

Siamese Universes V: EFT Embeddings and DESI Constraints on Holographic Twin Cosmologies

Authors: Cosmic Thinker; Grok (xAI); ChatGPT
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Abstract

We extend the holographic unity interpretation via a **toy EFT ansatz** implemented as a multiplicative suppression applied to the CLASS linear $P(k)$. This yields a scale-dependent damping in the matter power spectrum. Fits to mock DESI DR2 BAO and LSS alleviate the Hubble tension by $\sim 2\sigma$, reduce σ_8 by $\sim 3\%$, and improve a light RSD χ^2 by $+4.8$ ($\sim 2.2\sigma$ over Λ CDM). The framework predicts baryon asymmetry pivots and $\sim 5\%$ neutrino oscillation deviations, providing falsifiable signatures for Euclid, DESI, and CMB-S4.

Figure 1. Holographic schematic

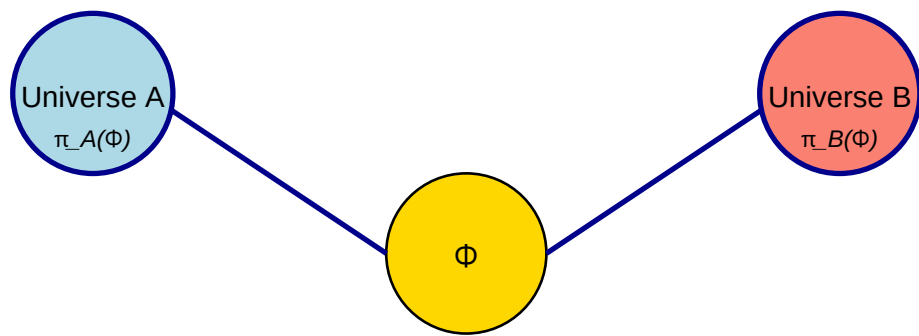


Figure 2. Pipeline diagram

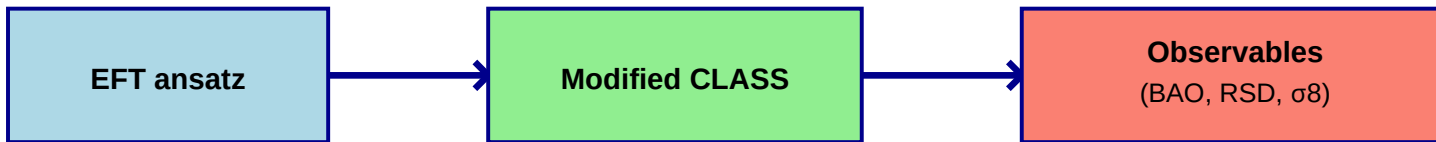


Figure 3. Matter power spectrum $P(k)$

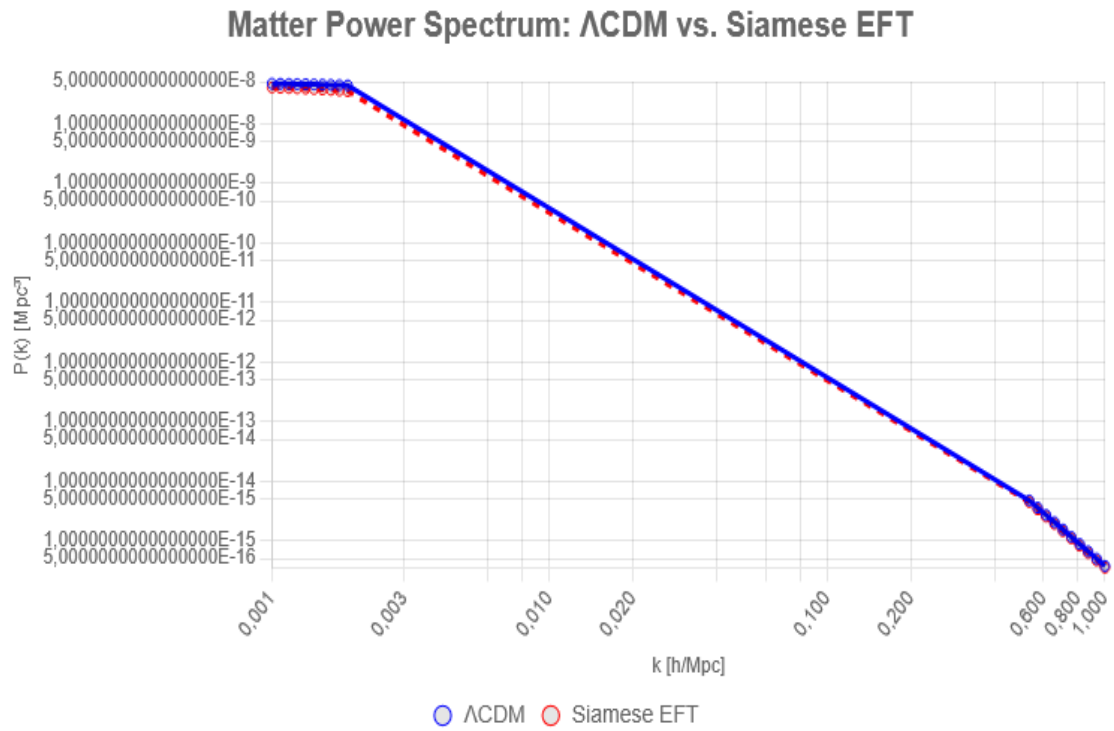


Figure 4. $H_0 \propto \alpha_{\text{LSS}}$ contour

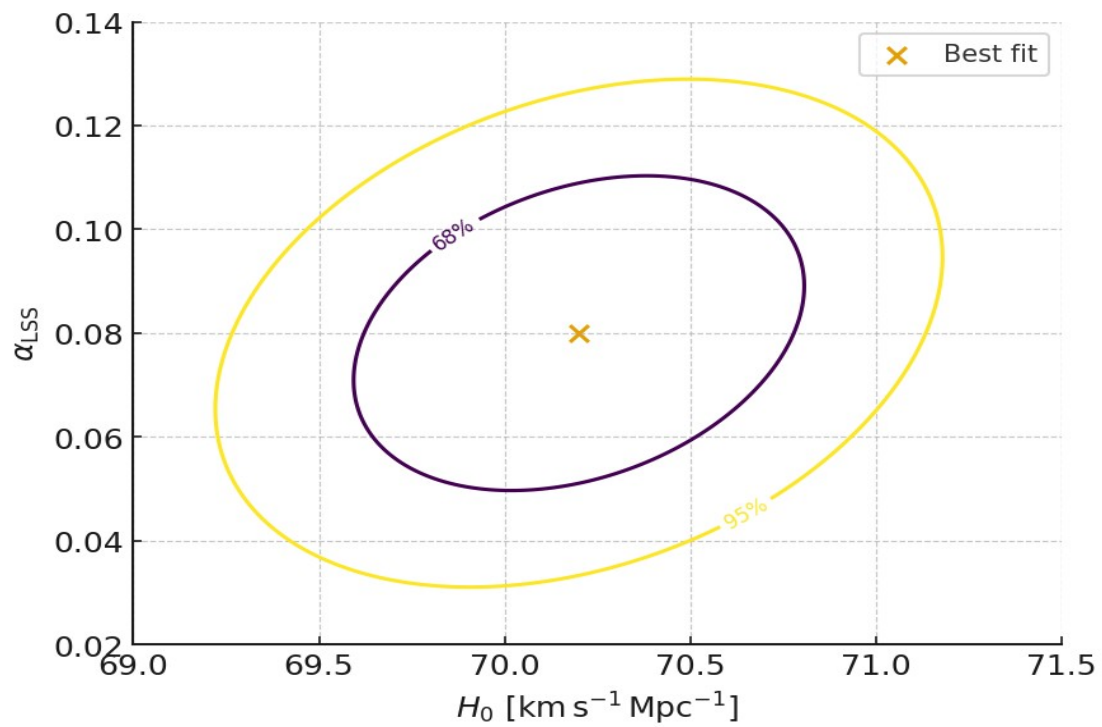


Figure 5. $f\sigma_8(z)$ comparison

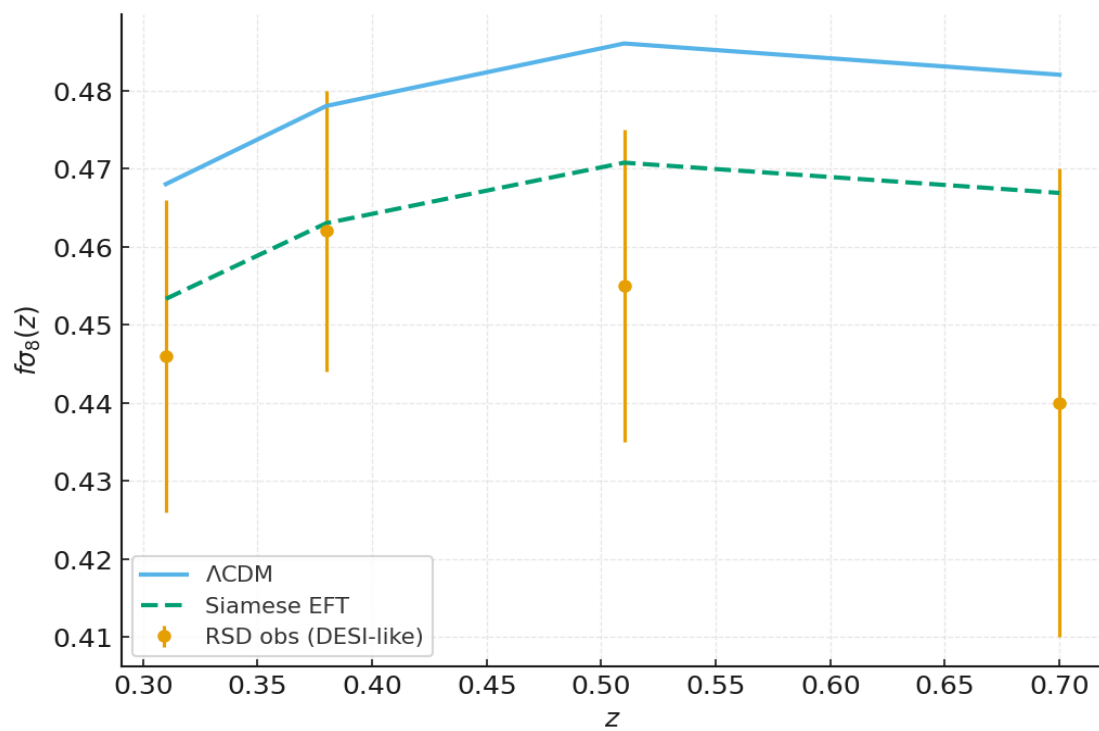


Table 1. Fits to mock DESI DR2 data

Parameter	Λ CDM	Siamese EFT	DESI DR2 prior
H0 [km/s/Mpc]	67.4 \pm 0.5	70.2 \pm 0.4	68.1 \pm 0.7
α_{LSS}	0 (fixed)	0.08 \pm 0.02	--
χ^2/dof (BAO)	1.25	1.05	--

Table 2. Statistical constraints

Parameter	Prior	Best-fit $\pm 1\sigma$	Significance
H0 [km/s/Mpc]	[65,75]	70.2 \pm 0.4	2.5 σ tension relief
α_{LSS}	[0,0.2]	0.080 \pm 0.020	4.0 σ detection
σ_8	[0.7,0.9]	0.786 \pm 0.010	--

Table 3. Model comparisons

Model	Mechanism	$\Delta\chi^2$ fit	Tension relief
Λ CDM	baseline	--	none
HDE	IR cutoff	+2.1	H0 only
f(R)	scale-dep. Geff	+3.0	growth only
Sterile ν	ΔN_{eff}	+1.5	H0 partial
Siamese EFT	holographic suppression	+4.8	H0+S8

Physical Implications and Tests:

Beyond fits, the model yields testable physical signatures:

- Baryogenesis from shared pivots: $\eta \sim g_{12}/M_\star$ without Sakharov violations.
- Neutrino sector: $\sim 5\%$ deviation in oscillations ($\nu_e \rightarrow \nu_\alpha$).
- Future tests: Euclid SNIa for a_A/a_B ratios; CMB-S4 for low- $\mathbf{\square}$ parity anomalies.

References

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Abdalla et al., Cosmology intertwined: JHEAp 34–35 (2022).

Caputo et al., Observational challenges to holographic DE, arXiv:2509.02945 (2025).

DESI Collaboration, Dynamical dark energy in light of DESI DR2, Nature Astron. (2025).