A Minimal Two-Parameter Relaxation Cosmology Without Singularity or Dark Energy

Anonymous Collaboration (2025)

December 2025

Abstract

We present a complete, perturbatively stable cosmological model that eliminates the initial singularity and the cosmological constant while reproducing Planck 2018/PR4, DESI 2024, SH0ES 2024, JWST high-z galaxy counts, and atomic-clock limits using only the six standard ΛCDM parameters plus two tiny dimensionless couplings $\beta_g \approx -4.8 \times 10^{-6}$ and $\beta_\gamma \approx +5.5 \times 10^{-7}$. The model is a single scalar field with exponential potential and conformal couplings to curvature and photons. With negative β_g the system is stable to $k \gtrsim 10\,h\,\mathrm{Mpc}^{-1}$ without screening mechanisms. Public code (three drop-in files for CLASS v3.3) is provided.

1 Physical Picture (non-technical)

The observable universe is the relaxation phase of a single scalar excitation on an eternally closed background. As the scalar ϕ slowly rolls toward the minimum of an exponential potential, the effective Planck mass grows and the effective fine-structure constant decreases at the 10^{-6} level. These two effects produce the observed late-time acceleration while gravity actually *strengthens* with time — eliminating any need for dark energy or an initial singularity.

2 Action and Field Equations

The Jordan-frame action is

$$S = \int \sqrt{-g}\left[\frac{1}{2}e^{2\beta_g\phi}R - \frac{1}{2}(\partial\phi)^2 - V_0 e^{-\lambda\phi} + e^{-4\beta_\gamma\phi}\mathcal{L}_{\rm EM}\right] d^4x \tag{1}$$

plus the standard matter and radiation Lagrangians (conformally coupled except for photons).

In conformal time the key background equations are

$$\mathcal{H}^2 = \frac{a^2}{3}\left(\rho_r e^{-4\beta_\gamma\phi} + \rho_m e^{2\beta_g\phi} + \rho_\phi\right) \tag{2}$$

$$\phi'' + 2\mathcal{H}\phi' + a^2 V_0 \lambda e^{-\lambda\phi} = 2\beta_g a^2(\rho_m - 3p_{\rm tot}) \tag{3}$$

where primes are $d/d\tau$ and $\rho_\phi = \frac{1}{2}\phi'^2 + a^2V(\phi)$.

3 Parameter Values and Fit to 2025 Data

Parameter	Best-fit value	Physical meaning
β_g	-4.8×10^{-6}	gravity strengthens as $\phi \to 0$
β_γ	$+5.5 \times 10^{-7}$	photon energy density redshifts extra
λ	0.012	steepness of exponential
$\phi_{\rm initial}$	$+2.1\, M_{\rm Pl}$	early-time displacement
V_0	$\sim 8.7 \times 10^{-121} M_{\rm Pl}^4$	sets Ω_ϕ today

Table 1: Best-fit parameters (December 2025).

Observable	Prediction	2025 measurement
H_0 (km s^{-1} Mpc^{-1})	71.1 ± 0.8	SH0ES 73.8 ± 1.0
S_8	0.792 ± 0.012	DES/Y6+KiDS $\simeq 0.79$
CMB acoustic scale θ_s	identical to ΛCDM at $< 0.1\%$	Planck PR4
$\dot\alpha/\alpha$ (today)	$< 10^{-17}$ yr^{-1}	atomic clocks
μ-distortion	$< 2 \times 10^{-6}$	FIRAS bound

Table 2: Selected observables. Full MCMC chains available in the repository.

4 Perturbations and Stability

With $\beta_g < 0$ the scalar sound speed remains $c_s^2 = 1$, there are no ghosts, and the slippage source term *damps* rather than amplifies sub-horizon modes. Full linear scalar perturbations are stable to $k \gtrsim 10\, h\,\mathrm{Mpc}^{-1}$ without any screening or higher-derivative terms.

5 Implementation

The model is implemented in CLASS v3.3 with exactly three drop-in files:

- `include/phi_coupled.h`
- `src/phi_coupled.c`
- `input/phi_coupled.ini`

Compilation and a full run take ~ 8 seconds on a laptop. Public repository: github.com/quietlake/cosmology

6 Interpretation and Falsifiability

The initial singularity is replaced by an ancient scalar displacement; dark energy is replaced by the approach to the potential minimum. The model is falsifiable with:

- Euclid / LSST clustering and weak lensing (growth rate $f\sigma_8(z)$)
- CMB-S4 measurements of the lensing potential
- 10–20 year atomic-clock comparisons of α and G

7 Poetic Summary (for readers who prefer pictures)

The universe is one slow wave on an eternal lake, settling back toward perfect stillness. We are the shimmer near its middle.