

Title: TBA

Speakers: George Efstathiou

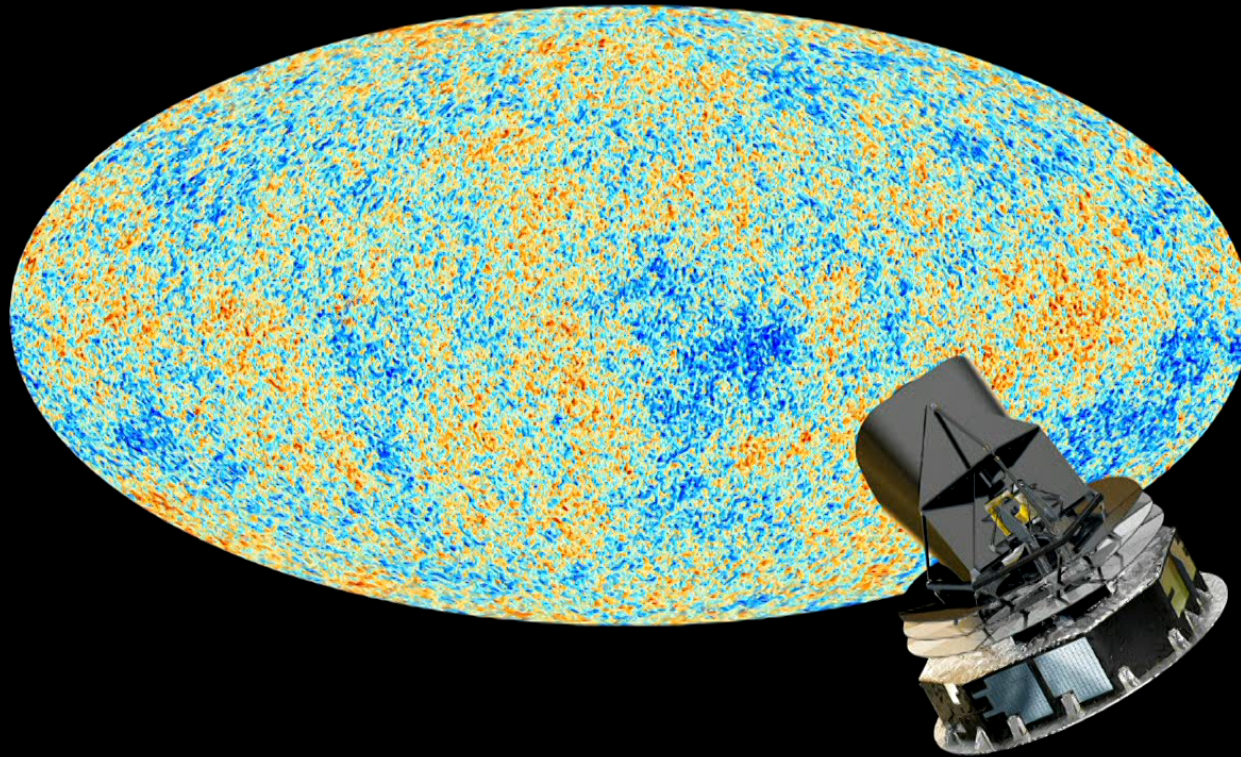
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The Planck Legacy: Inflation and the Origin of Structure in the Universe

George Efstathiou KICC

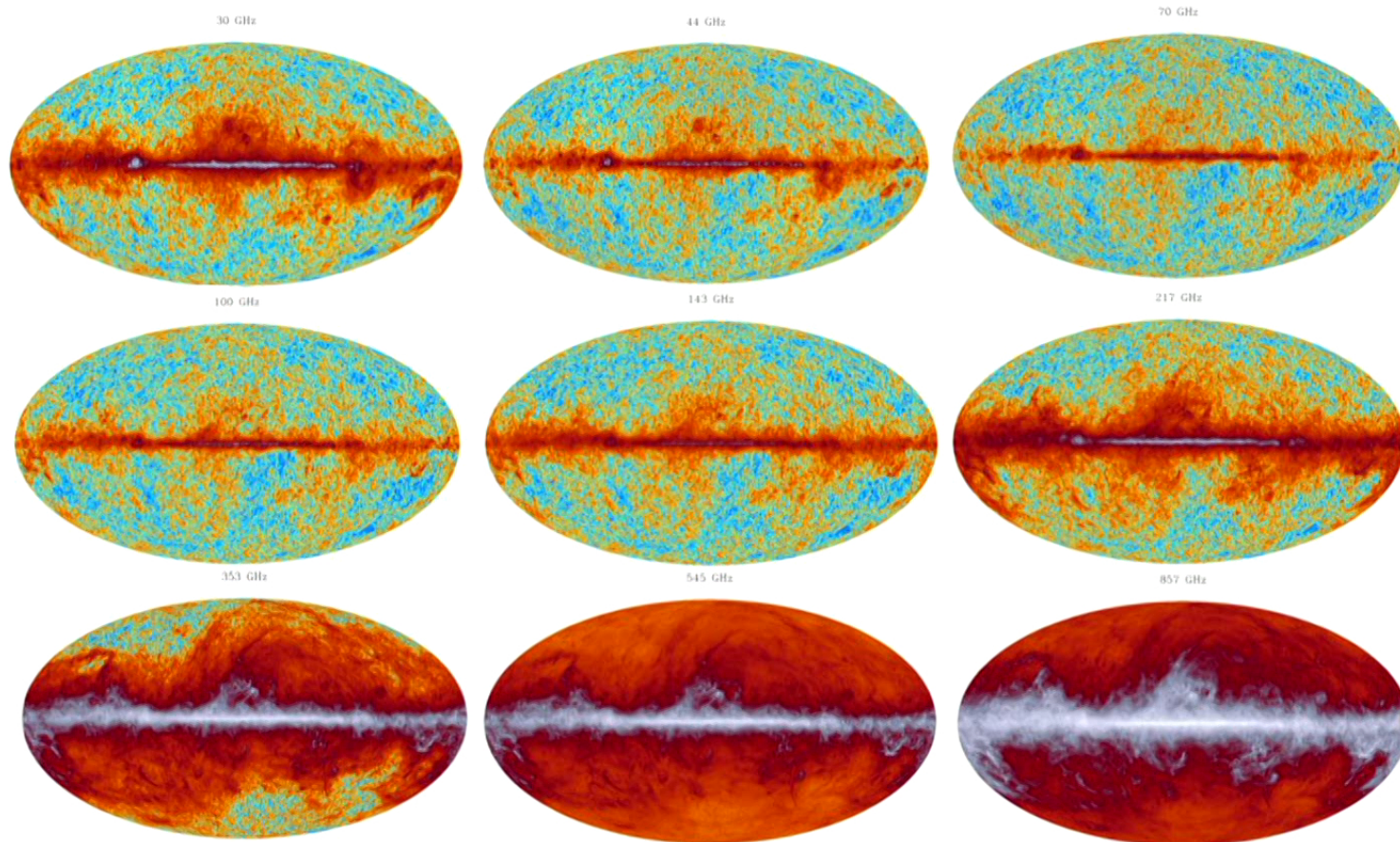




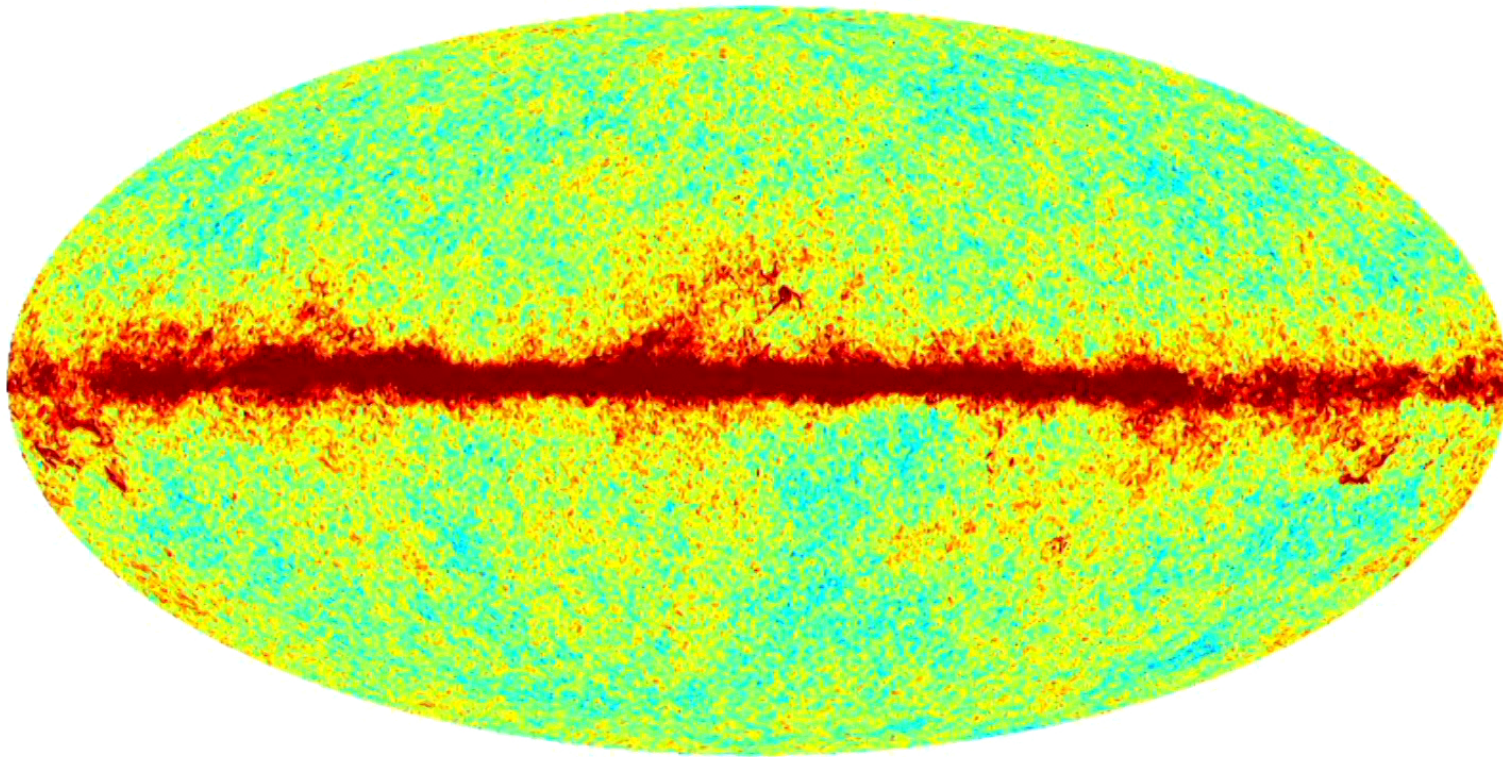
The Assertions:

- ❑ There are no internal inconsistencies in the Planck data
- ❑ Planck polarization tells the same story as Planck temperature
- ❑ Temperature and polarization restricted to $\ell < 800$ gives same Λ CDM parameters as full Planck.
- ❑ If your experiment (CMB, LSS, H_0 ) disagrees with Planck, then either you are wrong, or there is new physics beyond Λ CDM.

PLANCK FREQUENCYMAPS

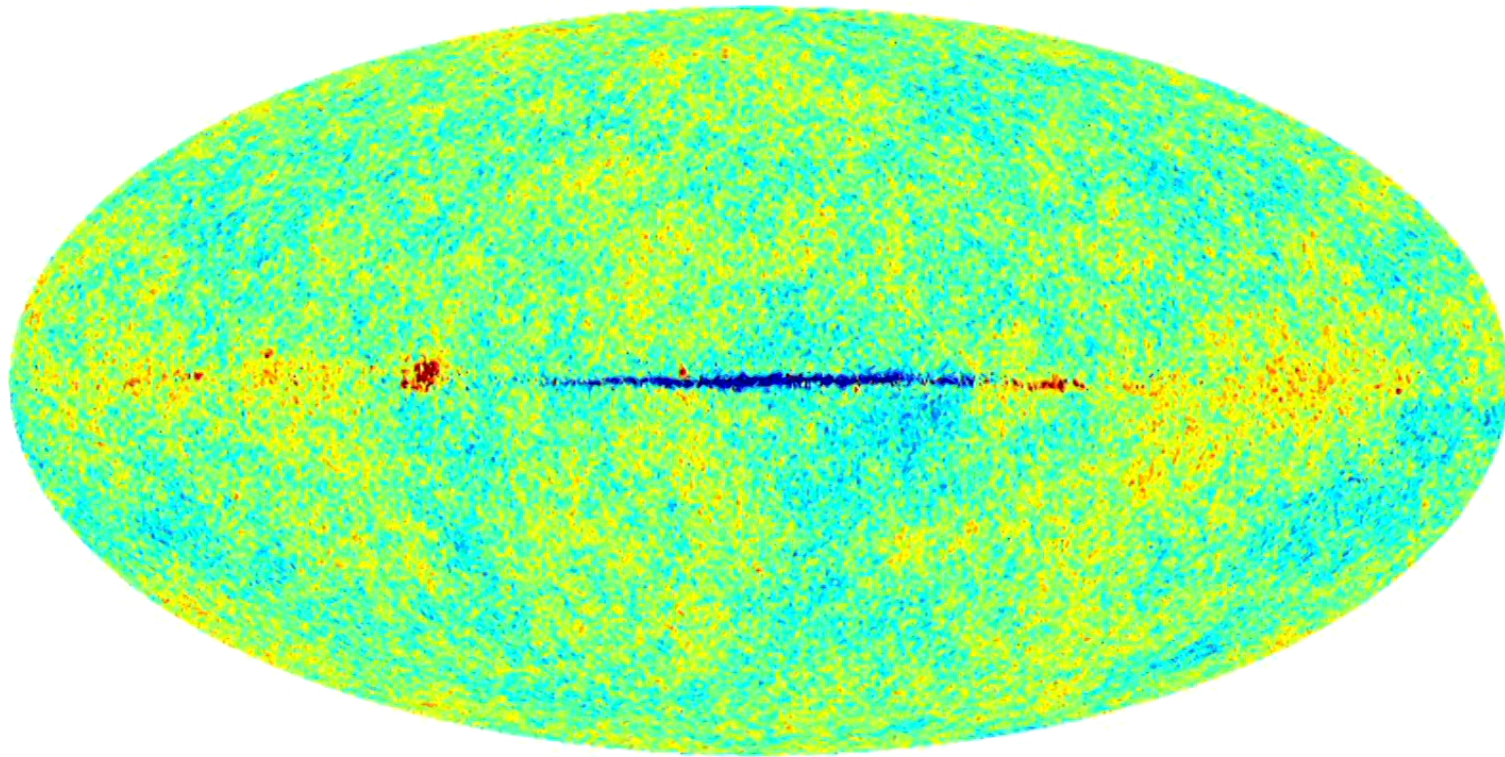


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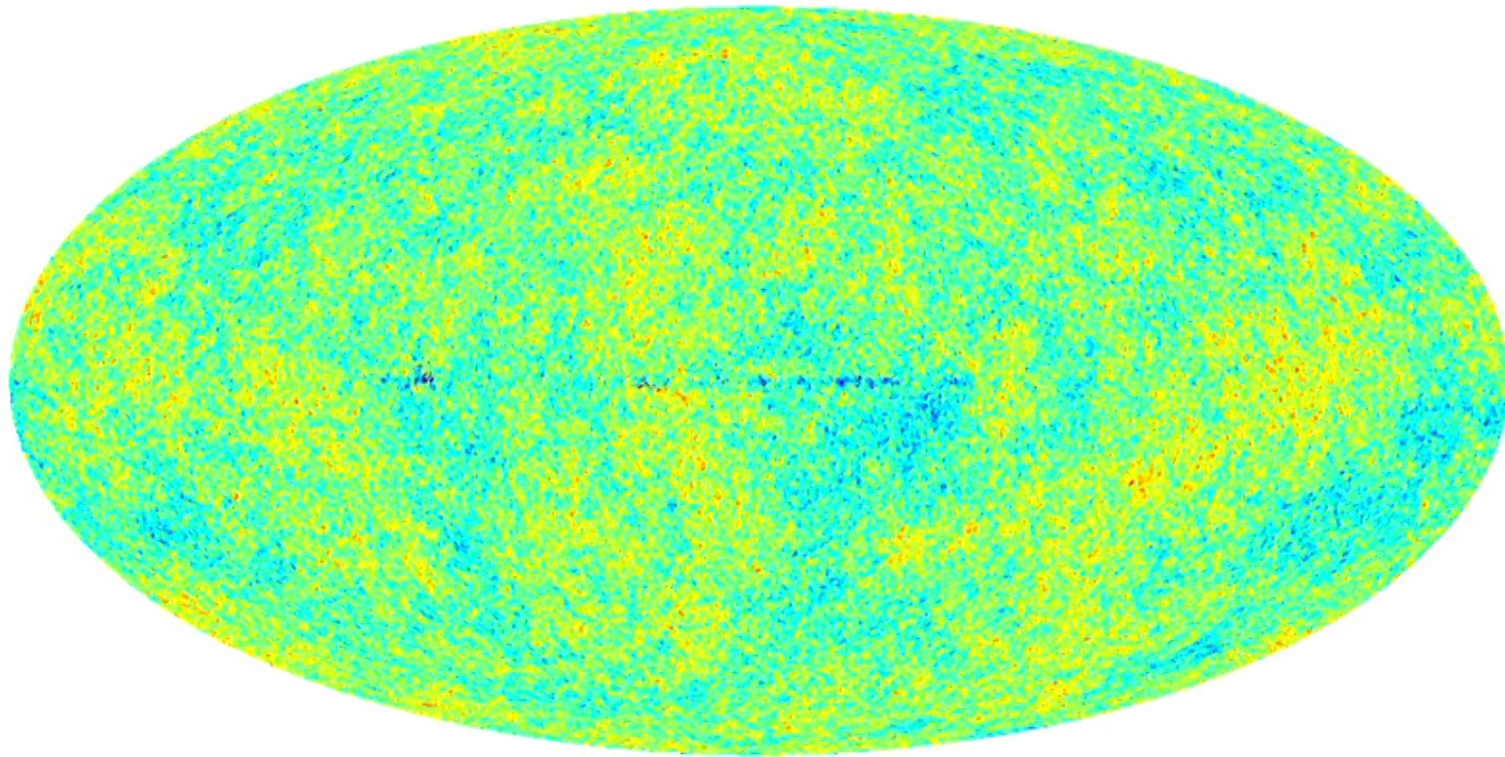
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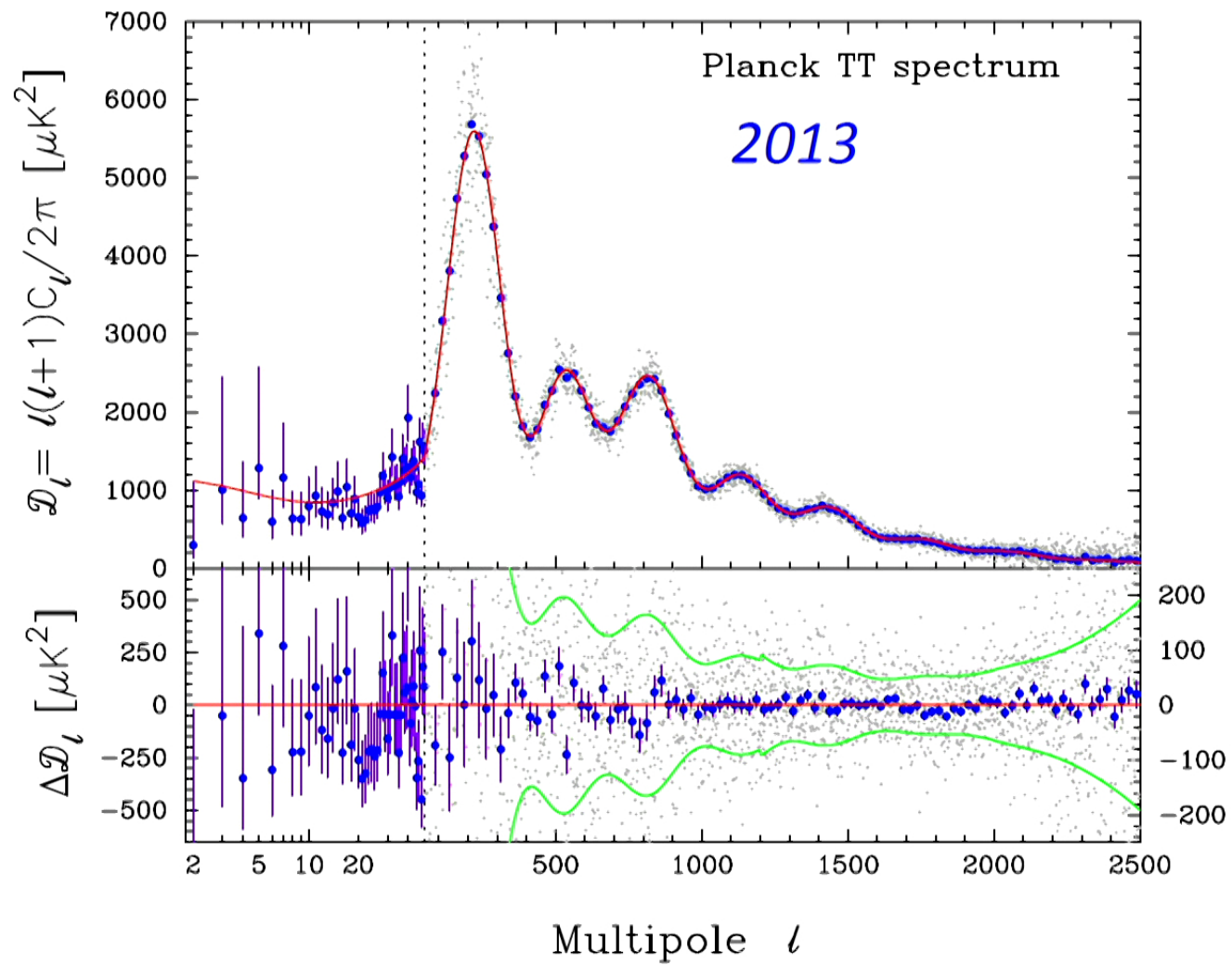
143 cleaned with 545

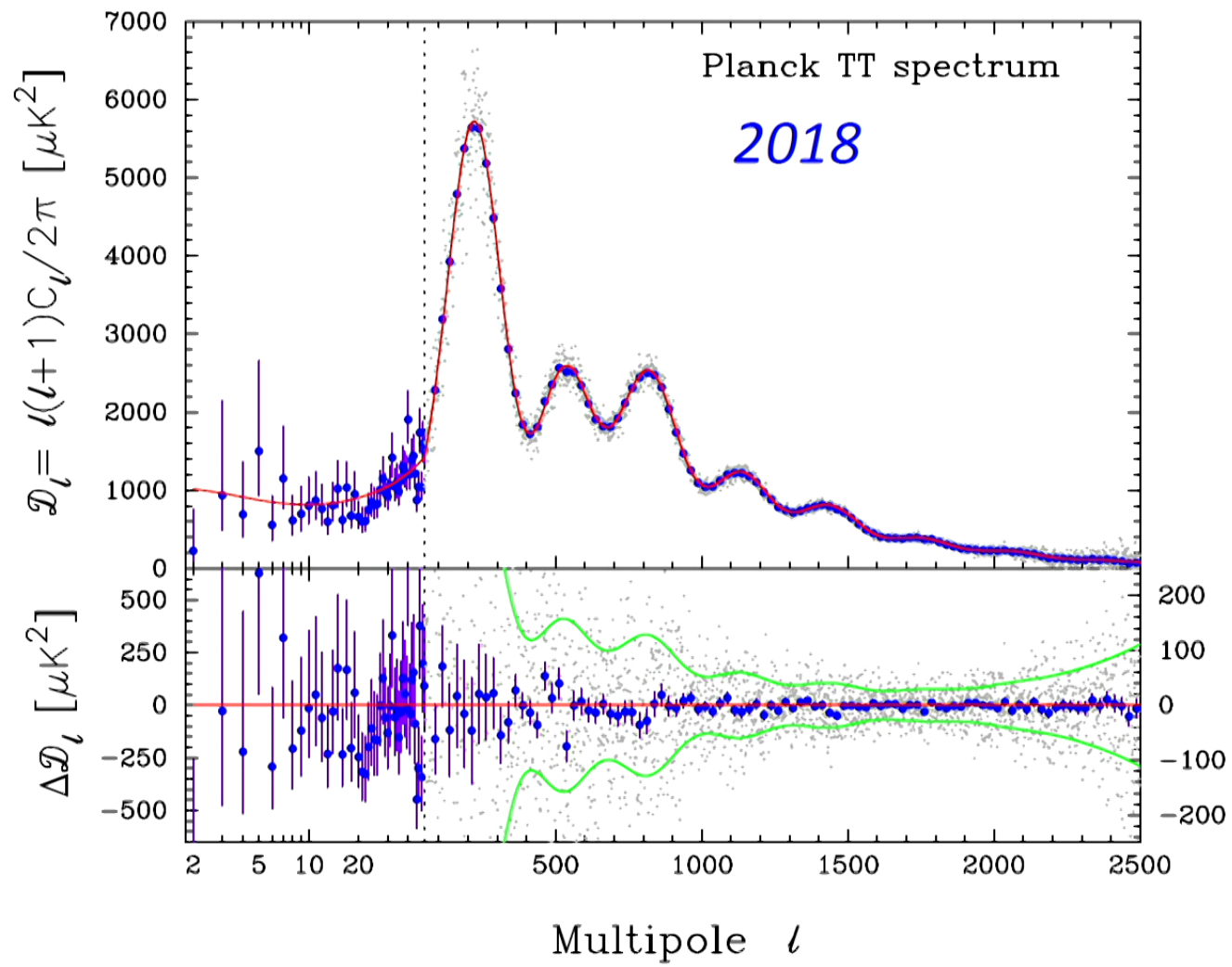


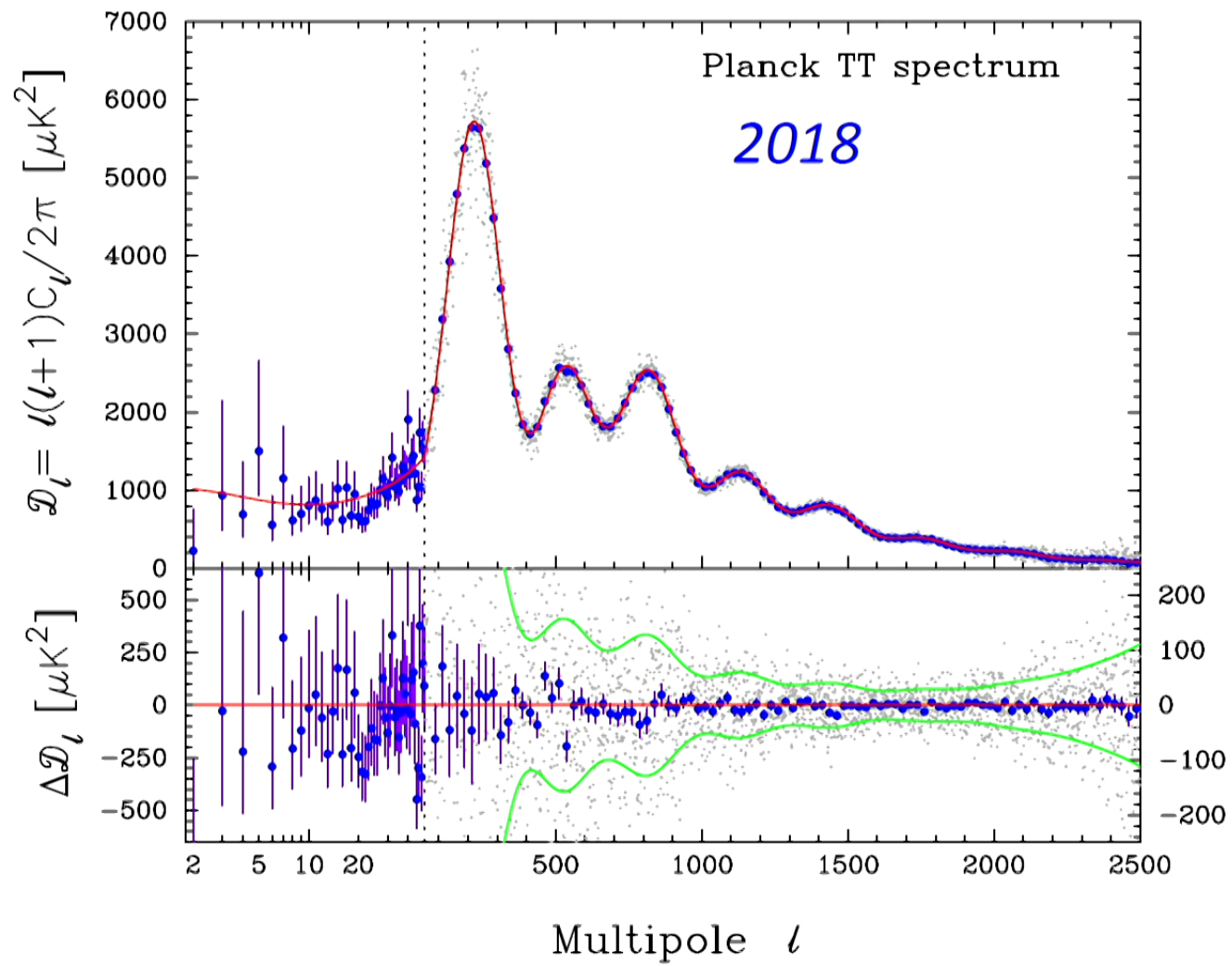
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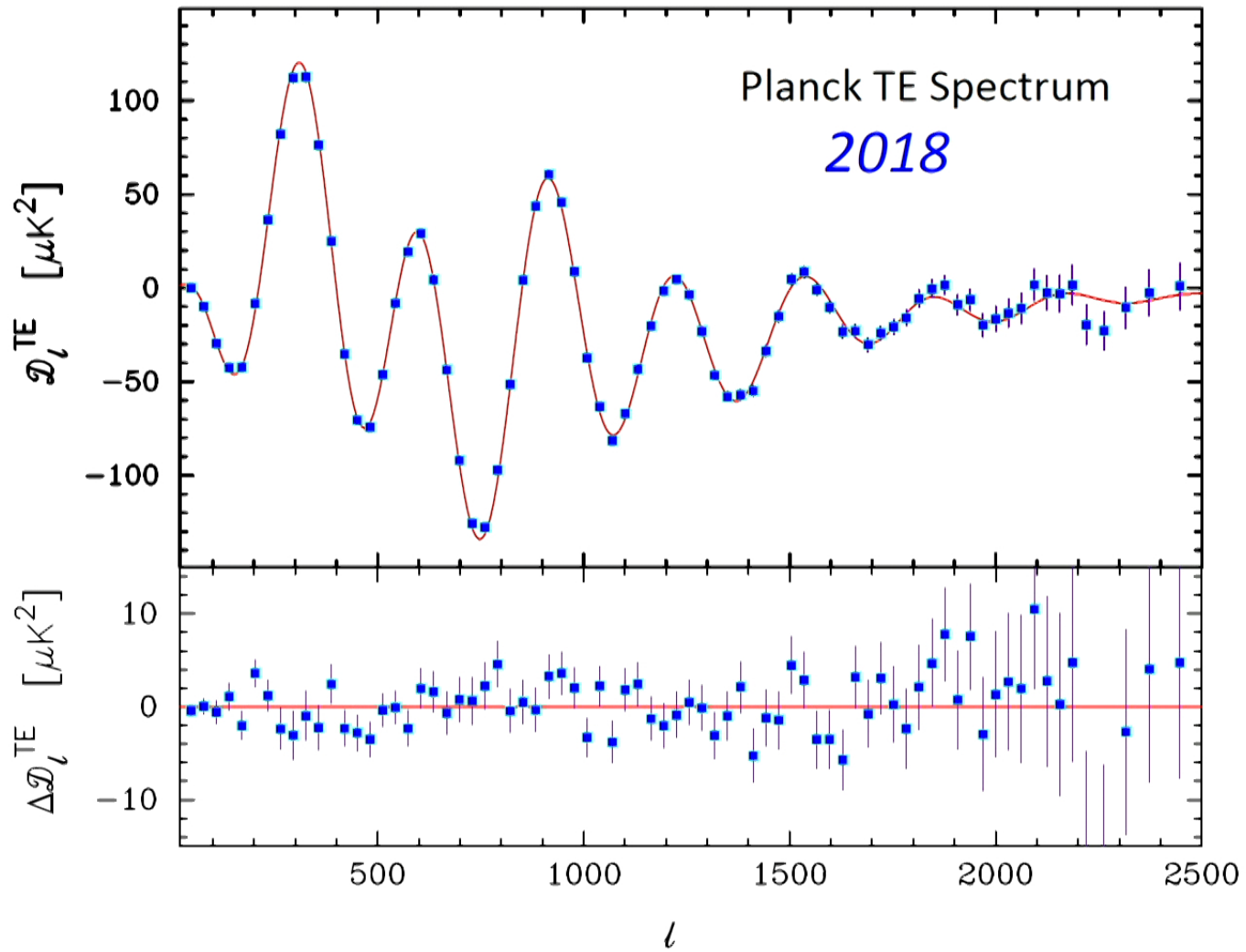
SMICA

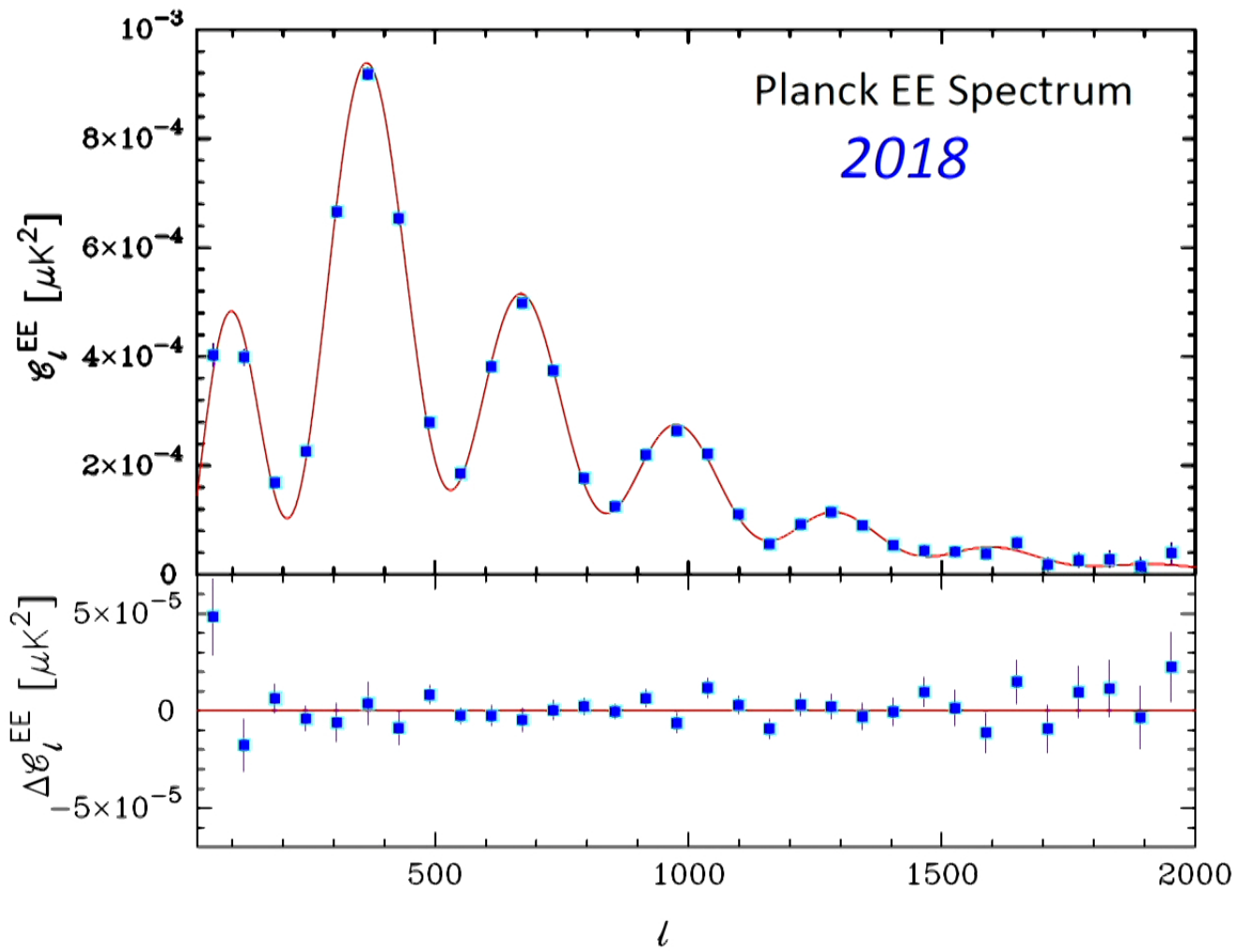


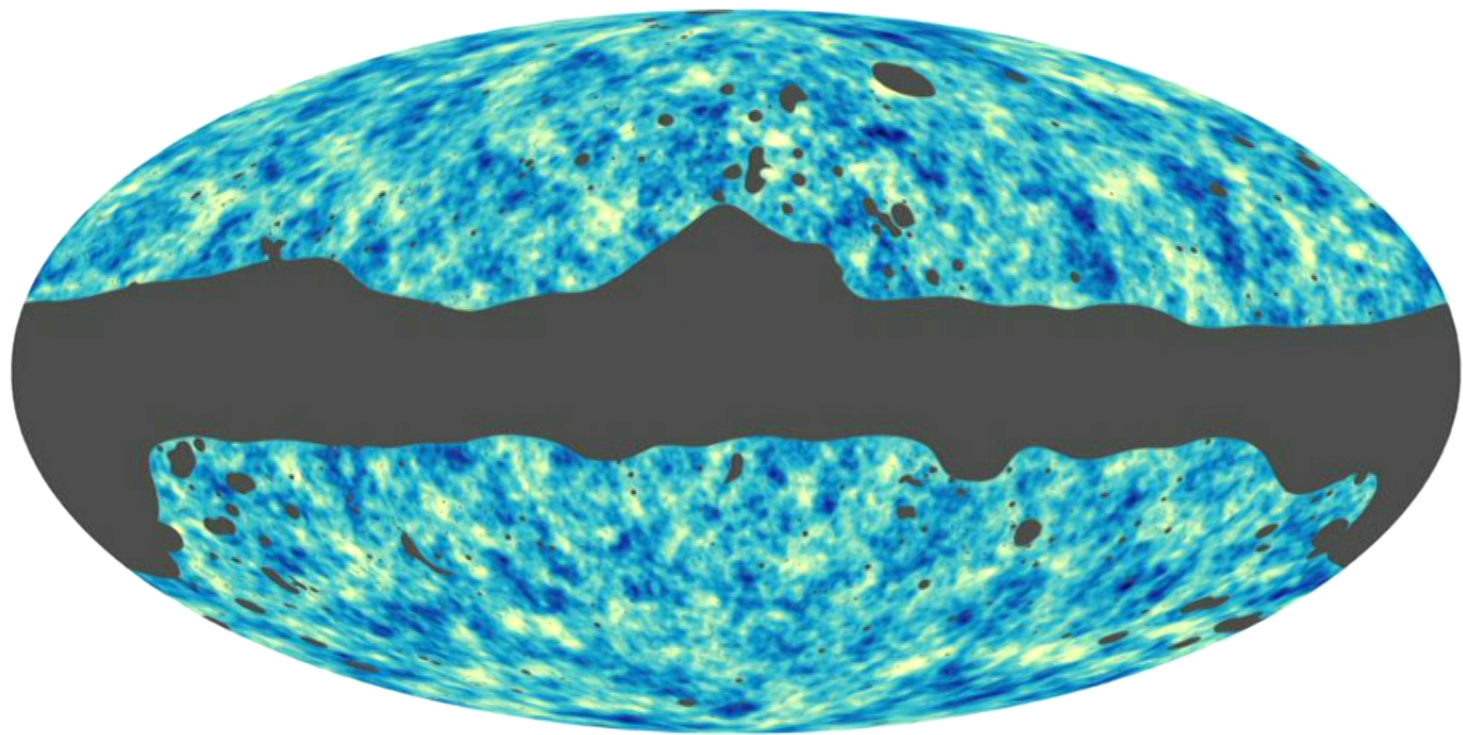


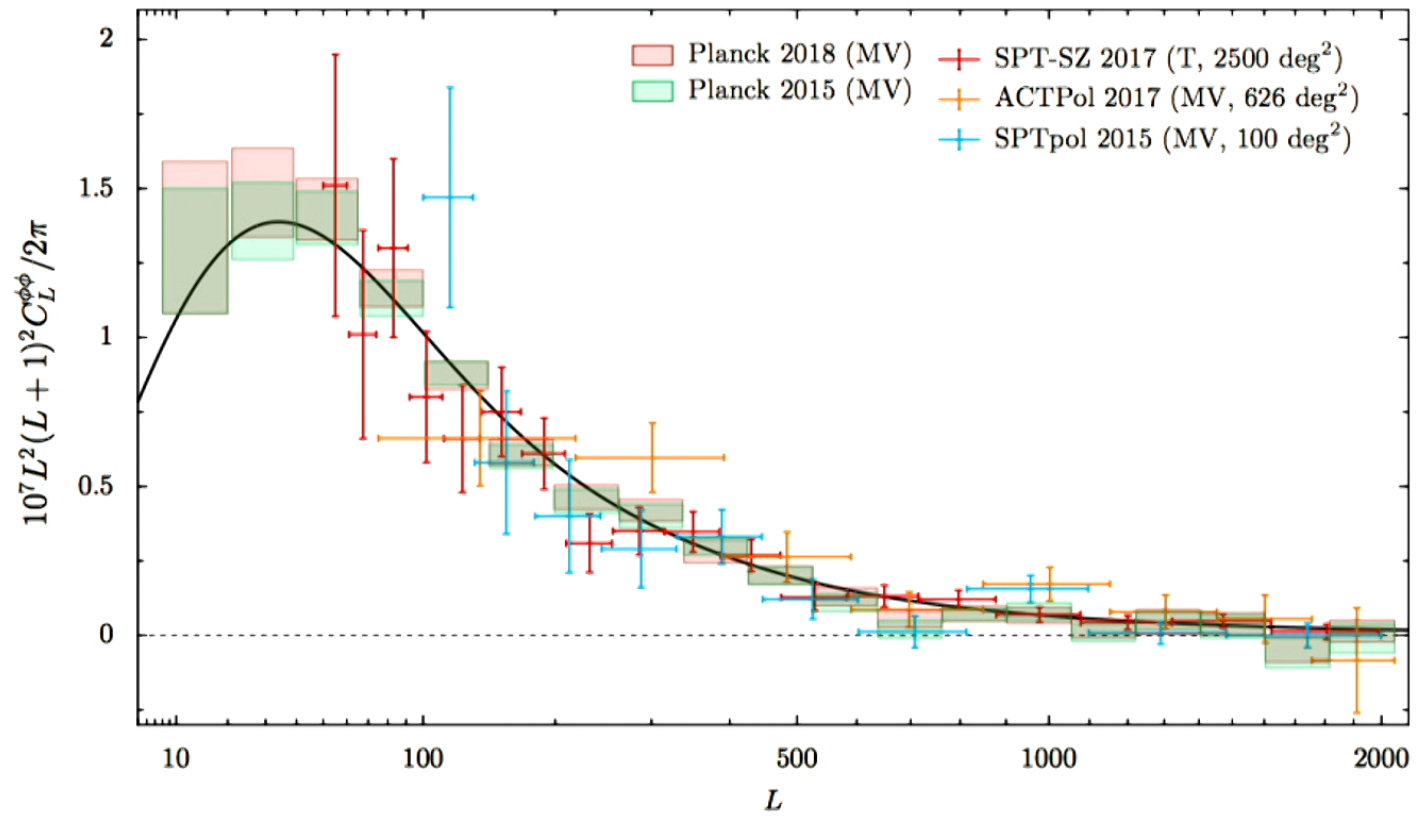


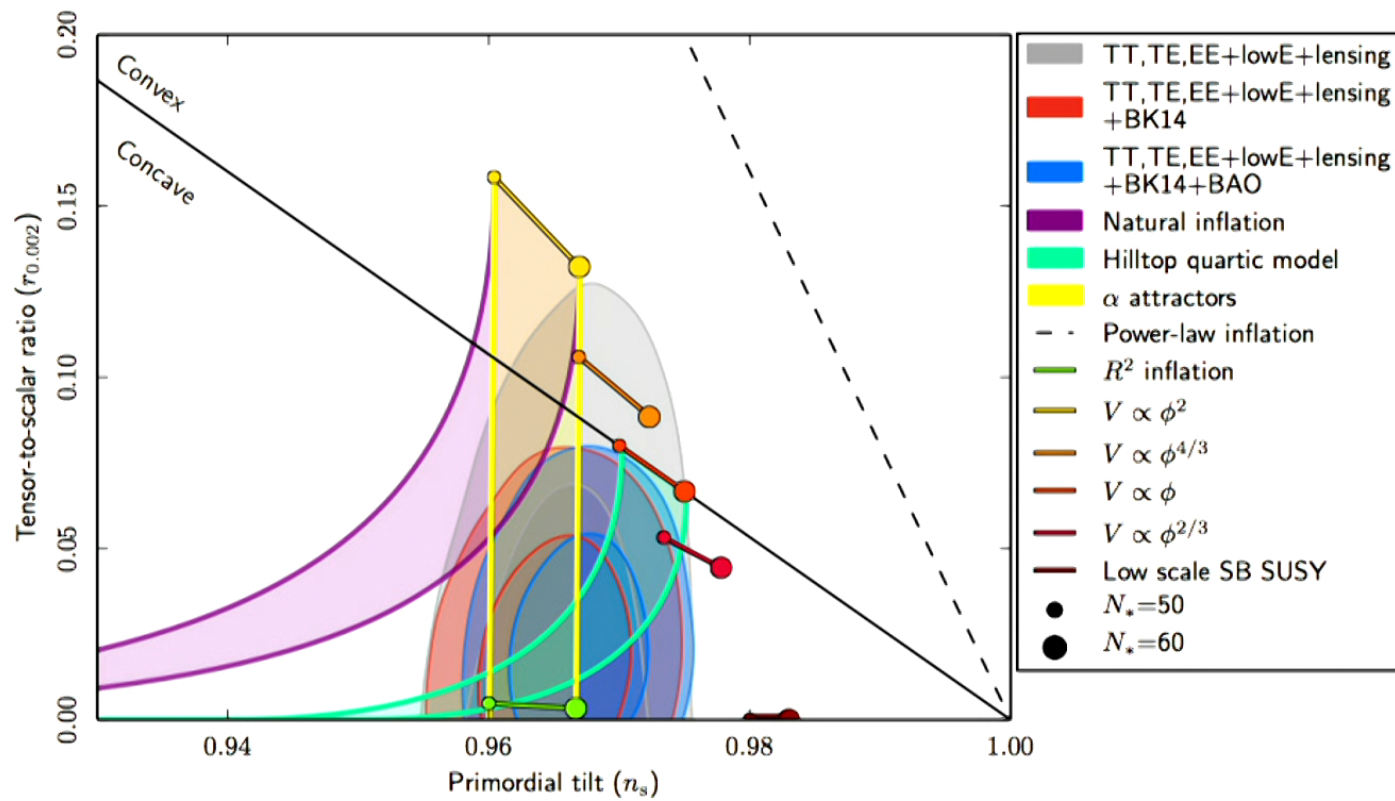












Slow roll parameters

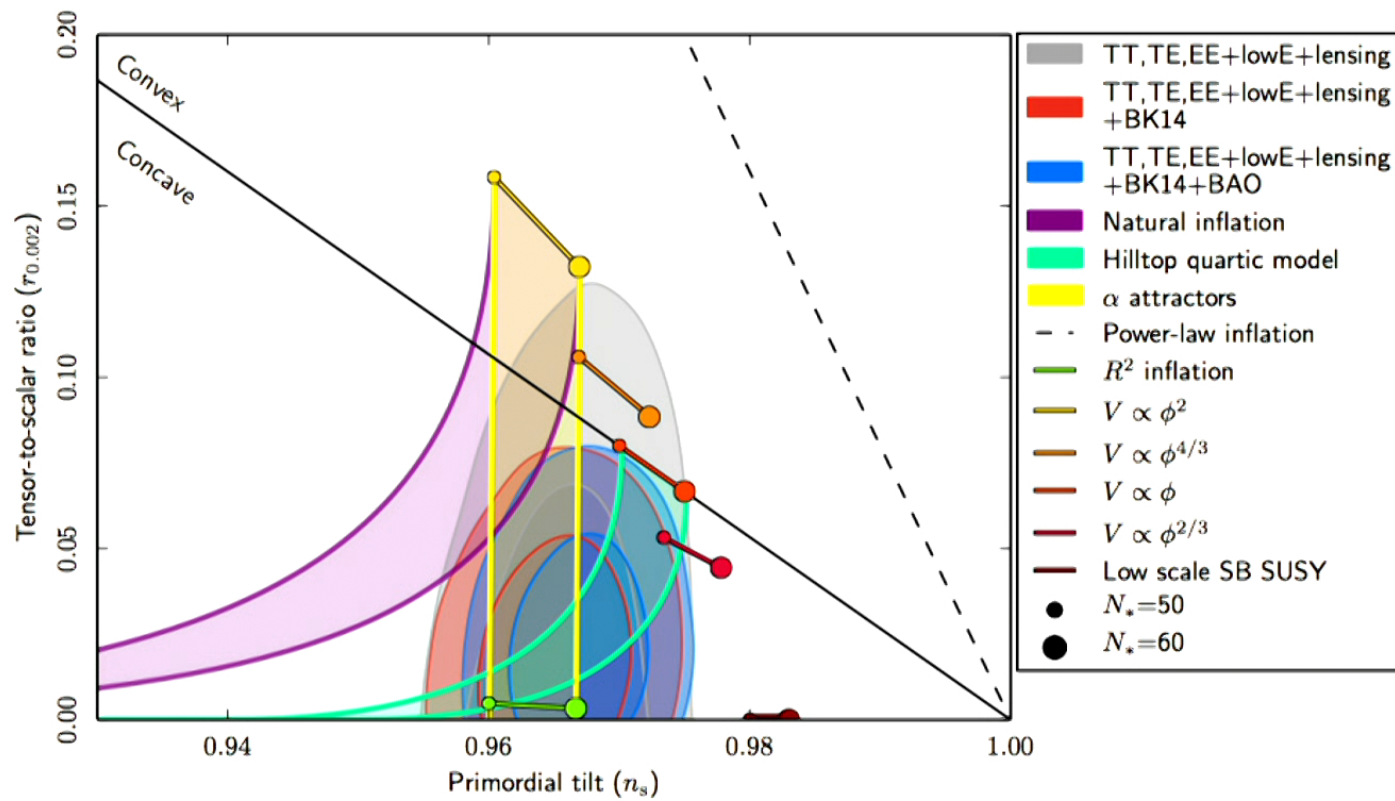
$$\epsilon = \frac{m_{\text{pl}}^2}{16\pi} \left(\frac{V'}{V} \right)^2, \quad \eta = \frac{m_{\text{pl}}^2}{8\pi} \left(\frac{V''}{V} \right)$$

$$n_s = 1 - 6\epsilon + 2\eta, \quad r = 16\epsilon, \quad n_t = -2\epsilon/N$$

If $V(\phi) = \lambda\phi^\alpha$ then

$$1 - n_s = (\alpha + 2)/N, \quad r = 4\alpha/N,$$

For $n_s = 0.965$, $N \approx 60$, $\alpha \approx 2.2$, $r \approx 0.15$.



Slow roll parameters

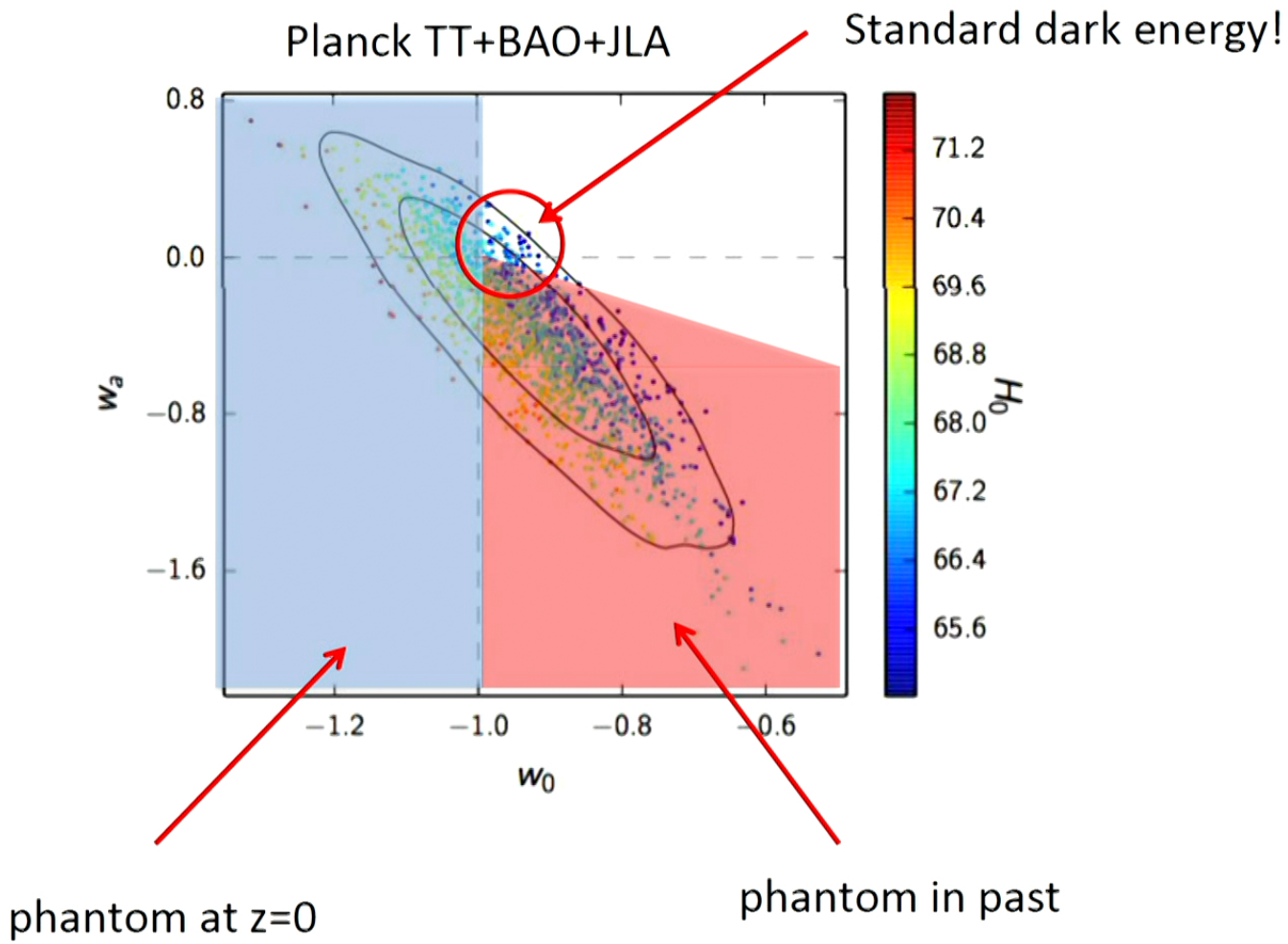
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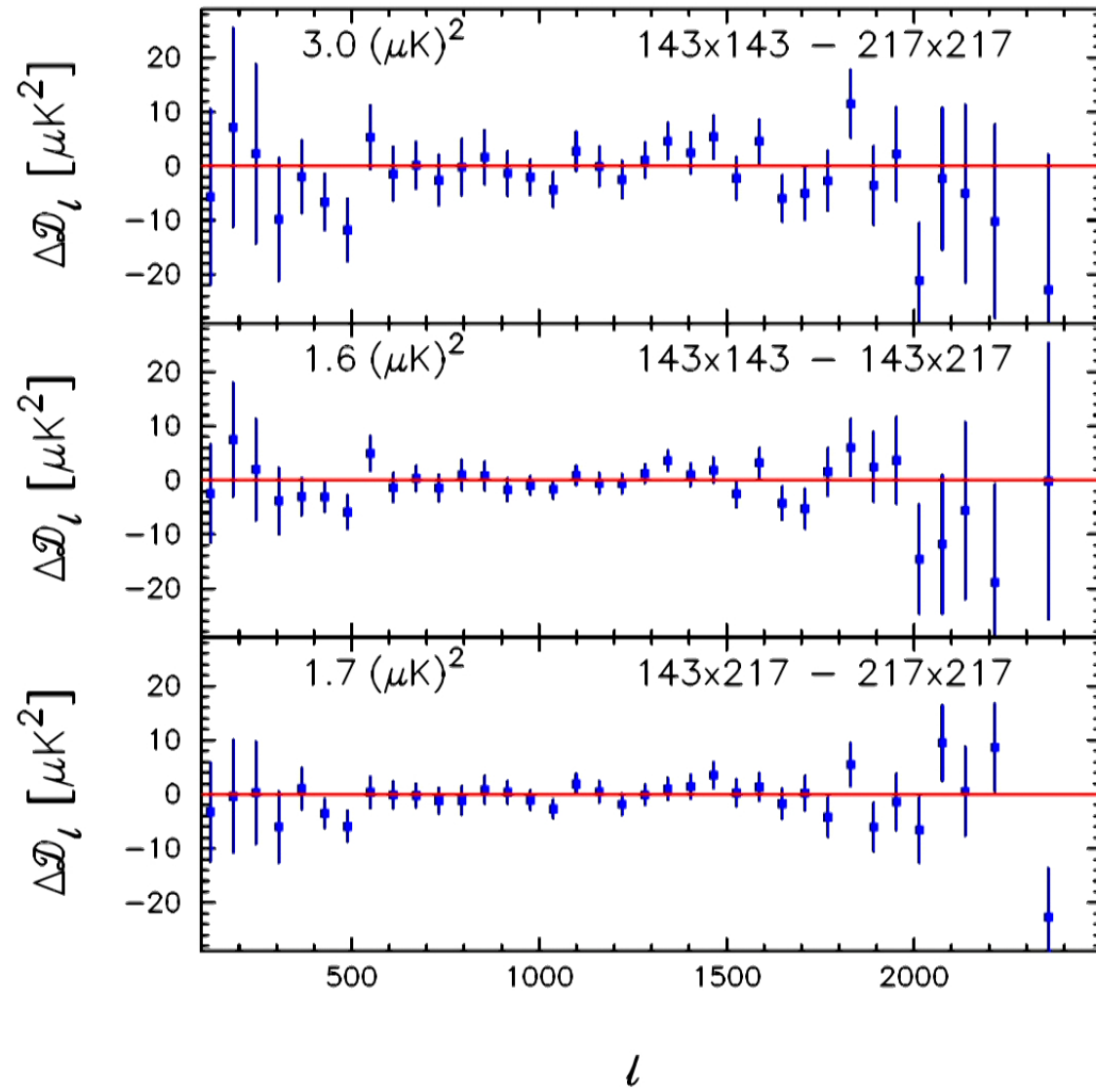
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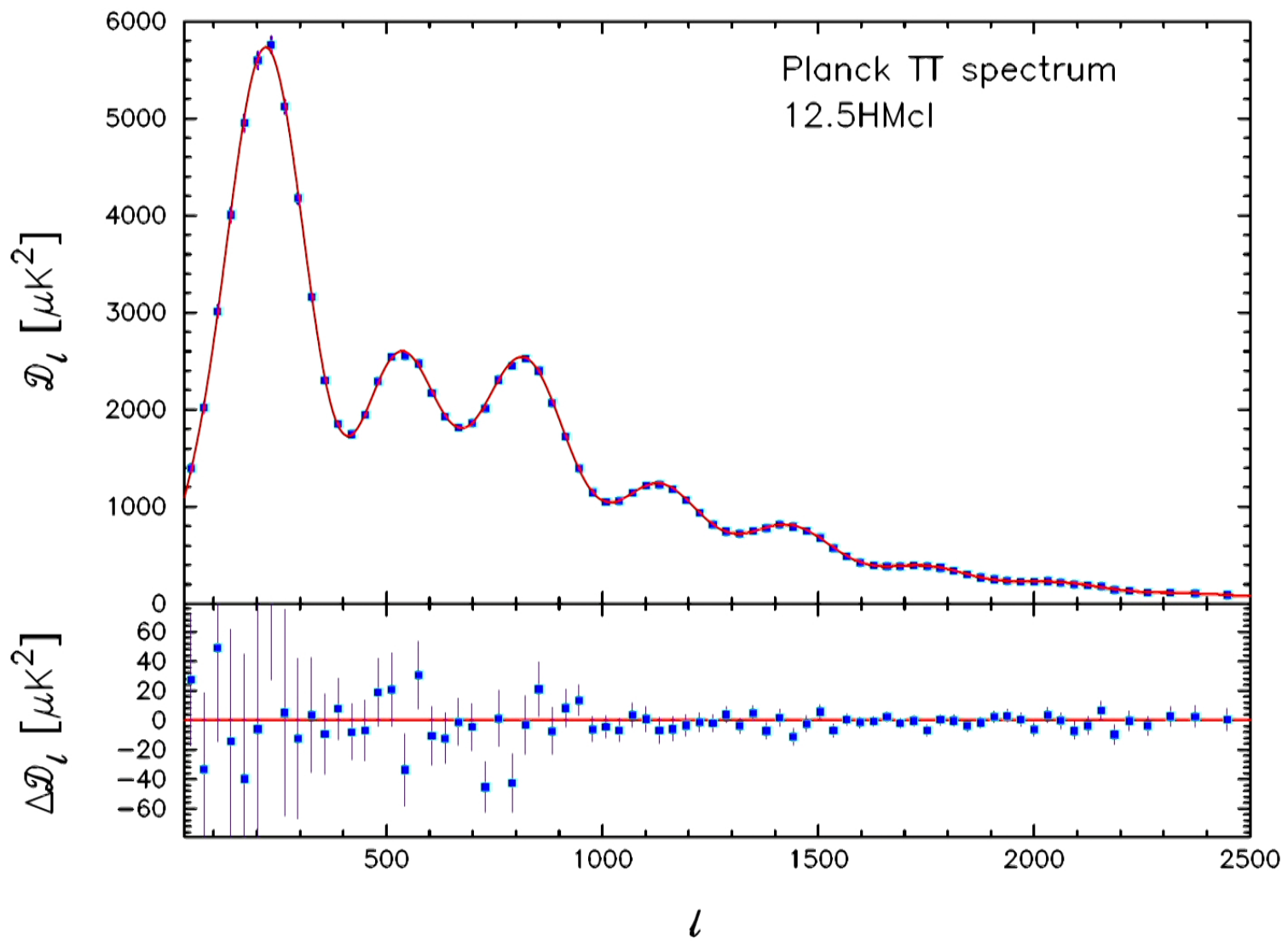


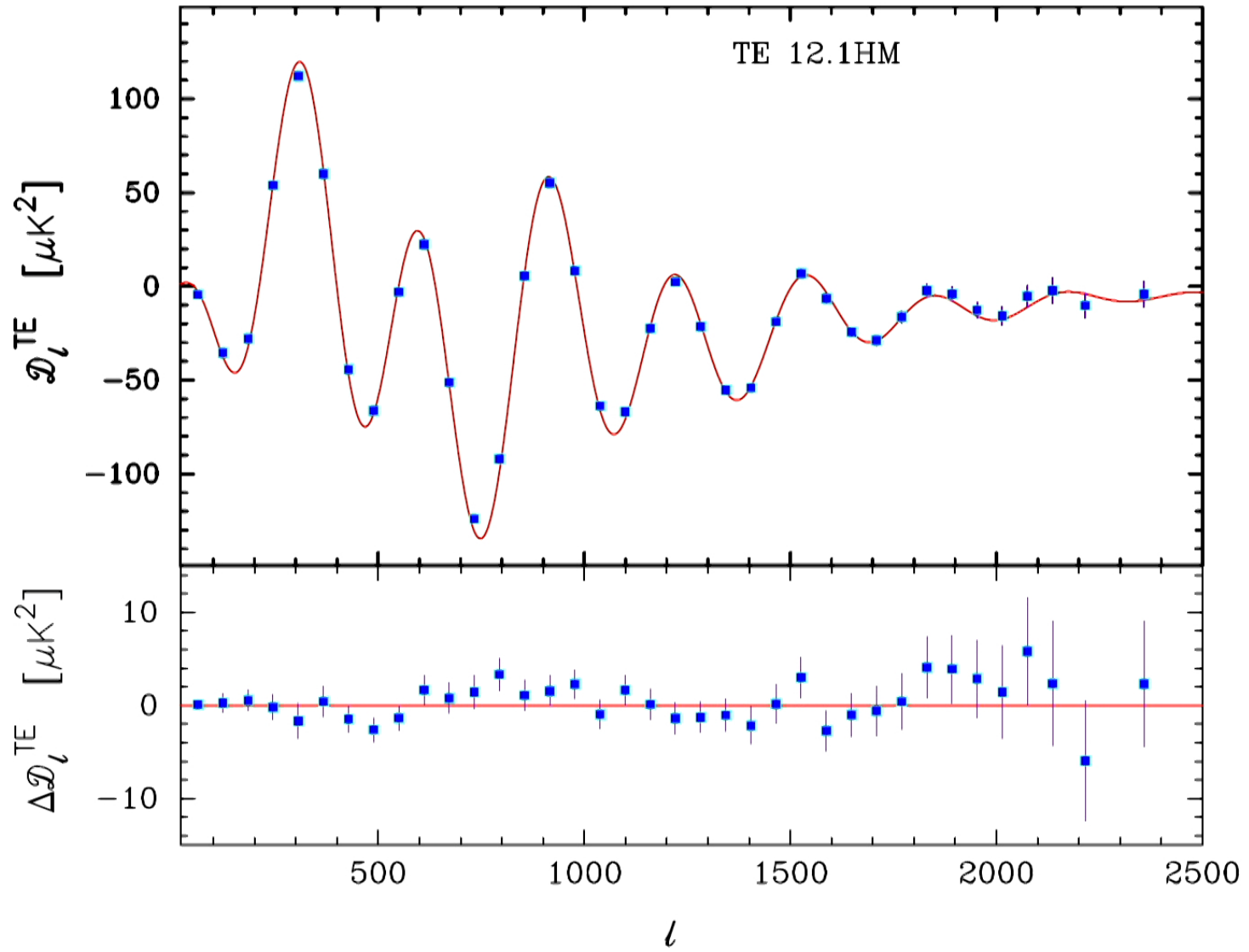
'Odd' aspects of Planck spectra?

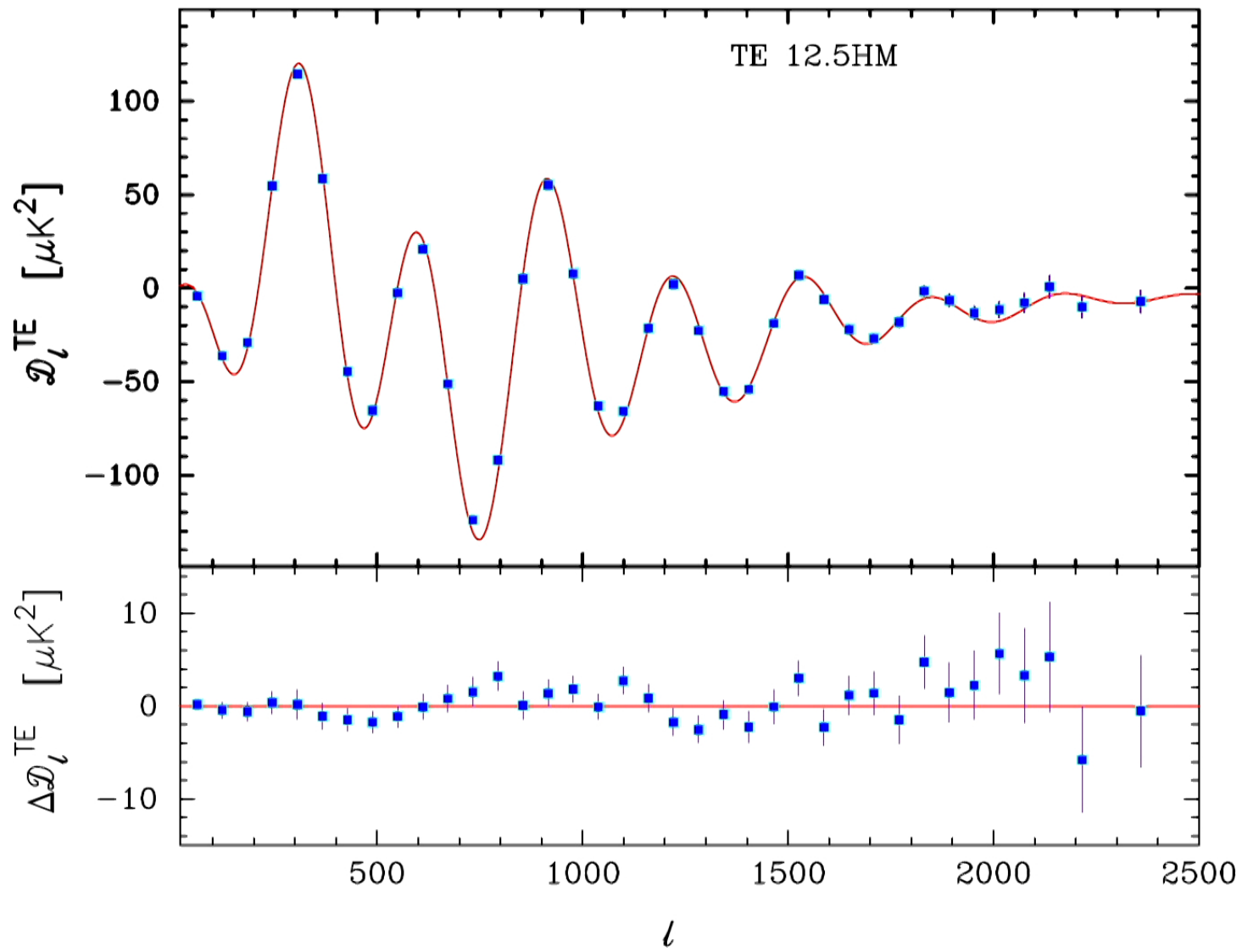
- ❑ Planck temperature spectra want more lensing ($A_L > 1$).
- ❑ Planck data favour closed universes.
- ❑ High multipoles ($\ell > 800$) give different parameters to lower multipoles (e.g. Addison et al 2016, ApJ, 818, 132).
- ❑ Outliers in TT spectrum and in TE spectrum (e.g. $\ell > 165$ in TE, Obied et al 2017, PRD, 083526).

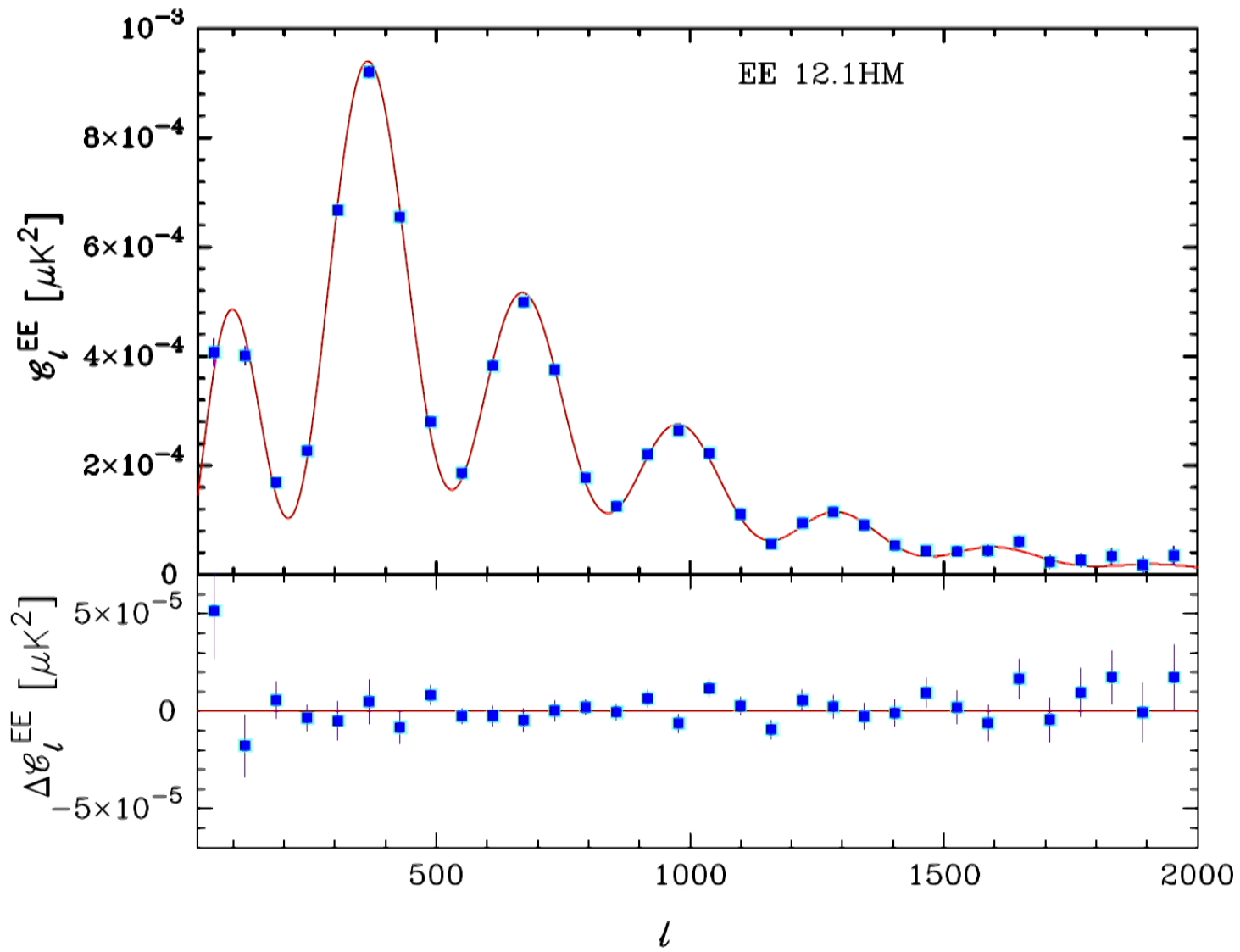
based on work done with Steven Gratton

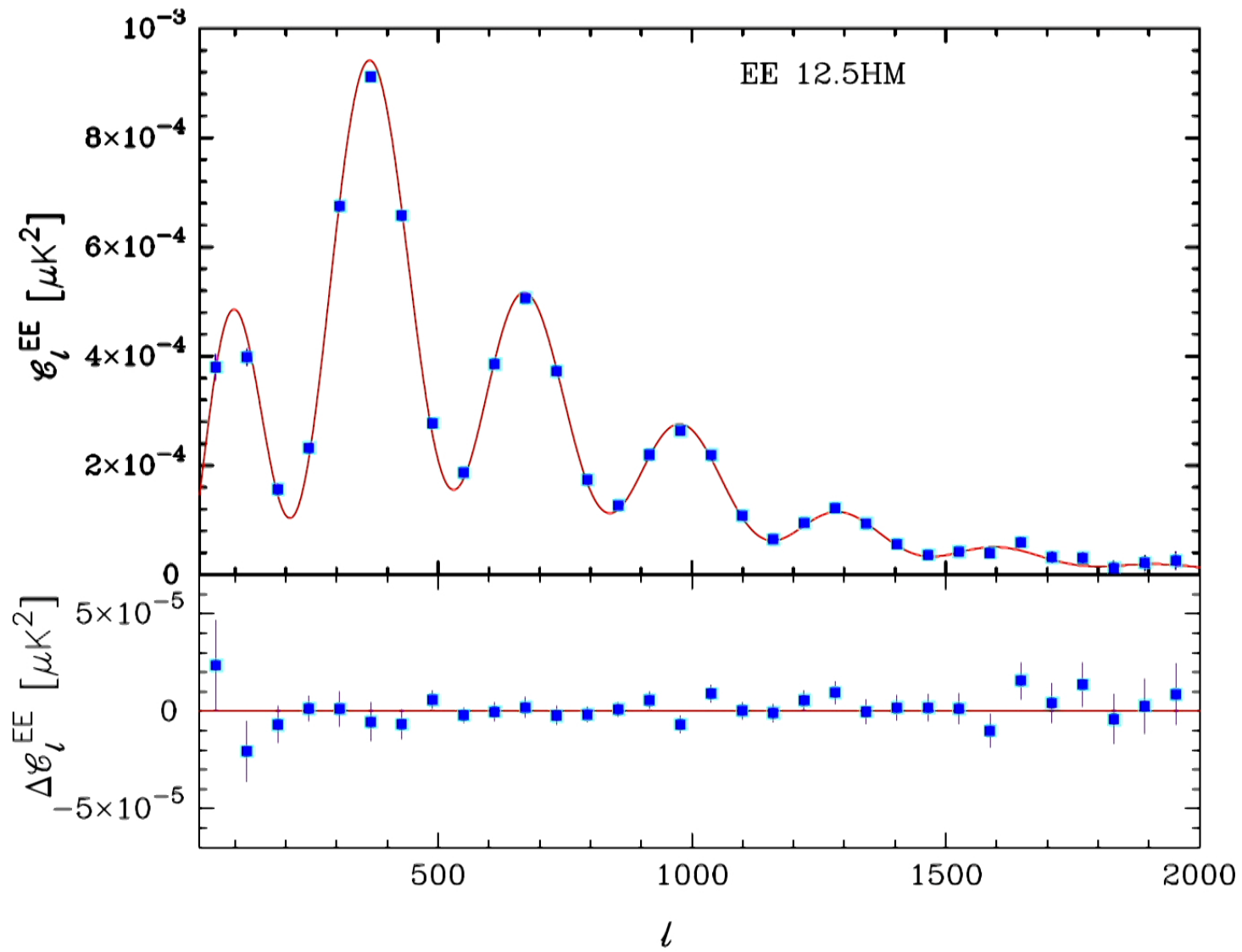


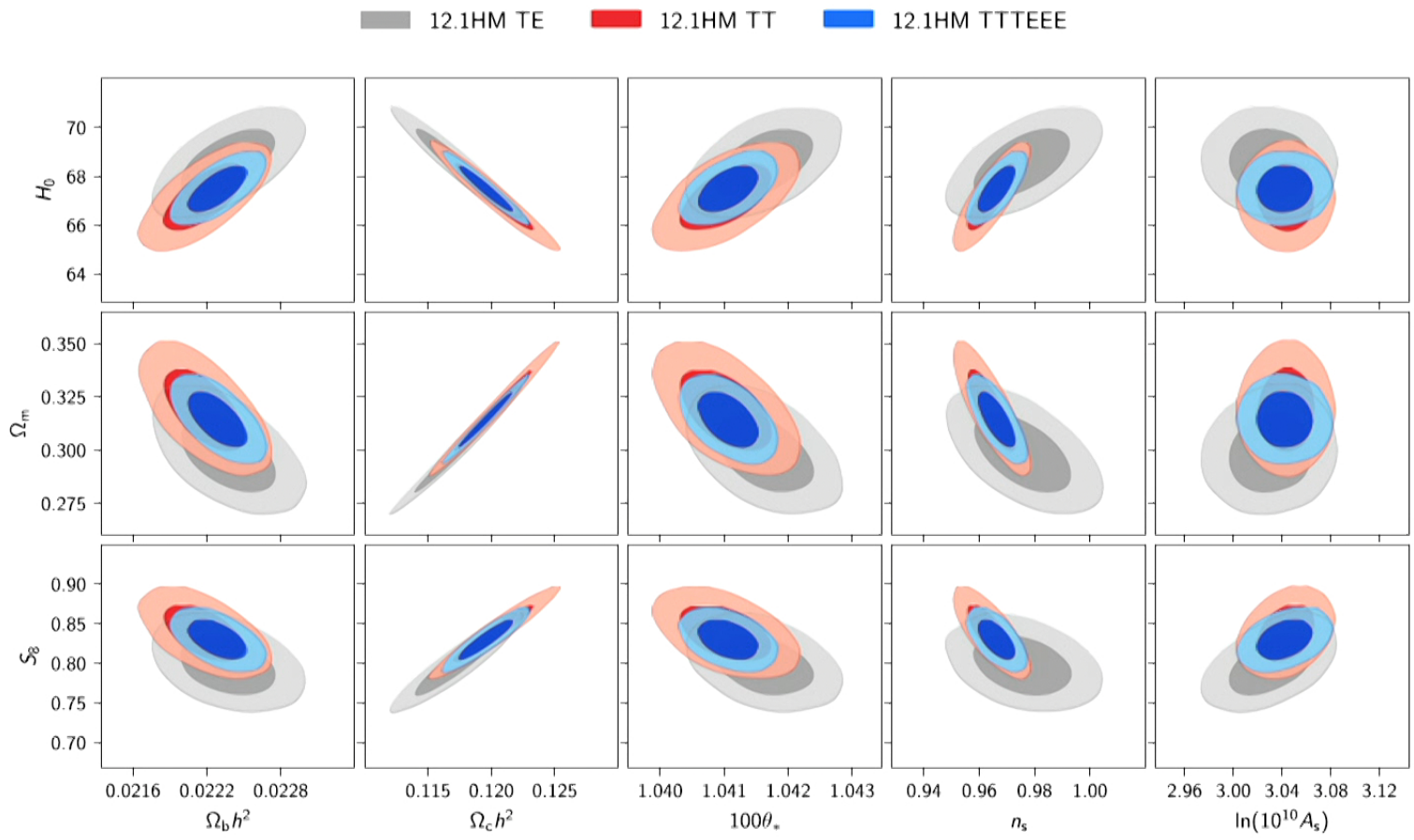


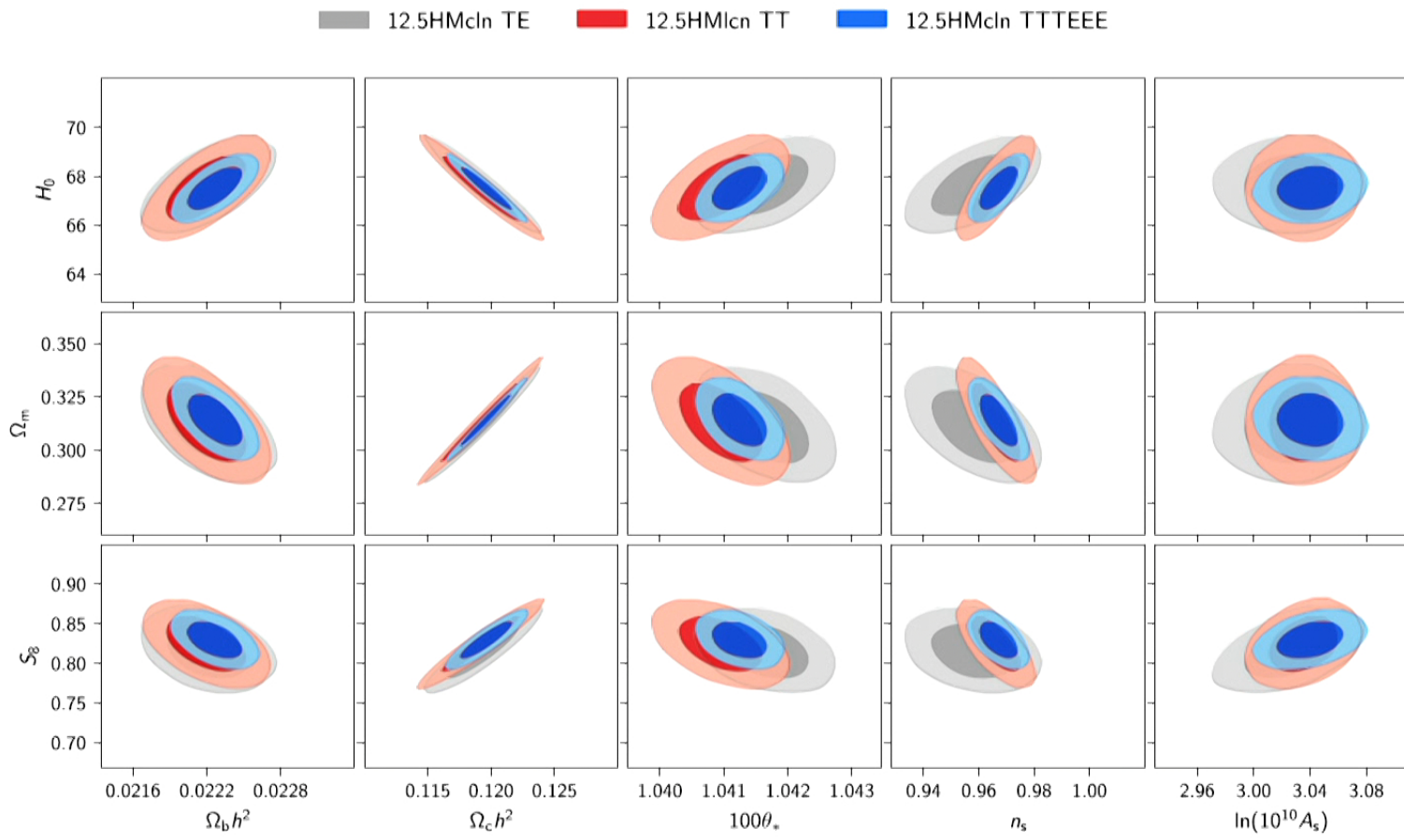


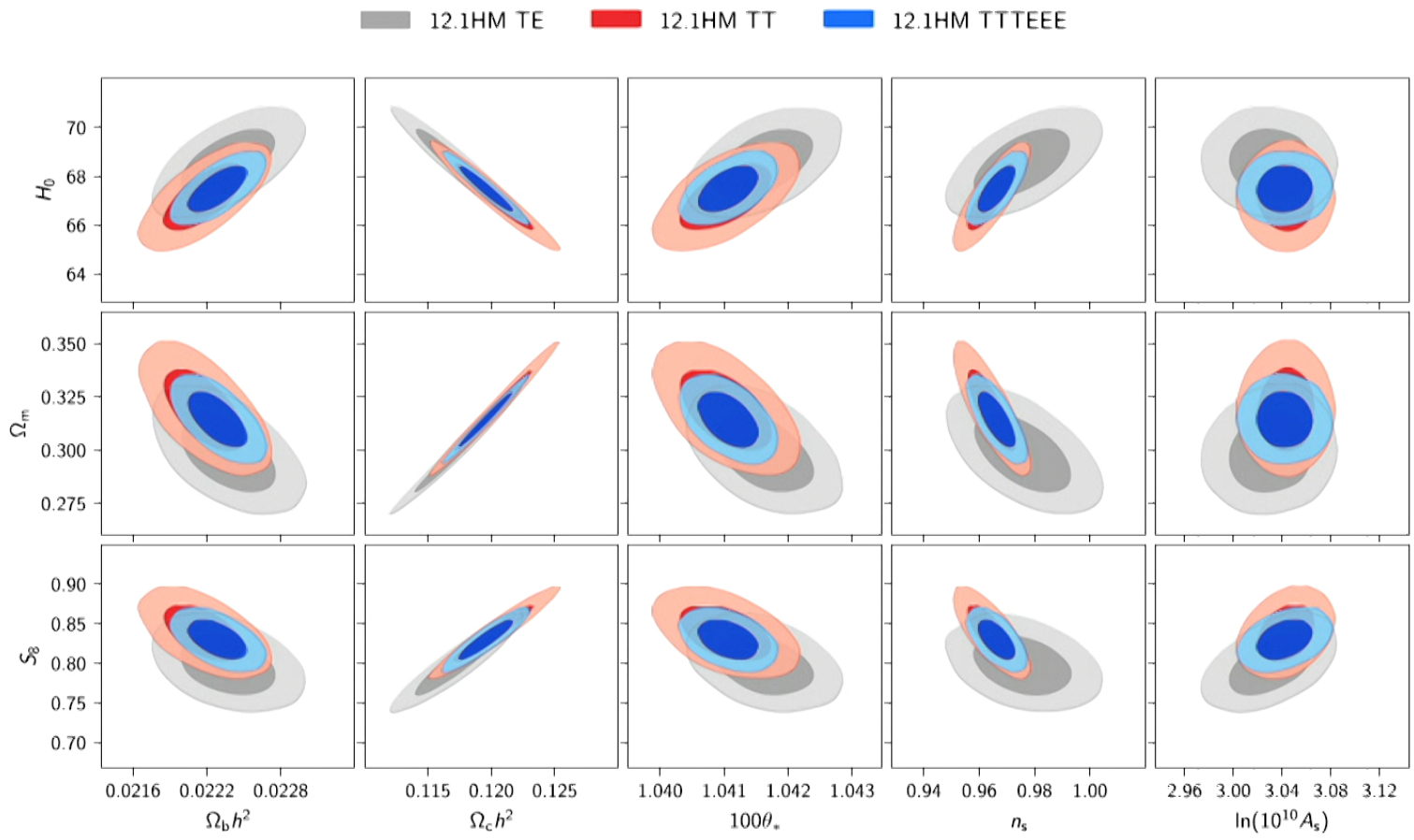


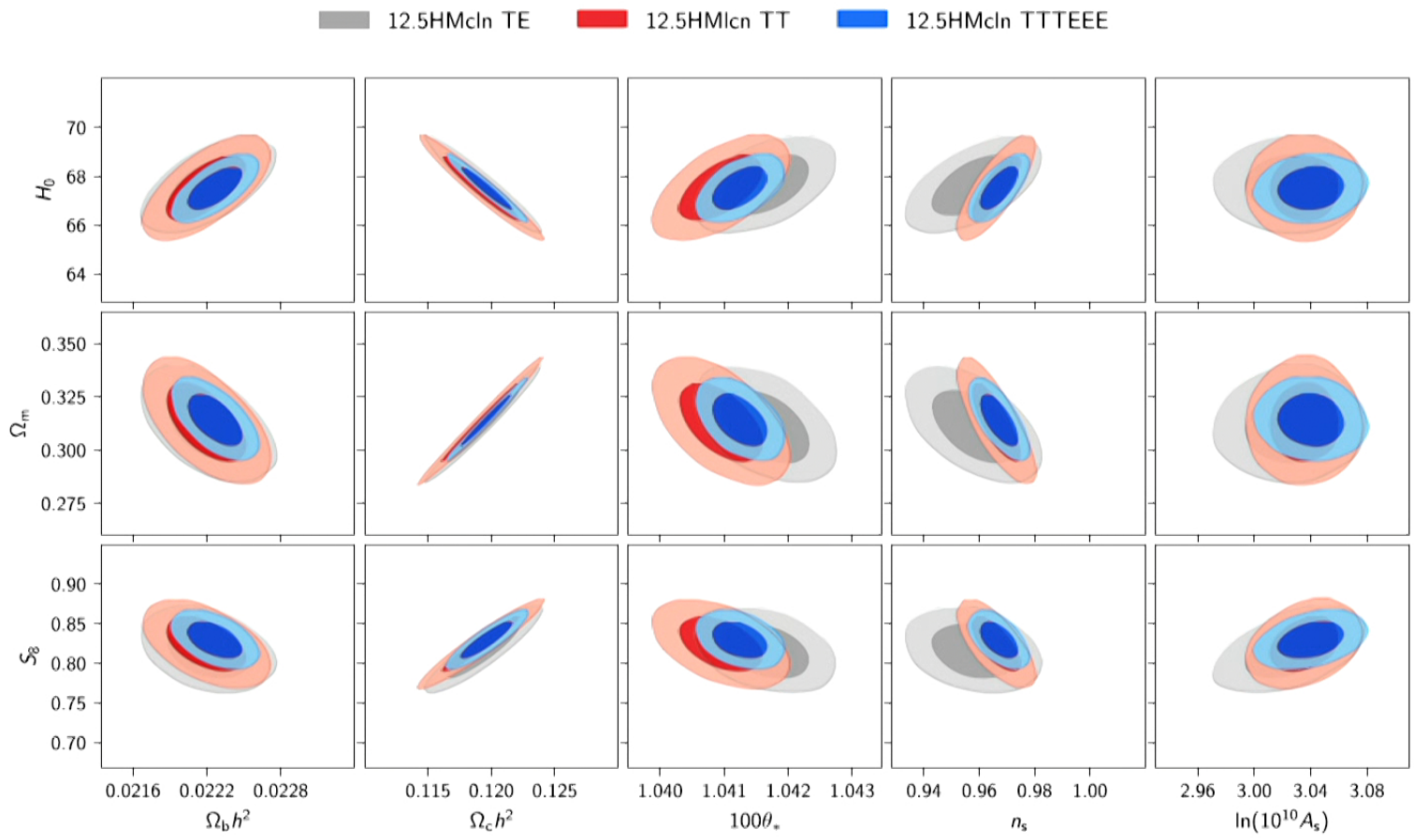


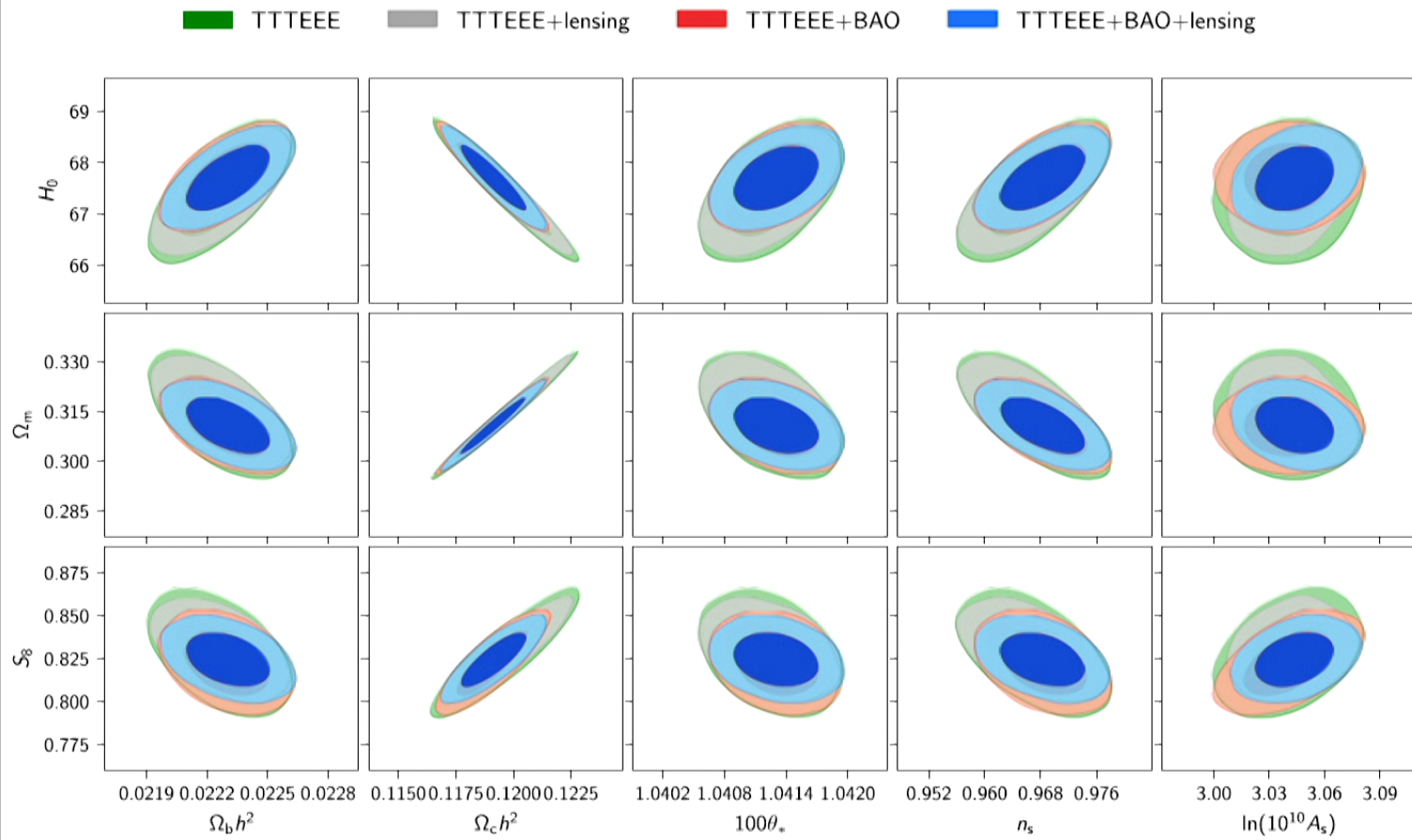




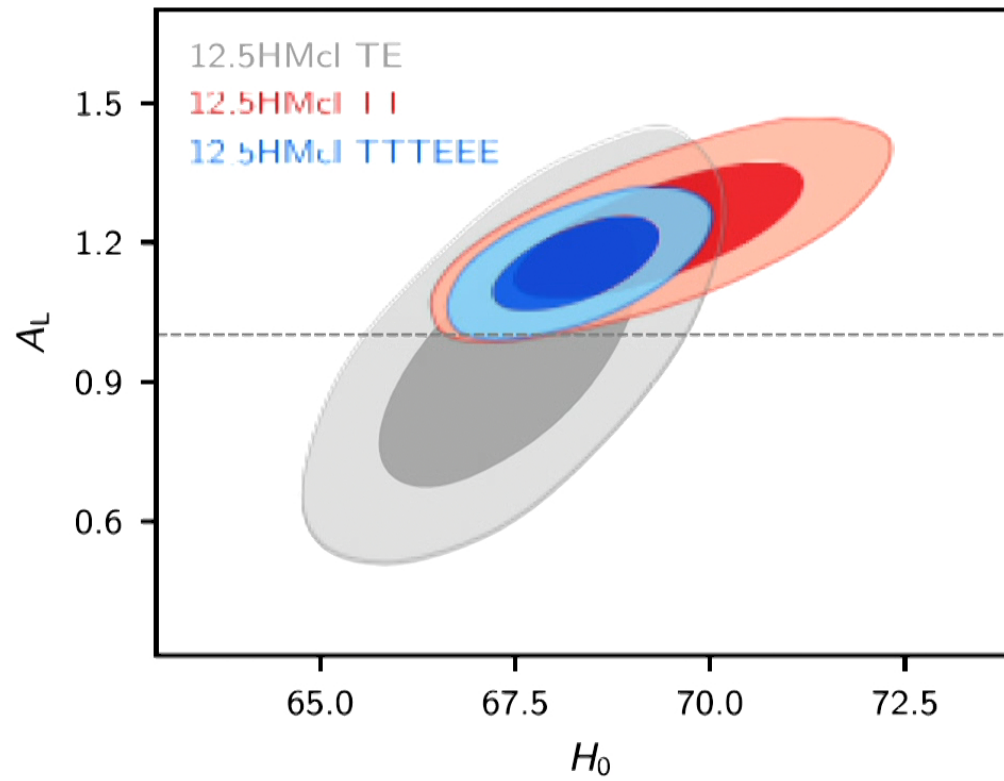


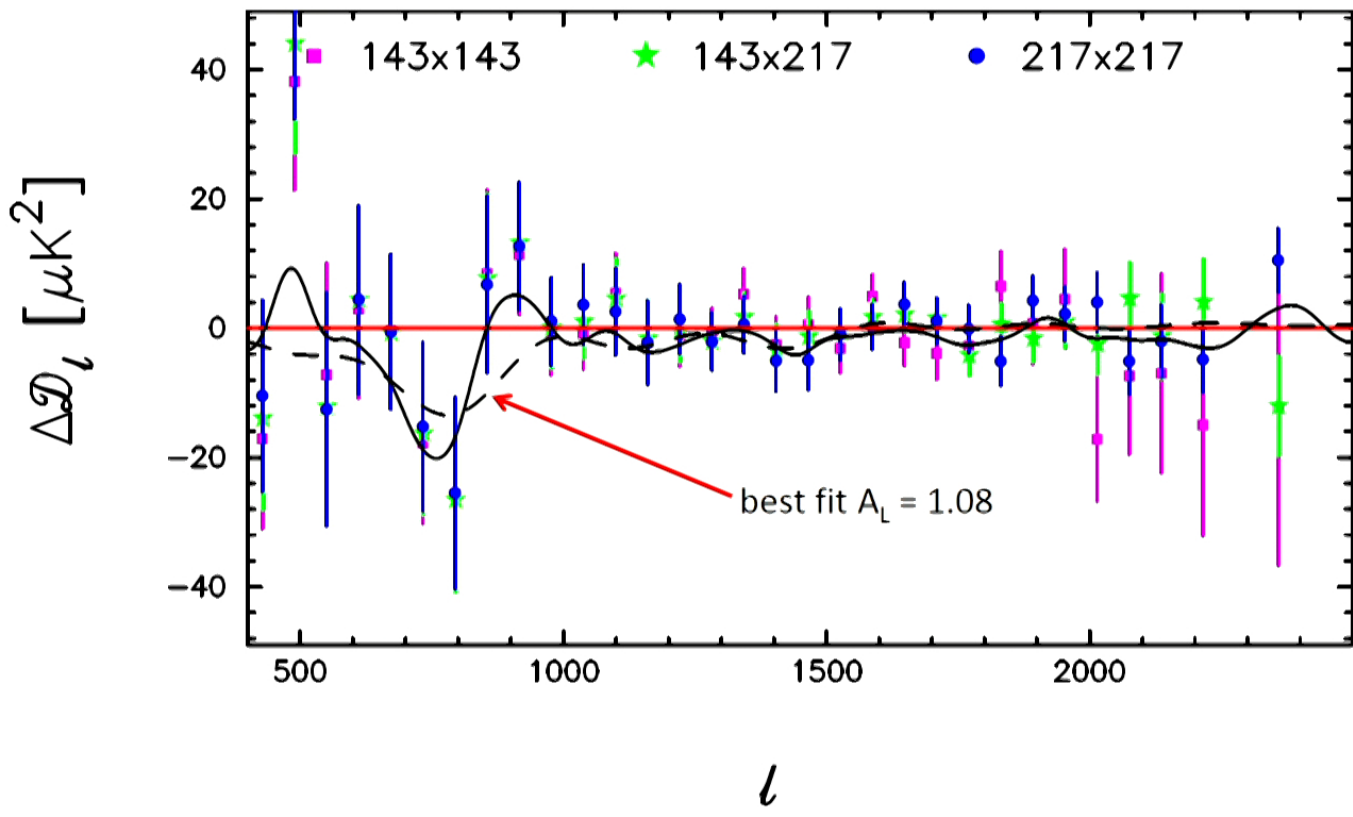




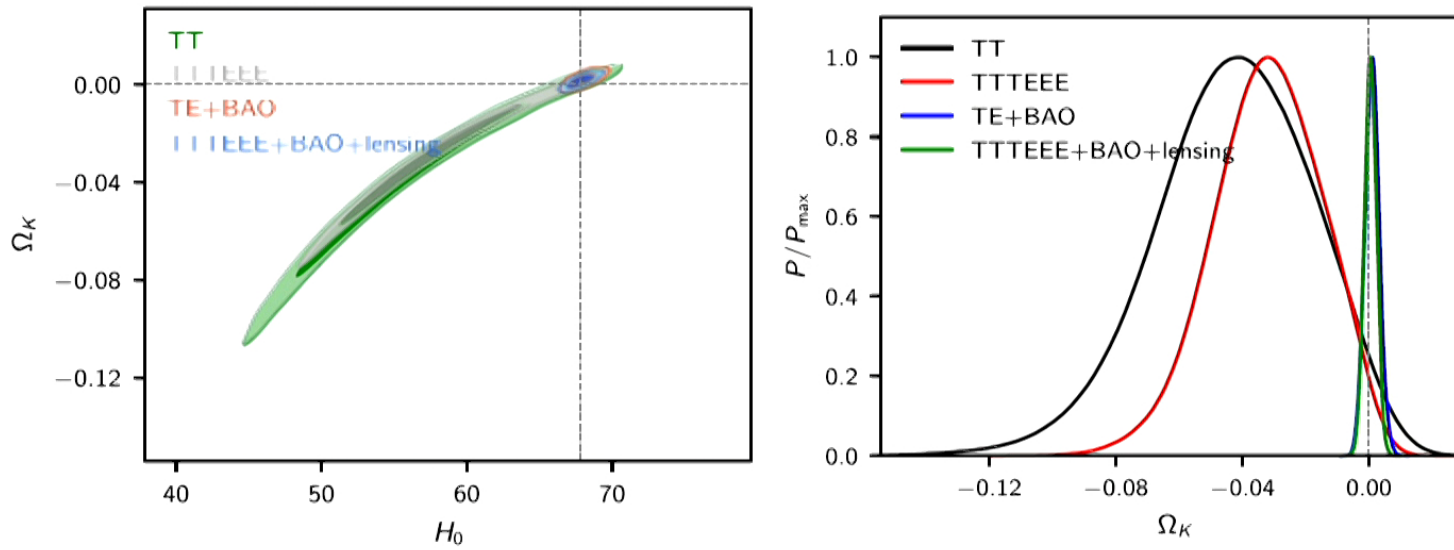


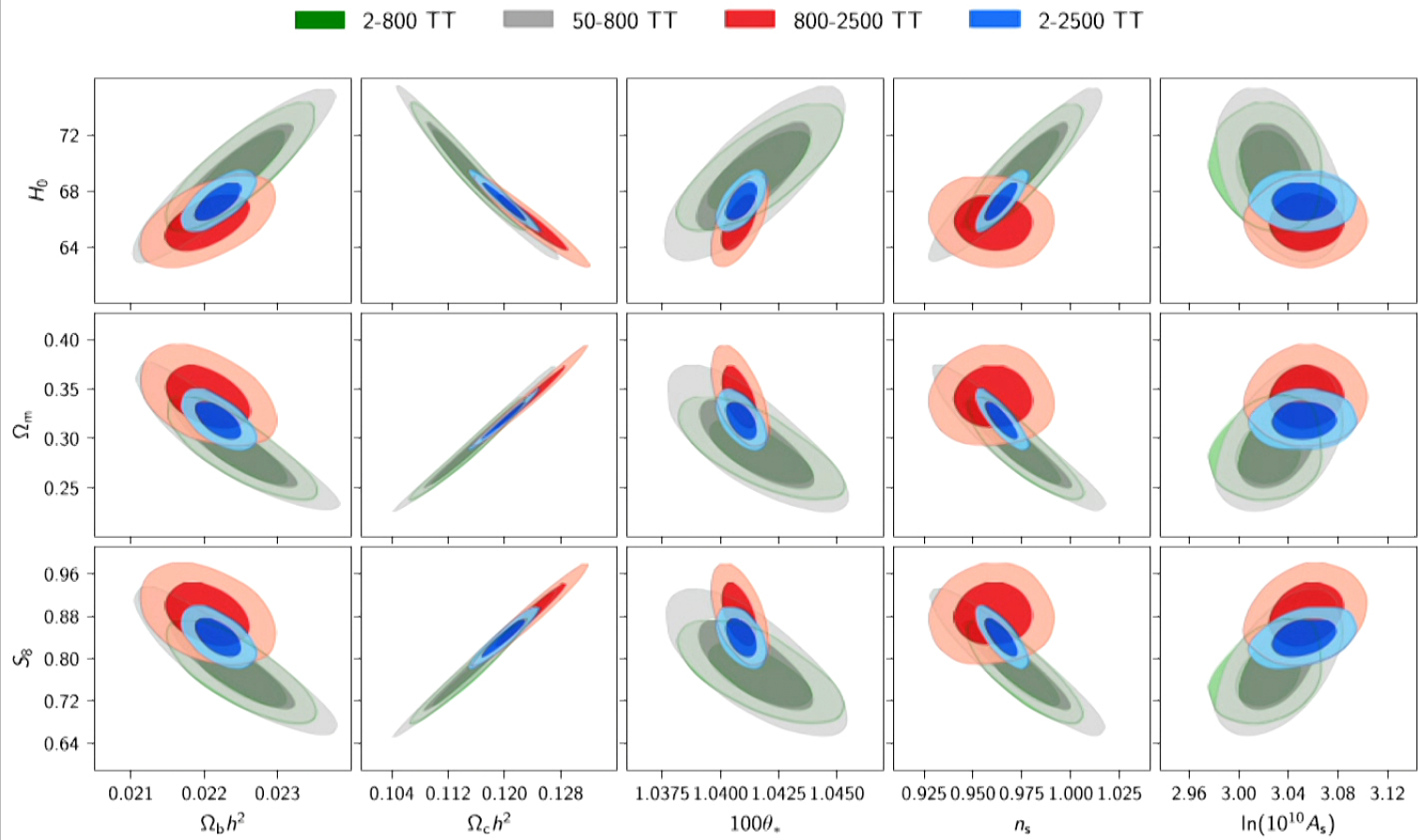
Lensing amplitude

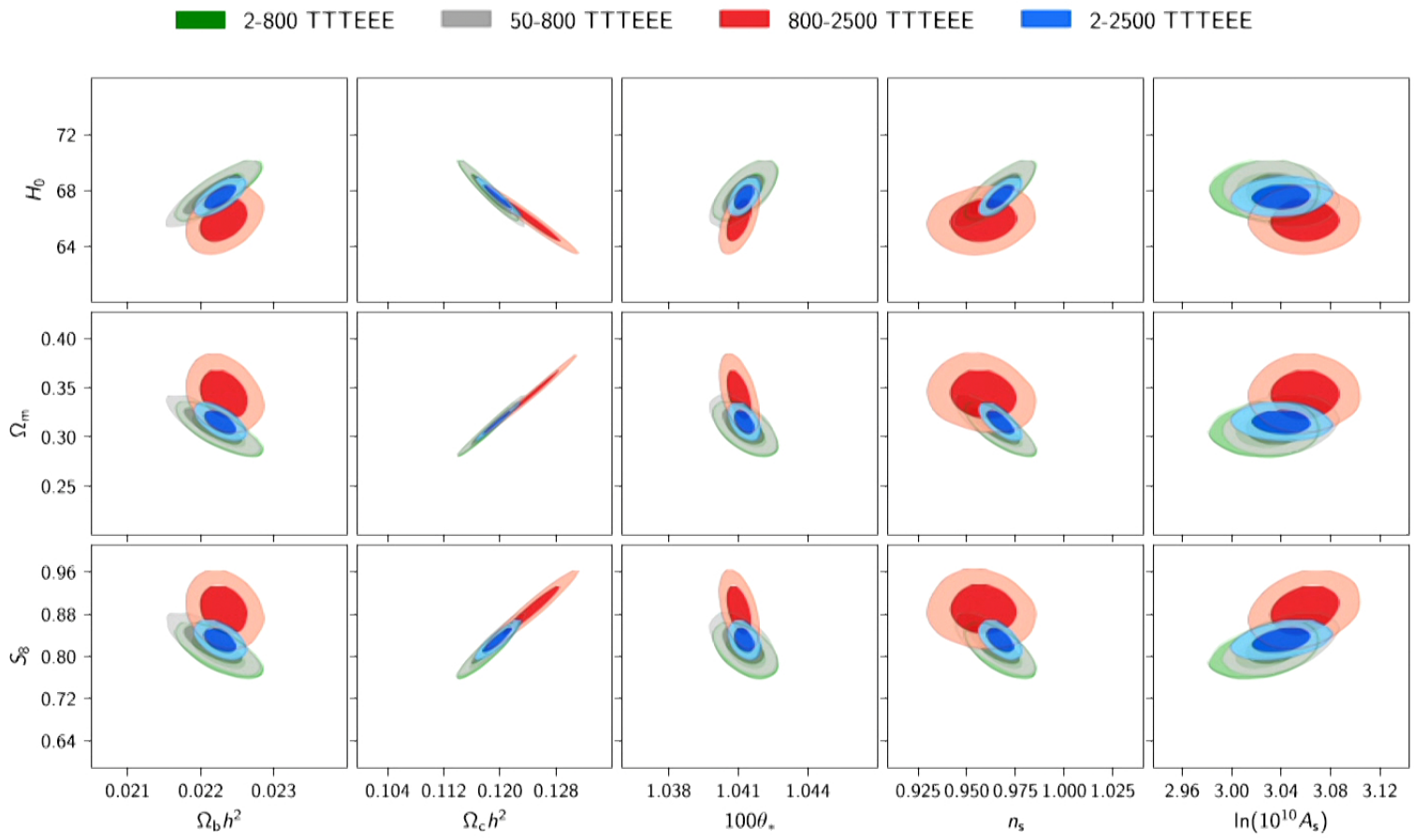


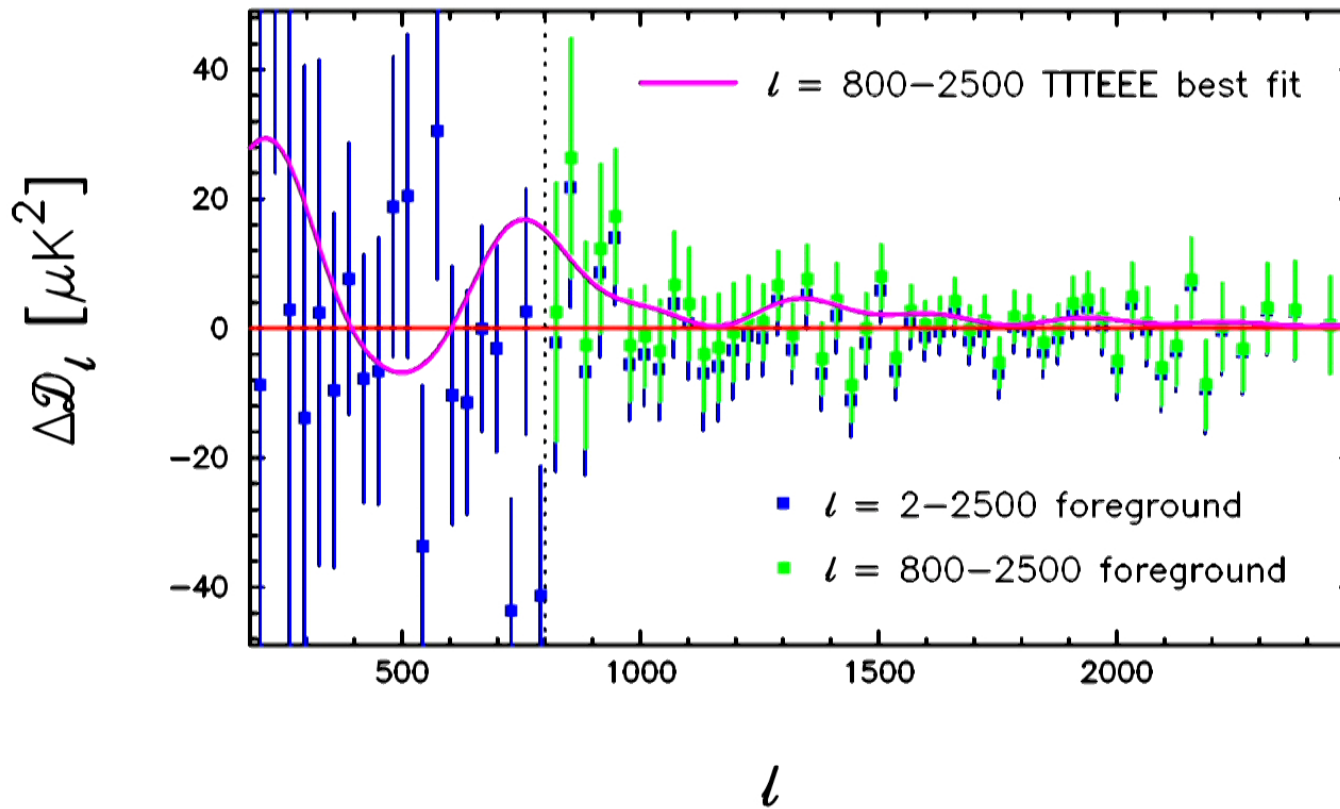


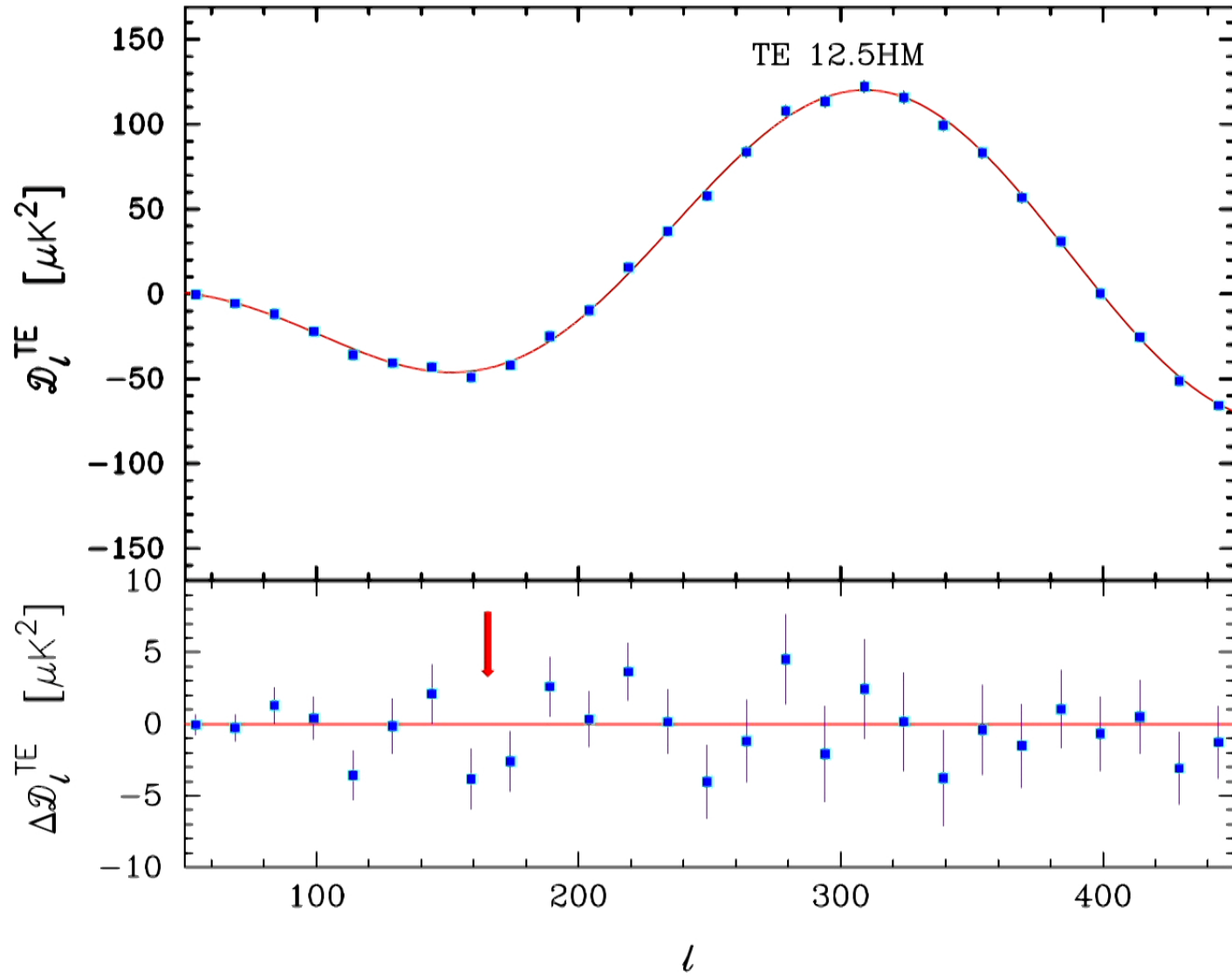
Curvature

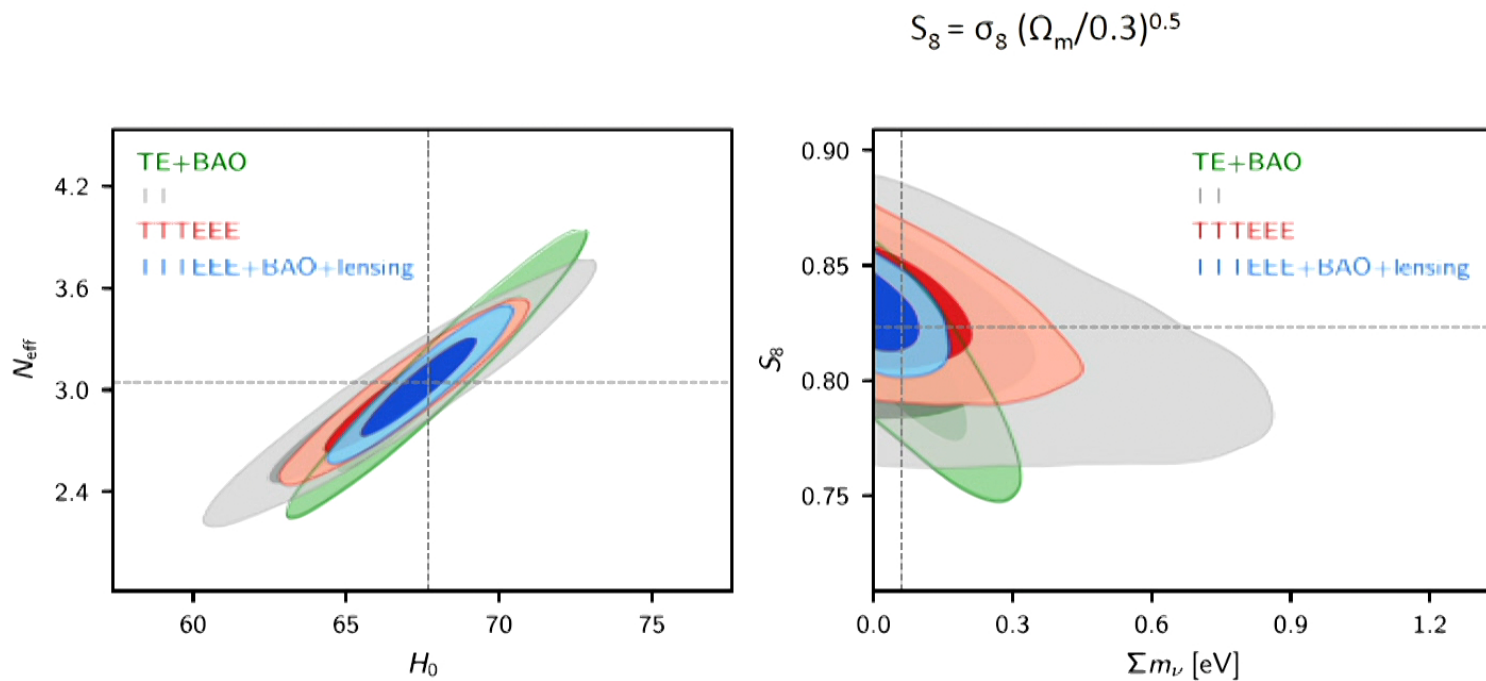


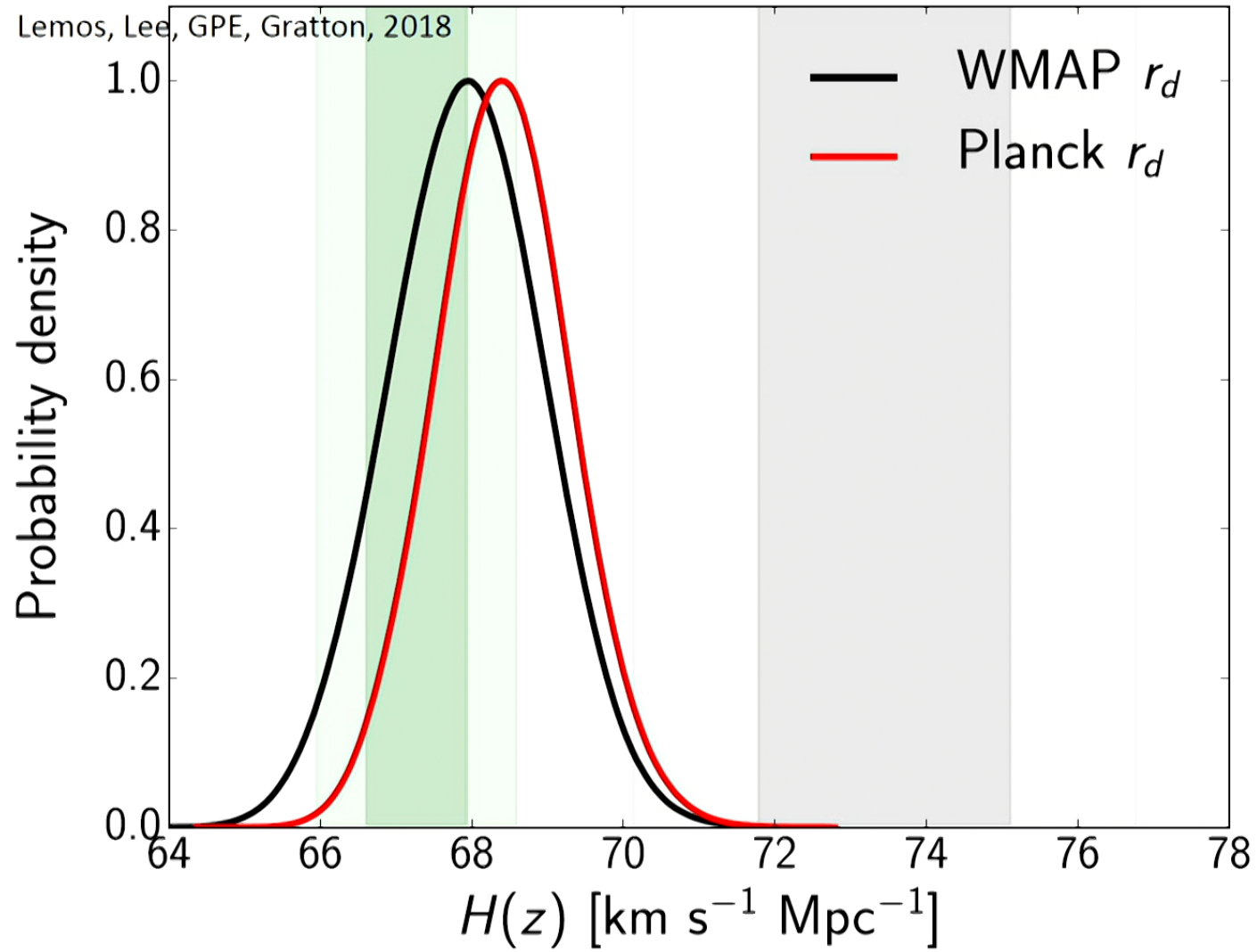




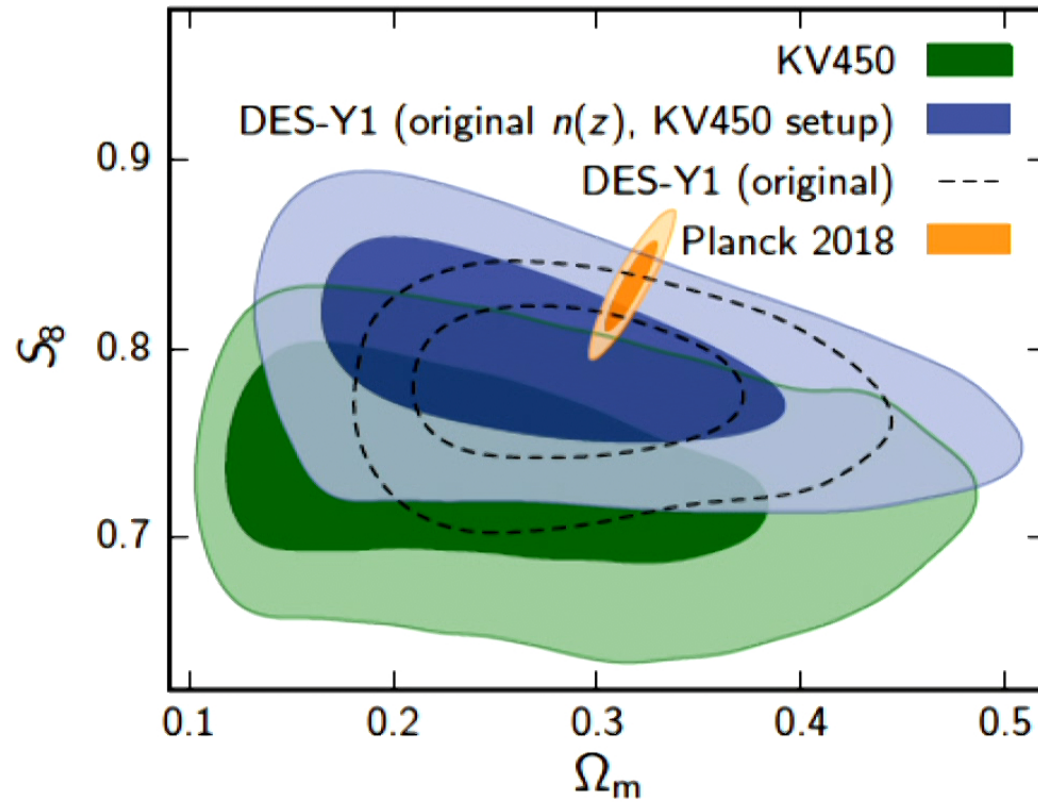




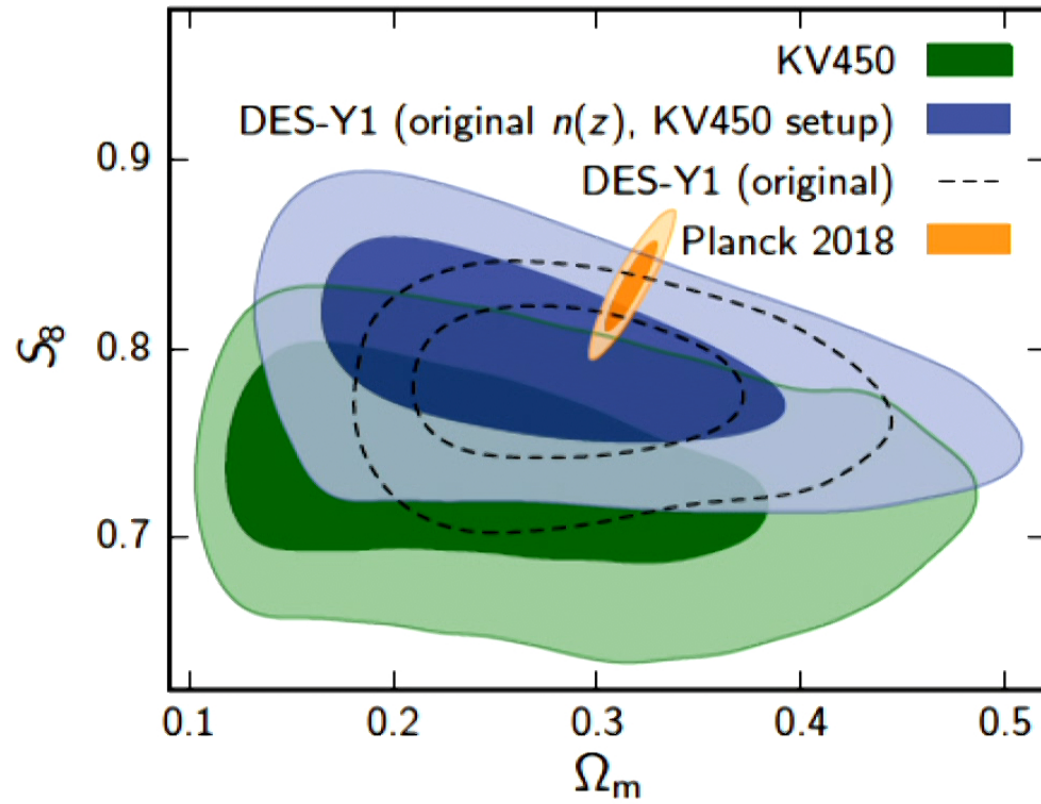




Galaxy Lensing: Joudaki et al arXiv:1906.09262



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The Conclusions:

- ❑ Λ CDM fits the Planck data **perfectly** within acceptable statistical errors
- ❑ If your experiment (CMB, LSS, H_0 ) disagrees with Planck, then either you are **wrong**, or there is new physics beyond Λ CDM.
- ❑ Any new physics must produce temperature and polarization spectra that are degenerate with base Λ CDM over the multipole range $2 \leq \ell \leq 2500$. Any such evidence is strongly dependent on the **fidelity** of other data.