

Falsifiable Predictions

Guide for the Next Three Work Packages

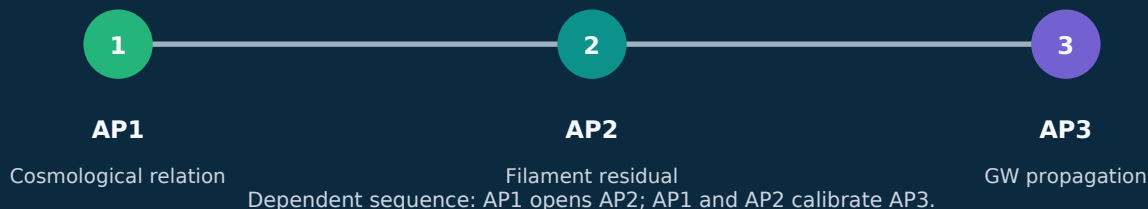
RESEARCH GUIDE v1.0

COMPANION TO v7.13

THE FIRST OBSERVATIONAL PATH

One parameter set - three independent measurement channels

Apeiron is intended to connect expansion, structure formation, filament gravity and gravitational waves through the same frozen model parameters rather than by independently retuning each sector.



SCIENTIFIC SCOPE

This appendix is not part of the stored v7.13 protocol HARD-PASS result. It defines new predictions that still need to be derived and tested. No item may be described as evidence for Apeiron before its derivation and preregistered test are complete.

Version 1.0 - 30 August 2026

Status: roadmap released; quantitative observables have not yet been derived

WHY THIS APPENDIX EXISTS

A clean bridge from model to measurement

The terminal computation remains frozen. This appendix begins where observability and genuine falsifiability start.

THIS APPENDIX IS

A prioritized research roadmap
A separation of assumptions from predictions
A plan for parameter freeze and blind tests
A definition of stopping and falsification points

THIS APPENDIX IS NOT

A retrospective modification of v7.13 Evidence for the Apeiron ontology
Permission for unrestricted parameter retuning
A claim that deviations have already been detected

STATUS

V7.13 COMPUTATION

FROZEN The stored protocol
HARD-PASS remains authoritative.

PREDICTIONS

IN PROGRESS No quantitative
observable curves have been released.

EMPIRICAL EVIDENCE

OPEN No observational
preference for Apeiron is claimed.

EVIDENCE CHAIN

ONTOLOGY

Apeiron idea

MATHEMATICS

AME-1

TEMPLATE

frozen

DATA

blind test

ASSESSMENT

PASS/NONPASS

GUIDING PRINCIPLE

An observation counts as an Apeiron test only if its curve was derived from the model, versioned and frozen before comparison with data. Any later adjustment creates a new version and must not rescue the original test.

WHY THE SEQUENCE IS FIXED

Three work packages - one shared parameter set

AP1 establishes the physical mapping and linear dynamics. Only then can filaments and gravitational waves consistently test the same Apeiron core.

AP1

Expansion, growth and lensing

Map tau physically; derive linear perturbations; generate $H(z)$, $f\sigma_8$, μ , η and Σ .

EXIT ARTIFACT Observable Dictionary + frozen cosmology templates

AP2

Residual filament gravity

Derive 3D perturbations, filament profile, lensing, velocity and node relations.

EXIT ARTIFACT Filament template $\Delta\kappa_{ap}(r,z,d_{node})$

AP3

Gravitational-wave propagation

Derive the tensor sector, standard-siren, polarization and filament line-of-sight tests.

EXIT ARTIFACT GW template dL_{GW}/dL_{EM} and polarization

NO PARALLEL RELEASE

AP2 and AP3 may be prepared conceptually, but neither may release final numerical values before AP1 has frozen the common parameter basis and the physical meaning of tau.

PRIORITY 1

Predict expansion, growth and lensing jointly

Apeiron must use the same parameters to describe background expansion, matter growth and light deflection.

CORE HYPOTHESIS

If Apeiron carries cosmological dynamics, deviations in $w_{\text{ap}}(z)$, $\mu(k,z)$, $\eta(k,z)$ and $\Sigma(k,z)$ must be rigidly linked by one shared AME-1 coupling. Independent adjustment of each function is not permitted.

OBSERVABLE VECTOR TO BE PRODUCED

 $H(z)$ $w_{\text{ap}}(z)$ $f\sigma_8(z)$ $\mu(k,z)$ $\eta(k,z)$ $\Sigma(k,z)$

DERIVATION STEPS

- 1 Map tau**
Define a unique relation to a field value, scale factor or redshift.
- 2 Linearize perturbations**
Derive scalar and metric perturbations from the frozen action.
- 3 Check stability**
Apply ghost, gradient, hyperbolicity and finiteness gates before data contact.
- 4 Generate templates**
Export curves on fixed z and k grids in machine-readable form.
- 5 Freeze parameters**
Version priors, calibration parameters, data masks and statistics.

MEASUREMENT CHANNELS

Expansion: BAO + supernovae $\rightarrow H(z)$, $D_A(z)$ | Growth: RSD + galaxy velocities $\rightarrow f\sigma_8(z)$ | Lensing: galaxy + CMB lensing $\rightarrow \Sigma(k,z)$, $\Phi+\Psi$

AP1 EXIT GATE

PASS to AP2 only with a stable, unique and versioned observable vector using one parameter set. NONPASS if perturbations are unstable, tau lacks a unique physical mapping, or expansion and growth require separate retuning.

PRIORITY 2

Test additional gravity in cosmic filaments

Apeiron filaments constitute an independent prediction only if a fixed gravitational residual profile remains after complete matter reconstruction.

CORE HYPOTHESIS

The observed lensing effect of a filament cannot be fully explained by the reconstructed distribution of galaxies, gas and standard dark matter. The remaining $\Delta\kappa_{\text{ap}}$ follows an AME-1-derived profile and increases systematically near nodes.

MEASUREMENT GEOMETRY



Cross-section r_{perp} - node distance - redshift - filament curvature

PREDICTION FUNCTION

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

LENSING

Stacked convergence and shear profiles

DYNAMICS

Peculiar velocities and infall toward nodes

ENVIRONMENT

Filaments and nodes; voids as null controls

AP2 EXIT GATE

PASS to AP3 only if sign, amplitude, radial profile and node scaling are fixed before observational analysis and reuse θ_{ap} from AP1. NONPASS if $\Delta\kappa_{\text{ap}}$ is zero after matter reconstruction, lacks a robust profile, or requires new independent filament parameters.

MANDATORY NULL TEST: identical pipeline on voids and randomly rotated filament axes.

PRIORITY 3

Gravitational waves and light through the same Apeiron sector

A viable prediction keeps $c_{\text{GW}} = c$ while testing a coupled modification of amplitude, polarization or line-of-sight dependence.

CORE HYPOTHESIS

The AME-1 tensor sector produces a small, precomputed difference between electromagnetic and gravitational luminosity distances. Any filament dependence must follow the same θ_{ap} already fixed by AP1 and AP2.

CORE OBSERVABLE

$$dL_{\text{GW}} / dL_{\text{EM}} = 1 + \Delta_{\text{ap}}(z, \text{integral } K_{\text{ap}} ds \mid \theta_{\text{ap}})$$

TEST CHANNELS

SPEED

$c_{\text{GW}} = c$ as a hard survival condition

AMPLITUDE

Standard sirens against EM distance

POLARIZATION

Additional scalar component with fixed amplitude

LINE OF SIGHT

Correlation with filament and node column

DERIVATION AND SAFEGUARDS

- Derive the tensor action: no phenomenological extra damping without an AME-1 origin.
- Stability before data contact: no ghosts, gradient instability or inadmissible superluminality.
- Shared parameters: no new GW coupling unless independently required by theory.
- Blind line-of-sight analysis: classify filaments before evaluating GW residuals.

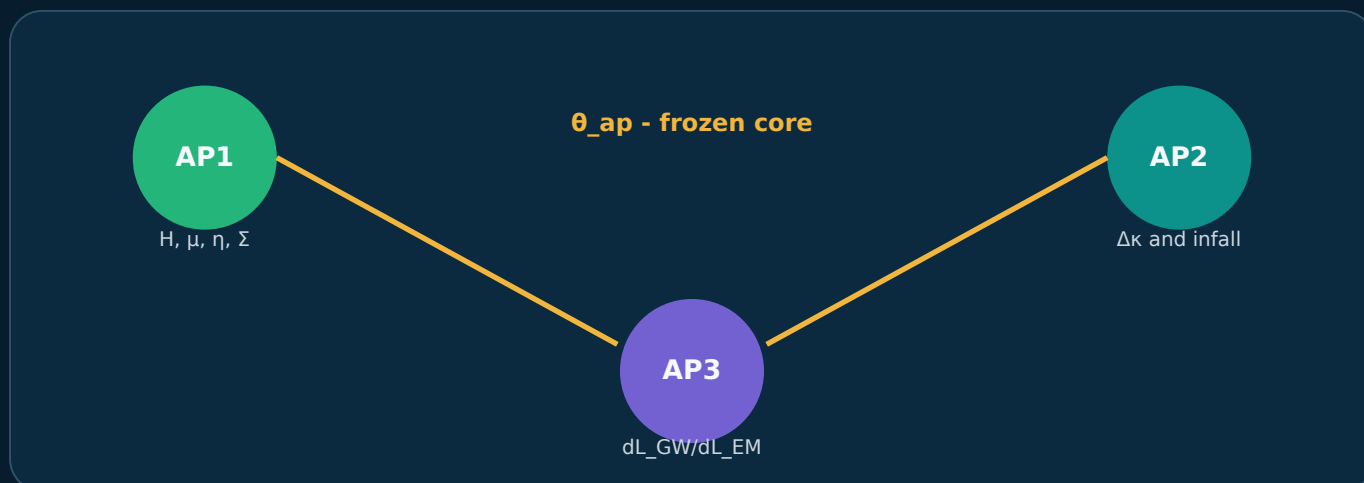
AP3 EXIT GATE

PASS only if speed, amplitude relation and any polarization follow from a stable tensor sector and are numerically fixed by AP1/AP2 parameters. Otherwise NONPASS.

PROTECTION AGAINST RETUNING

One parameter set must support all three channels

Scientific value comes from cross-channel relations. Every added free parameter weakens the claim and requires theoretical justification before data contact.



FREEZE PROTOCOL

F-01	Action and degrees of freedom	Version formulas, conventions and units.
F-02	Parameters and priors	Fix ranges and physical rationale before data contact.
F-03	Observable grids	Freeze z, k, r and frequency grids plus interpolation.
F-04	Data selection	Register catalog versions, masks, cuts and null tests.
F-05	Statistics	Preregister likelihood, comparator and decision thresholds.
F-06	Hash and release	Cryptographically freeze templates; changes create a new version.

CHANGE RULE

After the freeze, a change must not rescue the running test. It opens a new, clearly identified model version with its own prediction and assessment.

WHAT MUST ULTIMATELY BE DECIDED

Every work package needs a possible failure

Without a predefined NONPASS condition, a statement is not a robust prediction but a retrospective interpretation.

AP	OBSERVABLE	DATA CHANNEL	PASS TARGET	NONPASS
AP1	$H, f\sigma_8, \mu, \eta, \Sigma$	BAO, SN, RSD, lensing	one θ_{ap} covers all channels	instability or separate retuning
AP2	$\Delta\kappa_{ap}$ and infall	filament lensing + velocities	fixed profile and node scaling	null residual or wrong profile
AP3	dL_{GW}/dL_{EM}	standard sirens + EM	fixed z /line-of-sight relation	existing bounds exclude effect
AP3	polarization	LVK network	fixed admissible scalar fraction	no shared AME-1 derivation
TOTAL	cross-relation	all channels jointly	one frozen Apeiron core	channel-specific free parameters needed

AN OVERALL PASS IS STRICTER THAN THREE INDIVIDUAL PASSES

Apeiron gains scientific force only if AP1, AP2 and AP3 remain compatible with the same frozen θ_{ap} . Three separately tuned successes do not count as overall confirmation. Numerical significance and model-comparison thresholds must be fixed in the publication audit before the first data fit; until then, no empirical PASS may be declared.

RELEASE TO START

The next concrete work block begins with AP1

The publication-critical next step is not another Float64 boundary search, but the physical mapping of tau and derivation of the linear observable vector.

AP1 START CHECKLIST

- **S1 - Adopt status**
v7.13 remains unchanged; this appendix is a new roadmap.
- **S2 - Symbol table**
Record all fields, units, signs and conventions.
- **S3 - Tau mapping**
Select and mathematically justify one physical mapping.
- **S4 - Perturbations**
Derive the full linear scalar and metric system.
- **S5 - Stability gates**
Compute and document them before observational data.
- **S6 - Observable export**
Output H , w , $f\sigma_8$, μ , η and Σ on fixed grids.
- **S7 - Freeze**
Release templates, parameters, priors and hashes.

FIRST DELIVERABLE

APEIRON_AP1_ OBSERVABLE_ DICTIONARY_v1.0

Definition of tau, fields, parameters, observables, grids, stability gates and export format. No data fit.

STOP RULES

- tau remains ambiguous
- perturbation system is not closed
- ghost or gradient instability
- observable requires new free physics
- data are inspected before freeze

PUBLICATION AND MEASUREMENT SOURCES

- DESI DR2 - BAO and cosmology: [arXiv:2503.14738](https://arxiv.org/abs/2503.14738)
- Weak-lensing filaments: [arXiv:2510.26318v1](https://arxiv.org/abs/2510.26318v1)
- GWTC-3 - Tests of General Relativity: Phys. Rev. D 112, 084080
- LIGO - Black-hole spectroscopy: ligo.org/science-summaries/gw250114_tgr/

RELEASE STATEMENT

AP1 may begin. AP2 and AP3 remain preparatory until the AP1 freeze. This appendix neither changes nor reinterprets the stored v7.13 protocol HARD-PASS, its gates or its Float64 crossing classification.