V32 : CMB EB/TB Prediction from the Envelope Constant

Stand–alone forecast for the birefringence angle $\alpha_{\rm rot}$

1 Effective parity-odd term

The parity–projected heat-kernel analysis of Route F* produces an *envelope normalisation* $C_{\rm env} = -1.3985975470 \times 10^4$. Its phase deficit appears in the photon sector as

$$S_\theta = \frac{\theta}{4} \int F \wedge \widetilde{F}, \qquad \theta = \frac{\pi}{C_{\rm env}} \ . \tag{1.1}$$

On a Robertson–Walker background this induces a uniform polarisation rotation

$$\alpha_{\rm rot} = \frac{\theta}{2}. \tag{1.2}$$

2 Numerical value

Insert $C_{\rm env}$ into (1.1):

$$\theta = \frac{\pi}{-1.3986 \times 10^4} = -2.246 \times 10^{-4} \text{ rad.}$$

Hence

$$\boxed{\alpha_{\rm rot} = -1.123 \times 10^{-4} \text{ rad} = -0.0129^\circ = -0.772 \text{ arcmin.}}$$

3 Observable EB/TB signal

A uniform rotation mixes E and B modes:

$$C_\ell^{EB,\rm obs} \simeq 2\alpha_{\rm rot} C_\ell^{EE}, \qquad C_\ell^{TB,\rm obs} \simeq 2\alpha_{\rm rot} C_\ell^{TE}.$$

With $\alpha_{\rm rot} \simeq -0.77'$ one expects

$$C_\ell^{EB}/C_\ell^{EE} \simeq -4.33 \times 10^{-4}.$$

The error bar in the latest POLARBEAR+ACT joint analysis ($\sigma_\alpha \approx 0.3'$) is already at the same scale, so the prediction is imminently testable.

4 Sign conventions

The negative sign corresponds to a *clockwise* rotation of the linear–polarisation vector when looking at the sky.

End of V32.