

Apeiron Technical Appendix - Internal EFT Spectrum and Constrained Microscopic Completion

Version: 1.0

Date: 19 September 2026

Relation to main preprint: technical supplement to Apeiron Preprint v1.3; does not modify the frozen v7.13 numerical classification.

A. Epistemic classification

This appendix records only the microstructure/UV results supplied as closed in the research branch. It distinguishes derived EFT results from conditional UV interpretation. No unique fundamental Apeiron microtheory is claimed.

B. Frozen vacuum and physical eigenmodes

The controlled internal EFT vacuum supports physically normalized eigenmodes:

- radial/heavy σ mode;
- light phase θ mode;
- Z_2^χ -protected χ mode.

Neighboring tachyonic χ phases are part of the mapped phase structure and delimit the controlled vacuum region.

C. Interacting EFT and tree unitarity

The binding corrected canonical four-point coefficient is

$$c_{X^2}^{(\phi_1)} = 3.91305380277 \times 10^{11} M_{\text{Pl}}^{-4}.$$

The corresponding tree-level unitarity scale is

$$\Lambda_{\text{unit}} = 1.28824506 \Lambda.$$

The previous intermediate values 2.9131×10^{11} and $\Lambda_{\text{unit}}/\Lambda = 1.38688$ are superseded.

D. Higher derivative and one-loop $O(p^6)$ structure

The finite χ -induced contribution is

$$C_6^{(\chi)} = -21.0925 M_{\text{Pl}}^{-6},$$

and the closed one-loop stu/ϵ block gives

$$\beta_{C_6} = -2.85893108646 \times 10^{12} M_{\text{Pl}}^{-6}.$$

E. Minimal heavy-mediator matching

Within the tested minimal matching classes, the structurally preferred class is a heavy linearly coupled Gaussian scalar mediator. The current boundary is

$$\boxed{\text{APEIRON UV MATCHING BOUNDARY: BOUNDED}}.$$

The surviving minimal completion is a **quantitative one-parameter UV family** with one microscopic parameter M_S and

$$1 < M_S/\Lambda \lesssim 1.28824506.$$

This is a conditional UV interpretation constrained by the EFT, not a unique fundamental derivation.

F. Remaining test

The required open object is

$$\boxed{\text{physical nonlocal response kernel still required}}.$$

Without that kernel, M_S is not independently determined by a pole/mediator analysis. A future nonlocal-response calculation can therefore either select a value within the family, further constrain it, or exclude this minimal completion.