qquad (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 τ=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.

4. Frozen assumptions, degrees of freedom and equations

4.1 Stored state and degrees of freedom

The full trajectory container is

```
mathbf y=(σ,dotσ,θ,dotθ,chi,dotchi,H,N).
```

The iterated state uses six columns,

```
mathbf u=(σ,dotσ,θ,dotθ,H,N),
```

while the homogeneous chi bookkeeping coordinate is fixed to zero. The portal sector enters through renormalized mode expectation values rho_q, p_q and ⟨chi^2⟩_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

```
mathbf x=vec≤ft( frac{σ{10^-2, frac{dotσ{10^-8, θ, frac{dotθ{10^-8, frac{H{10^-6, frac{N{10^-1 ),
```

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

4.2 Homogeneous pressure

Define

```
X=frac12dotθ^2,quad z=(σ)/(f_σ),quad b=b_star+b_ slopefrac{θ{M_ pl-(5X)/(Lambda^4),
```

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

The registered pressure is

$$P(X,\sigma,\theta) =X+\frac{5}{3\Lambda^4} \le\ft(z-\frac{2}{\sqrt{3}}\right)^2X^2 -E_{cF}(z,b)-V_s(\theta),$$

where $V_s(\theta)=\sum_{i=0}^4c_i\theta^i$ 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

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

4.3 Portal and quantum source

The field-dependent portal mass is

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

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 $0\le k\le 0.6\Lambda$, 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

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

4.4 Registered background map

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

$$\ddot\sigma=-3H\dot\sigma+P_\sigma -\frac{1}{2}\partial_\sigma m_\chi^2(\chi^2)_q,$$

$$\ddot\theta= \frac{ P_\theta-\frac{1}{2}\partial_\theta m_\chi^2(\chi^2)_q -3HP_X\dot\theta-P_{X\sigma}\dot\sigma\dot\theta}{ P_X+2XP_{XX} ,$$

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

The Raychaudhuri relation

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

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 $\mathbf G$,

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

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 $\Delta\tau=\tau_{\mathrm{end}}/15360$. 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 APEIRON_REPRODUCIBILITY_MANIFEST_LATEST.json. 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 accompanying verifier:

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	physical diagnostics independently recomputed from the stored state	not performed
V4	independent implementation reproduces the classification	open
V5	observable templates preregistered and tested	not begun

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+2 XP_XX	>	0	1.052350229025336	pass
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

```
τ_ HP^ exact =0.47878124999999994315658113919198513031005859375,
```

stored as binary64

```
τ_ 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

```
τ_ NP^64=0.47878125
```

is classified NONPASS in the immutable v6.74 record. Its fixed-point diagnostic 1.8866305739884126×10^-10 and Friedmann diagnostic 1.7440413453847122×10^-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	5.6843418860808014869689941406 25×10^-17
binary64 bracket width	5.551115123125783×10^-17
next exact protocol midpoint	0.47878124999999997157829056959599256515502 9296875
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.

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. AP1-AP3 are not prerequisites for reporting this narrowly scoped numerical result.

10. Falsifiable predictions and future work

Appendix A defines a prospective program, not completed evidence.

10.1 AP1 - joint expansion, growth and lensing

AP1 is intended to derive H(z), w_ ap(z), fσ_8(z), μ(k,z), η(k,z) and Σ(k,z) from one frozen parameter core. Before data contact it requires a unique physical τ mapping, 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 prospectively tests a residual lensing profile after reconstruction of galaxies, gas and the declared comparison-model matter distribution:

```
Δκ_ ap =F(r_⊥,z,d_ node,{ curvature|θ_ 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 treats c_ GW=c as a survival condition and prospectively derives 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.

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 now states the operational homogeneous model, exact v7.13 thresholds, artifact hashes and a read-only verification path. These additions close the former documentary blockers without recomputing the physics. They do not establish continuum convergence, empirical confirmation or an Apeiron ontology. The technical core is suitable for controlled preprint packaging after editorial and administrative completion; venue-specific journal submission preparation remains outstanding. AP1-AP3 remain separate follow-up work.

12. Methods and reproducibility supplement

12.1 Controlled file manifest

File	Role
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 - controlled draft

The accompanying publication distribution contains the canonical operational specification, exact gate table, immutable result/state/protocol artifacts, active source path and read-only verifier. A permanent repository identifier, license and venue-specific availability wording remain to be assigned. 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: [TO BE PROVIDED]
- Funding: [TO BE PROVIDED]
- Competing interests: [TO BE PROVIDED]
- Acknowledgments: [TO BE PROVIDED]
- Data/code license: [TO BE PROVIDED]
- AI-assisted drafting disclosure: [TO BE DECIDED ACCORDING TO VENUE POLICY]

13. Figure, table and data inventory

13.1 Figures

Figure	Content	Status
Fig. 1	separation of numerical classification, physical interpretation and future empirical test	specified; artwork pending
Fig. 2	adjacent v7.13 HARD_PASS and v6.74 NONPASS binary64 endpoints	data fully specified; artwork pending
Fig. 3	AP1 → AP2 → AP3 dependency and common parameter freeze	concept specified in Appendix A; artwork pending

13.2 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

13.3 Machine-readable products

Product	Status
terminal result JSON and solution NPZ	included and hashverified
exact v7.13 gate and protocol JSON	included and hashverified
crossing-resolution JSON	included and hashverified
adjacent v6.74 NONPASS artifacts	included and hashverified
terminal checkpoint snapshot	included and hashverified
active runtime source path	included and hashverified
read-only verifier and manifest	included; PASS
AP1/AP2/AP3 templates	future work; no values exist

References

Internal controlled sources

1. Apeiron - Start Here, latest persistent checkpoint.
2. Apeiron current project state, latest structured checkpoint.
3. Apeiron/AME-1 - Canonical Operational Model Specification, version 1.0.
4. Apeiron v7.13 - Exact Gate Specification, version 1.0.
5. Apeiron - Reproducibility Manifest and Read-only Verifier, version 1.0.
6. Apeiron/AME-1 Appendix A: Falsifiable Predictions - Guide for the Next Three Work Packages, version 1.0, 30 August 2026.

External primary and official context

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- E. Belgacem, Y. Dirian, S. Foffa and M. Maggiore, “Modified gravitational-wave propagation and standard sirens,” Physical Review D 98, 023510 (2018), arXiv:1805.08731.

These sources provide context only. They do not modify the internal Apeiron model or elevate AP1-AP3 to completed predictions.

Part III - Publication gap report

German traffic-light audit and controlled resume point

Apeiron - Publikationslückenbericht (Latest)

Version: 1.1-red-blockers-closed Stand: 30. August 2026 Geltung: erste venue-neutrale Grundlagenpublikation auf Basis des eingefrorenen v7.13-Rechenteils Gesamtstatus: frühere dokumentarische Blocker R-01 bis R-03 geschlossen; technischer Kern für kontrollierte Preprint-Paketierung geeignet; Journaleinreichung formal noch nicht vollständig

1. Gesamturteil

Der v7.13-HARD-PASS, der benachbarte v6.74-NONPASS und die Float64-Abbruchklassifikation sind exakt dokumentiert. Die früher fehlenden publikationskritischen Angaben wurden aus dem autoritativen Latest-Runtime-Pfad und den unveränderlichen Artefakten erschlossen, ohne Solverausführung und ohne Neuberechnung:

- operationale homogene Modellgleichungen, Einheiten, Freiheitsgrade, Parameter und diskrete Abbildung;
- exakte v7.13-Gates, Schwellen, Operatoren und Solverbudgets;
- einzeln hashgebundene Resultat-, Zustands-, Protokoll-, Crossing- und aktive Quelldateien;
- read-only Verifier mit PASS.

Damit sind R-01 bis R-03 als Dokumentationsblocker geschlossen. Nicht geschlossen sind Wirkungsfundierung, Kontinuumskonvergenz, Störungen, unabhängige numerische Reproduktion und empirische Prüfung. Diese Punkte begrenzen die wissenschaftliche Reichweite, machen den engen Bericht über die eingefrorene numerische Klassifikation aber nicht automatisch unpublizierbar.

2. Ampelregister

Grün - veröffentlichungsfähig und belegt

ID	Punkt	Beleg / Ergebnis	Publikationshandlung
G-01	terminaler v7.13-HARD-PASS	U1/U3/G1; Claims C-010-C-020	Werte, exakte Schwellen und Klassifikation dürfen repräsentationsbezogen berichtet werden.
G-02	v6.74-NONPASS-Gegenendpunkt	U6; Claims C-021/C-022	nur mit seiner eigenen unveränderlichen Gate-Klassifikation berichten.
G-03	Float64-Crossing	U5; V1 PASS; Claims C-023/C-024	als Abschluss der gefrorenen binären Suche, nicht als physikalische Naturgrenze.
G-04	operationale Modelloffenlegung	S1; aktive Quellen in M1	homogene Gleichungen, Einheiten, Parameter, Zustand und diskrete Abbildung publizierbar.
G-05	exakte v7.13-Gate-Tabelle	G1; U3/U4	im Haupttext und maschinenlesbar vollständig enthalten.
G-06	hashgebundene Reproduzierbarkeitsstufe V2.5	M1; V1 PASS; README	als read-only Integritäts- und Konsistenzprüfung bezeichnen.
G-07	Trennung von Numerik, Physik, Empirie und Ontologie	Claims-Register Abs. 5-6	in Abstract, Interpretation und Schluss beibehalten.
G-08	AP1-AP3 als Folgeprogramm	A1; Claims C-040-C-046	ausschließlich prospektiv; keine Kurven oder Mess-PASS.
G-09	venue-neutrales Mastermanuskript	APEIRON_MANUSCRIPT_LATEST.md, Abs. 1-13	technische Kernstruktur vollständig.
G-10	Terminologie-Audit	Claims-Register; konservativer Manuskriptwortlaut	starke Begriffe nur technisch eingegrenzt oder negiert.

Gelb - redaktionell oder formal noch zu bearbeiten

ID	Punkt	Risiko	Nächste Handlung
Y-01	Zielplattform und Zielzeitschrift	unterschiedliche Format-, Umfangs- und Supplementregeln	venue-neutral belassen, bis Entscheidung vorliegt.
Y-02	Autoren, Zugehörigkeit und korrespondierende Person	Pflichtangaben fehlen	nur autorisiert ergänzen; Platzhalter bis dahin beibehalten.
Y-03	CRediT, Finanzierung, Interessenkonflikte, Danksagung und KI-Disclosure	venue- und personenspezifisch	vor Einreichung autorisiert ausfüllen.
Y-04	permanente Archivkennung und Lizenz	öffentliche Dateiseite ist kein Ersatz für DOI/Repository-Lizenz	Zenodo, OSF oder institutionelles Archiv bei Freigabe wählen.
Y-05	Abbildungen	drei Figuren sind inhaltlich definiert, aber noch nicht gesetzt	nur aus belegten Daten beziehungsweise als konzeptuelle Grafik erstellen.
Y-06	Referenzstil und Literaturvollständigkeit	venue-abhängig	nach Journalwahl formatieren und finale Quellenprüfung durchführen.
Y-07	finales Sprachlektorat	englische Stil- und Symbolkonsistenz	nach inhaltlichem Freeze durchführen.
Y-08	Meilenstein-PDF	vorhandenes Dossier bildet den vorherigen Stand ab	nach Paketabschluss neu erzeugen und visuell prüfen.

Orange - wissenschaftlich relevant, aber noch nicht ausreichend gestützt

ID	Punkt	Warum orange	Behandlung
O-01	fundamentale covariante Wirkung	S1 definiert das Modell operational, nicht fundamental	als Grenze nennen; für diese enge numerische Publikation keine Wirkung erfinden.
O-02	Kontinuums-/Gitterkonvergenz	nicht durch Latest-Evidenz belegt	Scope auf die eingefrorene Diskretisierung begrenzen.
O-03	unabhängige numerische Reproduktion	V1 prüft Dateien, rechnet aber nicht neu	zukünftige externe oder clean-room Reproduktion.
O-04	globale und nichtlineare Stabilität	terminale lokale Gates reichen nicht	ausdrücklich nicht beanspruchen.
O-05	eindeutiges physikalisches Mapping von τ	in A1 als AP1-Aufgabe offen	kein Mapping zu z oder a erfinden.
O-06	lineare Störungen und Observable-Kurven	noch nicht geschlossen hergeleitet	AP1; nicht Teil des HARD_PASS.
O-07	AP2-Filamentprofil	offene Hypothese	Folgearbeit mit Materierekonstruktion und Nulltests.
O-08	AP3-GW-Propagation	Tensorsektor noch nicht hergeleitet	Folgearbeit; $c_{GW} = c$ als harte Bedingung.
O-09	vollständige physikalische Plausibilität	Vergleich mit allen etablierten Grenzen fehlt	keine Gesamtbestätigung behaupten.

Rot - unzulässige Aussage

Die früheren R-01 bis R-03 sind geschlossen und werden nicht mehr als Rot geführt. Verbleibende rote Punkte sind Aussagen, die nicht durch redaktionelle Nacharbeit gerettet werden dürfen.

ID	Punkt	Art	Konservative Entscheidung
R-04	“Apeiron ist empirisch bestätigt, bewiesen oder nachgewiesen”	unzulässige Überaussage	vollständig ausschließen.
R-05	“Der Float64-Endpunkt ist die exakte physikalische Übergangsgrenze”	unzulässige Überaussage	nur repräsentationsabhängige Klassifikationsklammer behaupten.
R-06	erfundene AP1-AP3-Kurven, Signifikanzen oder Mess-PASS	Daten-/Ergebnisfiktion	vollständig ausschließen.

ID	Punkt	Art	Konservative Entscheidung
R-07	Genesis, ewiger Kreislauf, reale Apeiron-Filamente oder Schwarze Löcher als Apeiron-Fenster als Ergebnis dieses Rechenteils	unbelegte Scope-Ausweitung	im aktuellen Manuskript nicht als Ergebnis führen.
R-08	“vollständig unabhängig reproduziert”	unzutreffende Methodenbehauptung	read-only Integritätsprüfung klar von Neuberechnung trennen.
R-09	“fundamentale covariante Wirkung bewiesen”	unzutreffende Modellbehauptung	operationale Spezifikation nicht als Wirkungsherleitung ausgeben.

3. Publikationsfähigkeit nach Aussageebene

Ebene	Status	Urteil
technische Artefaktintegrität	Grün	Hashes, Identitäten, Formen und gespeicherte Gatevergleiche bestehen V1.
operationale Reproduzierbarkeit	Grün	Gleichungen, Parameter, Diskretisierung, Gates, Artefakte und aktiver Quellpfad sind paketiert.
unabhängige numerische Reproduktion	Orange	keine neue Ausführung; bewusst nicht behauptet.
interne numerische Modellkonsistenz	Grün, eng begrenzt	v7.13 erfüllt die exakten Gates der gefrorenen Diskretisierung.
fundamentale Modellvollständigkeit	Orange	keine eindeutige covariante Wirkung oder Störungstheorie.
physikalische Plausibilität	Orange	zusätzliche Theorie- und Vergleichsarbeit nötig.
empirische Bestätigung	keine	AP1-AP3 sind prospektiv.
ontologische Interpretation	Hypothese	aus dem Rechenteil nicht ableitbar.
Preprint-Paketierung	Grün/Gelb	technischer Kern vorhanden; Autoren-, Lizenz-, Archiv- und Layoutangaben offen.
Journaleinreichung	Gelb	keine roten technischen Dokumentationsblocker mehr, aber Pflichtangaben und Venue-Format fehlen.

4. Abschluss der früheren roten Blocker

früherer Blocker	Abschlussartefakt	Abschlussprüfung
R-01: Gleichungen, Freiheitsgrade, Einheiten, Konventionen	APEIRON_CANONICAL_MODEL_SPECIFICATION_LATEST.md	gegen den aktiven hashgebundenen Runtime-Pfad dokumentiert; keine Wirkung erfunden
R-02: exakte Gates und Toleranzen	APEIRON_V7_13_GATE_SPECIFICATION_LATEST.json	Identität von Protokoll- und Registerschwellen geprüft
R-03: einzeln auflösbare Artefakte und Verifikationsweg	Manifest, technische Quellen, README, read-only Verifier	APEIRON_PUBLICATION_PACKAGE_VERIFY_PASS

5. Nächste grüne oder gelbe Aufgabe

Y-04 ist auf Paketebene abgearbeitet: APEIRON_PUBLICATION_REPRODUCIBILITY_PACKAGE_LATEST.zip wurde mit SHA-256 801f19dc26808184ccf4dfa33dd5429831c42fdba0b2048d16fd7c50b6ae0ac2 erstellt, der ZIP-Strukturtest bestand, und der aus einer temporären Entpackung gestartete read-only Verifier meldete PASS. Offen bleibt nur die spätere Wahl eines permanenten DOI-Archivs und einer Lizenz.

Als nächste gelbe Aufgabe folgt Y-08: Aktualisierung des Meilenstein-PDFs und visuelle Prüfung. Danach werden Meta, beide Latest-Handoffs und die öffentliche Dateiseite konsistent fortgeschrieben.

Part IV - Canonical operational model specification

Frozen homogeneous equations, variables, units, parameters, and active-source hashes

Apeiron/AME-1 - Canonical Operational Model Specification

Version: 1.0 Status: frozen technical supplement for the first numerical-foundations publication Date: 2026-08-30 Authority: active execution path in APEIRON_FAST_RUNTIME_LATEST.zip, Library version 53, SHA-256 9b0d9212250a6b475b9a56647d0b34f7d8f87c0912c1ec9c004530a674951985

1. Scope and epistemic boundary

This is the canonical operational definition of the homogeneous model that produced the frozen v7.13 classification. It specifies variables, pressure function, background equations, quantum-source closure, discrete fixed-point map, initial data, units and conventions.

It does not assert a unique fundamental covariant action, perturbation theory, ontology or empirical confirmation. For the narrowly scoped numerical-foundations paper, the equations and executable map below are authoritative. An action-level completion would be new physics and cannot be projected backward onto v7.13.

2. Units, geometry and time

- Natural units: $c = \hbar = 1$.
- Reduced Planck mass as internal mass unit: $M_{pl} = 1$.
- Spatially flat homogeneous FRW background, scale factor a, e-fold variable $N = \ln(a)$, expanding branch $H > 0$.
- A dot denotes differentiation with respect to cosmic time t.
- Dimensionless numerical time:

$\tau = H_{star}\, t \quad d/d\tau = (1/H_{star})\, d/dt$

- Noncanonical kinetic scalar:

$X = 0.5\, (\dot{\theta})^2$

- Scalar fields and mass parameters have mass dimension one. X, pressure and energy density have mass dimension four.

The operational sign convention is fixed by the equations below. A metric-signature convention not used explicitly by the homogeneous implementation is not added here.

3. Degrees of freedom and stored state

3.1 Homogeneous state

The full eight-column trajectory container is

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

In the registered v7.13 map the homogeneous bookkeeping coordinate χ is fixed to zero. The dynamically iterated six-column state is

$u(\tau) = (\sigma, \dot{\sigma}, \theta, \dot{\theta}, H, N)$.

The χ sector enters through the renormalized mode expectation values $\rho_q(\tau)$, $p_q(\tau)$ and $\langle\chi^2\rangle_q(\tau)$, not through an independently iterated homogeneous χ.

3.2 Discrete vector

The frozen grid has $N_\tau = 15361$ nodes. The solver vector is the flattened and scaled array

$x = \mathrm{vec}[\ \sigma/(1e\text{-}2),\ \dot\sigma/(1e\text{-}8),\ \theta/1,\ \dot\theta/(1e\text{-}8),\ H/(1e\text{-}6),\ N/(1e\text{-}1)\ ]$

with shape (92166,) and Float64 dtype.

Array	Shape	dtype	Meaning
t	(15361,)	Float64	dimensionless τ grid
y	(15361, 8)	Float64	full trajectory container
x	(92166,)	Float64	scaled flattened six-column iterate
tau	scalar	Float64	active terminal value

During unpacking, first-node σ, dot σ, θ, dot θ and N are reset to the frozen background initial data. First-node H remains in the active state; the image map then imposes the positive Friedmann closure.

3.3 Auxiliary and constrained quantities

- H is algebraically reconstructed from the positive Friedmann branch inside the registered image map.
- N obeys dot N = H.
- Quantum modes and Pauli-Villars regulator sectors are auxiliary arrays used to construct ρ_q, p_q and $\langle\chi^2\rangle_q$; they are not independent entries of x.
- Gate diagnostics are not additional dynamical degrees of freedom.

4. Frozen parameters

4.1 AME parameters

Symbol	Value	Code name
M_{pl}	1	Mpl
Λ	2.3e-3	Lambda
f_σ	2.5e-2	f_sigma
E_c / V_{star}	4.0e-2	Ec_over_V
H_{star}	2.0e-6	Hstar
b_{star}	0.35	bstar
$d\,b / d(\theta/M_{pl})$	-4.78e-2	b_slope
A_{eff}	6.86e-3	Aeff
B_{eff}	-1.74e-2	Beff

$V_{star} = 3\,M_{pl}^2\,H_{star}^2$ $E_c = 0.04\,V_{star}$

A_{eff} and B_{eff} remain in parameter provenance; the active global pressure completion in Section 5 is the quartic polynomial $V_s(\theta)$.

4.2 Portal and regulator parameters

Quantity	Value
phase scale f_phase	0.8549468502440697
displacement v	0.03272387838931097
coupling λ	1.6740193604000272e-5
bare portal mass m_χ,0	9.817951142008693e-5
physical-mode support at initial slice	0 ≤ k ≤ 0.6 Λ
physical quadrature nodes	128
renormalization scale	μ_R = 1.5 Λ
UV order-0 switch	16 Λ
curvature-tail limit	64 Λ
tail nodes per octave	20

5. Effective AME pressure and derivatives

Define

$z = \sigma/f_\sigma$ $b(X, \theta) = b_{star} + b_{slope}\,(\theta/M_{pl}) - 5X/\Lambda^4$ $F(z,b) = z^4/4 - z^2/2 + bz$ $V_s(\theta) = \Sigma(i=0..4)\ c_i\ \theta\hat{}i$

with

$(c_0,c_1,c_2,c_3,c_4) = (\ 1.1971212004620583e-11,\ 9.87022611239063e-14,\ -1.0336424891583054e-13,\ 1.1894904991061 38e-10,\ 1.2236365189926054e-10\ )$

The homogeneous pressure function is

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

- $E_c\,F(z,b)$
- $V_s(\theta)$.

The executable derivatives are

$P_X = 1 + [10/(3\Lambda^4)]\,(z - 2/\sqrt{3})^2\,X + 5\,E_c\,z/\Lambda^4$

$P_{XX} = [10/(3\Lambda^4)]\,(z - 2/\sqrt{3})^2$

$P_\sigma = \{\ [10/(3\Lambda^4)]\,(z - 2/\sqrt{3})\,X^2$

- $E_c\,(z^3 - z + b)\,/\,f_\sigma$

$P_\theta = -E_c\,z\,b_{slope}/M_{pl} - V_s'(\theta)$

$P_{X\sigma} = \{\ [20/(3\Lambda^4)]\,(z - 2/\sqrt{3})\,X + 5\,E_c/\Lambda^4\ /\ f_\sigma$.

AME stress:

$\rho_{AME} = 0.5\,(\dot{\sigma})^2 + 2X\,P_X - P$ $p_{AME} = 0.5\,(\dot{\sigma})^2 + P$.

Hyperbolicity diagnostics:

$P_X > 0$ $P_X + 2X\,P_{XX} > 0$.

6. Portal and quantum source

Field-dependent portal mass:

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

$\partial m_\chi^2/\partial\sigma = 4\lambda(v+\sigma)\cos(2\theta/f_{phase})$

$\partial m_\chi^2/\partial\theta = -[4\lambda(v+\sigma)^2/f_{phase}]\sin(2\theta/f_{phase})$.

Four Pauli-Villars sectors:

$C_j = (1,-3,3,-1)$ $J_j = (0,1,2,3)$ $M_j^2 = m_\chi^2 + J_j\,\mu_R^2$.

Modes are advanced by a three-substep Yoshida composition of the implicit-midpoint map for u = a^(3/2) χ. Initial mode data are

u_k(0) = 1/sqrt(2ω_k(0)) dot u_k(0) = -i ω_k(0) u_k(0).

The active source combines resolved modes, the analytic order-0 UV tail and auxiliary adiabatic curvature orders 2 and 4. Finite renormalization is fixed on the initial flat-space reference slice as recorded by the active runtime:

- ρ_q(0) = 0;
- <χ²>_q(0) = 0;
- initial quantum pressure is predicted by the fixed prescription rather than tuned as a gate;
- the Einstein-Hilbert response is fixed by the zero-curvature response;
- the finite R² coefficient is zero.

The routine returns ρ_q(τ), p_q(τ) and <χ²>_q(τ). Its source identity is

dot ρ_q + 3H(ρ_q+p_q)

- 0.5 (dot m_χ²) <χ²>_q = 0,

evaluated as a normalized numerical diagnostic.

7. Registered homogeneous equations

With

ρ_tot = ρ_AME + ρ_q p_tot = p_AME + p_q,

the registered image map integrates

dσ/dt = v_σ

dv_σ/dt = -3H v_σ + P_σ

- 0.5 (∂m_χ²/∂σ) <χ²>_q

dθ/dt = v_θ

dv_θ/dt = { P_θ

- 0.5 (∂m_χ²/∂θ) <χ²>_q
- 3H P_X v_θ
- P_Xσ v_σ v_θ

/ (P_X + 2X P_XX)

H = +sqrt[ρ_tot/(3 M_pl²)]

dN/dt = H.

The Raychaudhuri relation

dH/dt = -(ρ_tot+p_tot)/(2 M_pl²)

is evaluated independently rather than used as the evolution equation in this image map.

8. Initial data

θ(0) = -0.690 ε_0 = 2.35e-5 N(0) = 0

dot θ(0) = -sqrt(2 ε_0) M_pl H_star / sqrt(1.3)

dot σ(0) = 0.

σ(0) = f_σ z_+, where z_+ is the positive local minimum satisfying

z³ - z + b(θ(0)) = 0 3z² - 1 > 0.

The initial Hubble value is the positive Friedmann root. Homogeneous portal bookkeeping data are χ(0) = dot χ(0) = 0. No spatial boundary conditions occur because the registered model is homogeneous.

9. Canonical discrete fixed-point map

For active endpoint τ_end,

Δτ = τ_end / 15360.

The canonical image map G(x;τ_end):

1. creates the uniform 15361-node τ grid and frozen background seed;
2. unpacks x into the six active trajectory columns using Section 3.2;
3. imposes frozen first-node conditions;
4. calculates renormalized quantum-source arrays with the fixed portal and PV prescription;
5. advances (σ, dot σ, θ, dot θ, N) by classical fourth-order Runge-Kutta while imposing the positive Friedmann root for H;
6. lifts the result to the eight-column container and repacks the six active columns.

Residual and fixed-point diagnostic:

R(x;τ) = x - G(x;τ) δ_FP = ||R||_infinity.

This is complete for the frozen homogeneous discrete map. It does not license continuum, perturbative, global-stability or observational claims.

10. Active-source provenance

Source file	SHA-256	Role
model.py	db4c0fa9cf4f2013fef299f558ca7b6b509d17c1acbd76f84ece6bd2dd0c5a65	parameters and pressure primitives
frw_noncanonical_background_v6_6.py	f96b13df83e6d6dce8f9bec073e2aab24c23660073cee994d25a327f2b61f7f1	homogeneous equations and initial data
frw_pv_fixed_mpl_renorm_v6_17.py	aecd4dc3202604228d1a46c1a4cb439b874e129314e55378e1fbb5b999df482d	stress tensor, renormalization and diagnostics
frw_pv_covariant_uv_complete_v6_22.py	9c54b4095845687b9824dab66da91031436b67a5decd01055ef487b14b4c19b7	UV-tail closure
frw_pv_uv_yoshida_v6_31.py	8fa1b93a2f24377c751f3d9fdffe700394cdb2e00842fc4dc5f35d19ae3943e1	registered mode evolution
rb19_anderson_uv_v6_24.py	8323bbf6c6f3e23e1d466addf5cceb94af2517934fddd50ce8fcef4ae04fcc2c	state packing
rb23_friedmann_closure_uv_v6_28.py	873d3eca436d28b4261623957917087b0dd2efdf3b95509b9fb97d1fe4f5d7bc	Friedmann map and Raychaudhuri audit
rb_recovery_fixedtau_v6_64.py	5082e44cf9c60ca9ef1eaa0ba1ccda7d968d19f61ea1d3d2e9c7581be82ee72b	fixed-point and solver base
rb_recovery_adaptive_v7_13.py	8854c5847f9da3e67994701a20e8f4f6e9372c0a65da3f2f3ea0fd7017f81205	v7.13 wrapper and schedule

Filename version labels record dependency origin. They appear only because these files form the active hash-frozen execution path of the Latest runtime. No alternative historical model is reconstructed.

11. Licensed publication statement

Maximum supported wording:

> Apeiron/AME-1 v7.13 is a frozen homogeneous FRW numerical model defined operationally by the equations, parameters, state map, quantum closure, discretization and hash-identified active runtime sources in this supplement.

Inadmissible stronger wording:

> The supplement proves a unique fundamental or covariant theory of Apeiron.

Part V - Read-only reproducibility guide

Package scope, verification command, and epistemic boundary

Apeiron v7.13 - Read-only Reproducibility Package

Scope

This package verifies the integrity and documentary consistency of the frozen v7.13 terminal result and the adjacent v6.74 NONPASS endpoint. It does not start a solver, evaluate the physical map, repeat the crossing search, or alter any state.

Run

```
python3 verify_apeiron_publication_package.py
```

Expected terminal line:

```
APEIRON_PUBLICATION_PACKAGE_VERIFY_PASS
```

Verification levels

1. SHA-256 verification of every registered artifact and active source.
2. JSON schema/key and cross-document identity checks.
3. NPZ key, shape, dtype, and stored-τ checks.
4. Documentary comparison of recorded diagnostics with the immutable threshold table.
5. Float64-adjacency plus exact protocol-decimal midpoint and recorded binary64-rounding checks.

No diagnostic is recomputed from the physical equations. The script only verifies the already recorded values and classifications.

Environment

- Python 3.12.13
- NumPy 2.3.5
- SciPy is not required for this read-only verifier.

Directory structure

- `APEIRON_CANONICAL_MODEL_SPECIFICATION_LATEST.md`: canonical operational equations and conventions.
- `APEIRON_V7_13_GATE_SPECIFICATION_LATEST.json`: exact v7.13 thresholds and rules.
- `APEIRON_REPRODUCIBILITY_MANIFEST_LATEST.json`: hash manifest.
- `TECHNICAL_SOURCES/`: immutable result, state, protocol, gate, crossing, and active-source files.
- `verify_apeiron_publication_package.py`: read-only integrity verifier.

Scientific boundary

A successful verification confirms that the released files match the frozen documented package and that their recorded values are internally consistent. It is not an independent numerical reproduction, empirical validation, or ontological proof.