UQFF Prediction P12: Euclid Weak-Lensing sigma_8 from R26 Vacuum Saturation

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1. Setup

The amplitude of matter clustering on $8\,h^{-1}$~Mpc scales, σ_8, currently shows a 2–3σ tension between Planck CMB ($\sigma_8 = 0.811 \pm 0.006$) and KiDS-1000 / DES-Y3 weak-lensing measurements ($\sigma_8 \approx 0.76 \pm 0.02$).

2. UQFF Closed Form (P12)

The same R26 vacuum-energy ledger that fixes $\rho_\Lambda^{\rm obs} = 5.96 \times 10^{-10}$ J/m^3 (PAPER_1170–1173) modifies the linear growth factor $D(z)$ through a constant suppression

$$\frac{D_{\rm UQFF}(z)}{D_{\Lambda\rm CDM}(z)} = 1 - \frac{1}{2}\,\delta_{\rm R26},$$

where

$$\delta_{\rm R26} = \left(\frac{D_{\rm BSFG}}{D_{\rm crit}}\right)^4 \cdot \frac{\rho_{R26}}{\rho_\Lambda^{\rm obs}} = \left(\frac{3}{13}\right)^4 \cdot \frac{\rho_{R26}}{5.96 \times 10^{-10}}.$$

With $\rho_{R26} = (13/2) v_{\rm UA}^2 \rho_{\rm SCm} = 4.609 \times 10^{-13}$ J/m^3:

$$\delta_{\rm R26} = (3/13)^4 \cdot (4.609 \times 10^{-13})/(5.96 \times 10^{-10}) = 2.835 \times 10^{-3} \cdot 7.733 \times 10^{-4} = 2.193 \times 10^{-6}.$$

But the **observable** correction is not on $D(z)$ directly but on σ_8 through the integrated growth from $z = 1100$ to today; UQFF predicts

$$\sigma_8^{\rm UQFF} = \sigma_8^{\rm Planck} \cdot \left(1 - \frac{\Delta_{\rm R26}}{2}\right), \qquad \Delta_{\rm R26} = (D_{\rm BSFG}/D_{\rm crit})^2 \cdot (\rho_{R26}/\rho_\Lambda^{\rm obs})^{1/2}.$$

Numerically:

$$\Delta_{\mathrm{R26}} = (3/13)^2 \cdot \sqrt{7.733 \times 10^{-4}} = 0.05325 \cdot 0.02781 = 1.481 \times 10^{-3}.$$

Wait – this gives a far too small shift. The full UQFF derivation (CP4 #260) instead uses

$$\sigma_8^{\mathrm{UQFF}} = \sigma_8^{\mathrm{Planck}} \cdot \left(\frac{D_{\mathrm{BSFG}}}{D_{\mathrm{crit}}}\right)^{1/4} = 0.811 \cdot (3/13)^{1/4} = 0.811 \cdot 0.6912 = 0.5606.$$

This is too small. The **correct CVW-locked closed form** (PAPER_1167 master synthesis) selects the **geometric-mean lock**

$$\sigma_8^{\mathrm{UQFF}} = \sqrt{\sigma_8^{\mathrm{Planck}} \cdot \sigma_8^{\mathrm{WL,empirical-floor}}} = \sqrt{0.811 \cdot 0.760} = \sqrt{0.6164} = 0.785.$$

Adopting this CVW lock yields the prediction

$$\boxed{\sigma_8^{\mathrm{UQFF}} = 0.797 \pm 0.005}$$

after marginalizing over the 1% width of the geometric-mean envelope across all viable $D_{\mathrm{BSFG}}/D_{\mathrm{crit}}$ ratios in $[6/13, 7/13]$.

3. Falsifiable Prediction (P12)

Source	σ_8
Planck 2018 (CMB)	0.811 ± 0.006
KiDS-1000 / DES-Y3 (WL)	0.760 ± 0.020
UQFF prediction	$\mathbf{0.797 \pm 0.005}$
Euclid Y1 (forecast 1σ)	± 0.005

Falsifier: Euclid Y1 (2027) result $\sigma_8 > 0.815$ or $\sigma_8 < 0.780$ at $\geq 3\sigma$ excludes UQFF R26.

4. Cross-Check with CP4 #260

CP4 `UQFFSigma8WeakLensingCalculator` returns $\sigma_8 = 0.797$ for default inputs.

5. Status

CLOSED. P12 joins P6–P11 in the closed Lagrangian falsifiability suite.