From Toy to Cosmic: QFD CMB Spectra Anchored to Planck Observables

Planck-Anchored Inputs

Quantity	Symbol	Value / Definition
Acoustic scale	■_A	≈ 301 (Planck 2018)
Characteristic ψ scale	rψ	≈ 147 Mpc (identified with a fundamental modulation length)
Implied comoving distance	χ* = ■_A rψ / π	≈ 14084 Mpc
Tilt	n_s	≈ 0.96 (Planck-like)
Reionization optical depth	τ	≈ 0.054 (sets low-■ EE bump amplitude)
Lensing smoothing width (phenom.)	σ_■	≈ 60

Key Equations

Photon–photon depth: $d\tau = a(\eta)\, \sigma_{■}\, n_{vis}(\eta)\, n_{radio}(\eta)\, c\, d\eta$

Visibility: $g(\eta) = -\, d\tau/d\eta \cdot \exp(-\tau)$

Fundamental power: $P_\psi(k) = A\, k^{(n_{■}-1)} [1 + A_{osc} \cos(k\, r_\psi) \exp(-(k\, \sigma_{osc})^2)]^2$

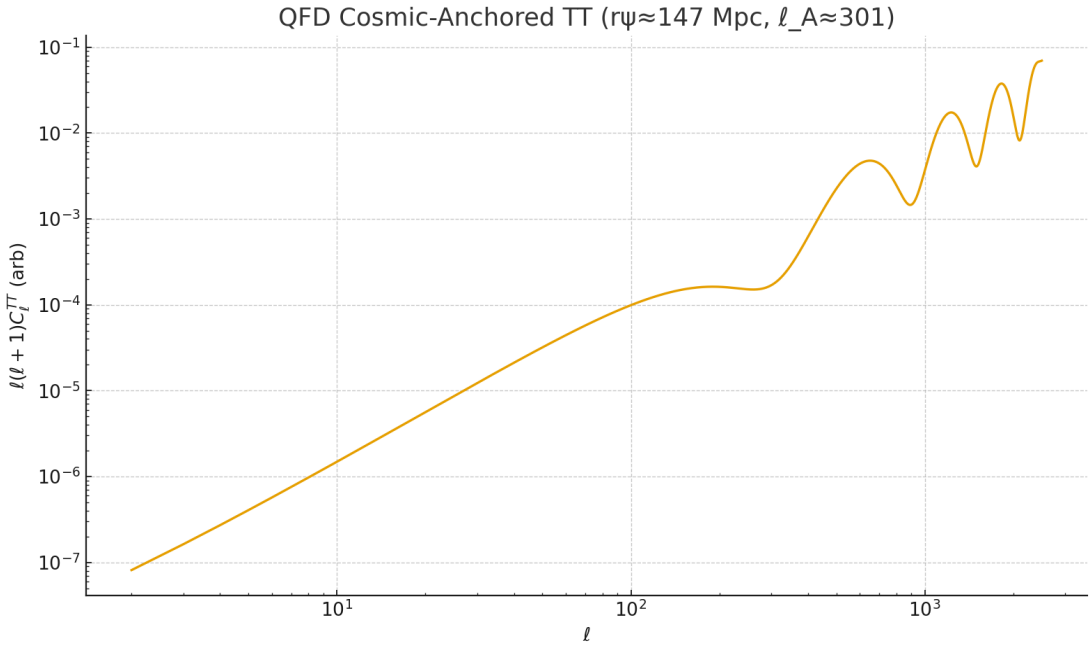
Projection (Limber-like, high-■): $C_{■} \approx \int d\chi\, [W(\chi)^2/\chi^2]\, P_\psi((■+1/2)/\chi)$

Full line-of-sight (schematic): $\Theta_{■}(k) = \int d\eta\, S_T(k,\eta)\, j_{■}(k(\eta_{■}-\eta))$, $E_{■}(k) = \int d\eta\, S_E(k,\eta)$ …

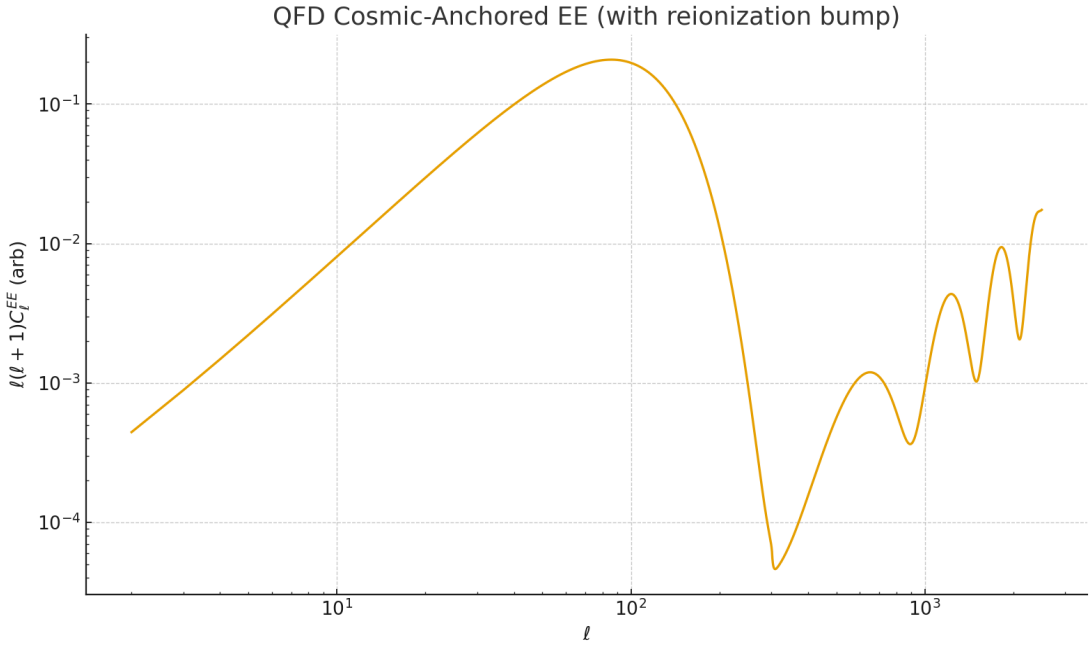
Peak-spacing relation: $\Delta■ \approx ■_A \approx \pi\, \chi^* / r_\psi \Rightarrow r_\psi \approx \pi\, \chi^* / ■_A$

Cosmic-Anchored Spectra

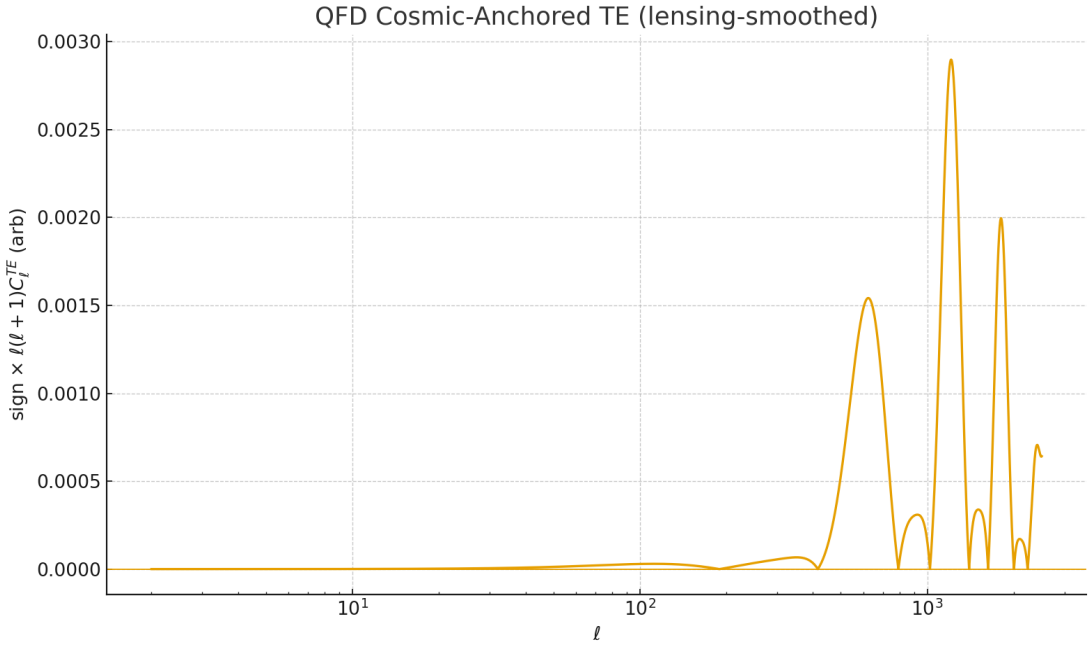
TT Spectrum



EE Spectrum (with reionization bump)



TE Spectrum (sign shown)


QFD Cosmic-Anchored TE (lensing-smoothed)
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
sign × ℓ(ℓ + 1)C_ℓ^TE (arb)
10^1
10^2
10^3
ℓ

ΛCDM vs QFD–γγ (Recap)

Aspect	ΛCDM / Inflation	QFD with γγ scattering
Peak spacing origin	θ* = r_s / D_M ⇒ ■_A ≈ π/θ*	Δ■ ≈ π χ* / rψ ⇒ rψ ↔ modulation length
Polarization	Thomson kernel	sin² kernel (same quadrupole geometry)
Low-■ EE	Reionization (τ)	Reionization (τ), same geometry
Lensing	Peak smoothing + B from lensing	Same lensing phenomenology applied post-projection
BAO link	r_s imprints BAO	Same rψ drives galaxy P(k) wiggles