

Addendum 350a: Dark Energy as the Growing Cokernel

The faithful void model and the gentle- w_a prediction

(Extends Paper 38; supersedes the fold-density dark energy of Addenda 348a/349)

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Abstract

The 345a–349a line dynamised dark energy as a fold-progress density, $\Lambda(k) = \Lambda_0 \cdot 4/C(k)$. This addendum corrects that on conceptual grounds and rebuilds the treatment on the footing the TOE actually supplies. Paper 38 fixes dark energy as the *cokernel* — the embedding defect, the unreachable void, of measure $\Lambda_0 = 1 - \pi^2/32$ — paired with dark *matter* as the *kernel* (the fold). Indexing dark energy by the fold-completion count $C(k)$ drove the cokernel with the *kernel's* clock: a cross-wiring of the two defects. The faithful dynamics is the void *growing*: a cokernel is a spatial embedding defect, so its energy is set holographically by the horizon *area*, $\rho_{\text{DE}} \propto L^{-2}$, with L the future event horizon — the region no light will ever reach, the “cell growing larger” like a black-hole horizon (Paper 4). Pinning $\Omega_{\text{DE},0} = \Lambda_0$ and saturating the bound ($c = 1$) gives a *zero-parameter* prediction (w_0, w_a) $\approx (-0.89, -0.19)$: *gently* evolving, w near -1 . The gentle running is robust ($w_a \in [-0.24, -0.15]$ over $c \in [0.8, 1.2]$): a geometric void-defect cannot weaken fast. Against published DESI DR2 the committed point sits at $2.4\text{--}2.7\sigma$ — disfavoured, but the faithful model, and gentler than the fold-density's $3\text{--}4.5\sigma$. The TOE's committed, falsifiable stance is therefore: dark energy evolves *gently*, because it is a void, not a fold. Verifier: `verify_P350a.py` (11/11).

1 The conceptual correction

Paper 38 (“Dark as Kernel”) fixes the ontology: one geometry, two exactness defects. Dark *matter* is the *kernel* of the fold map (its null space, what folds away); dark *energy* is the *cokernel* (the embedding defect, the part of the container the geometry cannot fill). The cokernel measure is the corner residual

$$\Lambda_0 = 1 - \frac{\pi^2}{32} = 0.6916,$$

the fraction of the bounding cube the unit ball never reaches (Paper 32, Cantor bridge): the unreachable void.

The fold-density model of Addenda 348a/349 set $\Lambda(k) = \Lambda_0 \cdot 4/C(k)$, with $C(k)$ the cumulative Euler sum over completed *folds*. But the fold is the *kernel* structure — the dark-matter side. Driving the cokernel by the fold count indexes dark energy with the kernel's clock: the two defects are cross-wired. A cokernel is a *spatial embedding* defect; its natural dynamics is the growth of the embedding region, not a temporal fold count. This is the correction.

2 The faithful model: the void growing

Proposition 2.1 (Area law for the void). *The energy of the cokernel/void in a region of horizon scale L is bounded by the horizon area (holographic bound): $\rho_{\text{DE}} L^3 \lesssim M_{\text{Pl}}^2 L$, hence*

$$\rho_{\text{DE}} \simeq \frac{c^2 M_{\text{Pl}}^2}{L^2},$$

with L the future event horizon — the comoving region no light will ever reach, the geometric image of the unreachable void. As the universe accelerates L grows: the void cell grows larger (its bounding area increasing, as a black-hole horizon’s does under Paper 4’s fold picture), rather than more void cells being added.

This is area-based, not volume-based: dark energy scales with L^2 (the boundary), the holographic content of the growing void, exactly the “cell growing” rather than “more cells” distinction. The normalisation is fixed by the void measure, $\Omega_{\text{DE},0} = \Lambda_0$, and the saturation by $c = 1$ (the void is the maximally-unreachable region), leaving *no* free parameter.

3 The committed prediction and DESI

For the future-event-horizon law the equation of state evolves as $w = -\frac{1}{3} - \frac{2}{3c}\sqrt{\Omega_{\text{DE}}}$ with $\Omega'_{\text{DE}} = \Omega_{\text{DE}}(1 - \Omega_{\text{DE}})(1 + 2\sqrt{\Omega_{\text{DE}}}/c)$ (Li 2004).

Proposition 3.1 (Gentle evolution). *With $\Omega_{\text{DE},0} = \Lambda_0$ and $c = 1$,*

$$(w_0, w_a) \approx (-0.89, -0.19),$$

gently evolving, w near -1 . The gentle running is robust: across the saturation range $c \in [0.8, 1.2]$, $w_a \in [-0.24, -0.15]$. A geometric void-defect, however its horizon is grown, cannot produce a steep w_a .

Corollary 3.2 (DESI confrontation). *Against the published DESI DR2 $w_0 w_a$ CDM constraints (full 2×2 covariance, $\rho \approx -0.9$), the $c = 1$ committed point lies at $2.4\text{--}2.7\sigma$ across the three SN combinations — disfavoured, but markedly gentler than the fold-density model’s $3\text{--}4.5\sigma$, and now conceptually faithful. The tension is again in the running: DESI’s $w_a \approx -0.6$ to -1.1 versus the void’s ≈ -0.19 .*

The two faithful geometric mechanisms tested — fold-density and cokernel-void — agree on the essential point: $w_a \approx -0.2$, gentle. The TOE’s dark energy is a geometric defect, and a defect weakens slowly.

The TOE’s committed stance, scope, and falsifiers

Committed stance. Dark energy is the cokernel/void; it evolves *gently* ($w_a \approx -0.2$, w near -1) because its dynamics is the slow growth of a geometric embedding defect, not a fast density change. This is a sharp, zero-parameter, falsifiable bet.

Scope. This addendum supersedes the dark-energy treatment of Addenda 348a/349a on *conceptual* grounds — the kernel/cokernel cross-wiring — and replaces the fold-density $\Lambda(k)$ with the void-growth law of Proposition 2.1. The inflation result of Addendum 347a ($n_s = 1 - 2/N$, matching Planck) is independent and stands unchanged. The static residual Λ_0 (Paper 32) is unchanged; only its *dynamics* are corrected.

Falsifiers. (F1) If DESI’s steep $w_a \approx -0.8$ holds up with improved data, the TOE’s dark-energy ontology — a geometric void — is challenged at the conceptual level, not repairable by reparametrising. (F2) If w_a softens toward ≈ -0.2 as systematics settle, the void-growth prediction is vindicated. (F3) The void floor predicts $w \rightarrow -1$ and $\Omega_{\text{DE}} \rightarrow \Lambda_0$ asymptotically; w crossing well below -1 in the future refutes it.

Data sources. DESI DR2 (2025) published $w_0 w_a$ CDM constraints; Planck 2018 (Ω_Λ).