IPhU meeting (Marseille September 2021)

Curvature effects on the large scale structure of the universe

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The example of the cosmic microwave background (CMB):

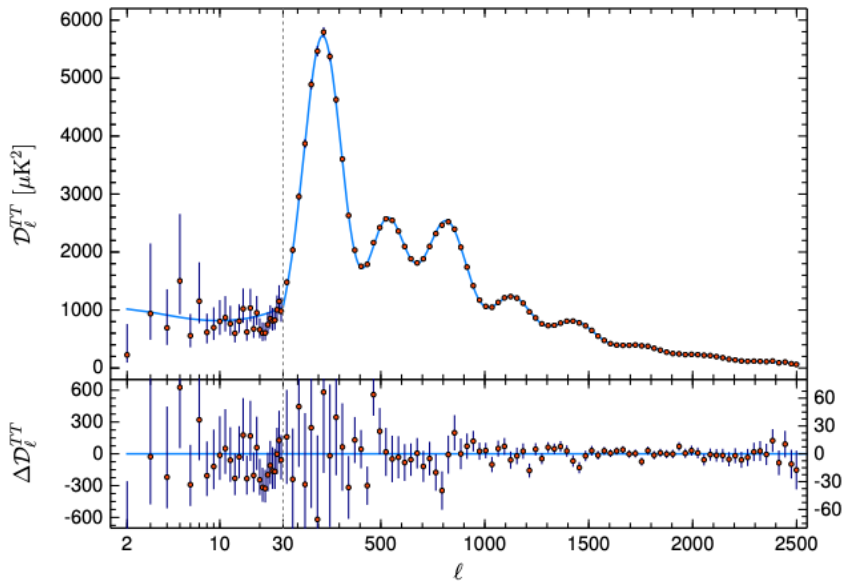

Fig. 1. *Planck* 2018 temperature power spectrum. At multipoles $\ell \geq 30$ we show the frequency-coadded temperature spectrum computed from the `Plik` cross-half-mission likelihood, with foreground and other nuisance parameters fixed to a best fit assuming the base-ΛCDM cosmology. In the multipole range $2 \leq \ell \leq 29$, we plot the power spectrum estimates from the `Commander` component-separation algorithm, computed over 86 % of the sky. The base-ΛCDM theoretical spectrum best fit to the *Planck* TT,TE,EE+lowE+lensing likelihoods is plotted in light blue in the upper panel. Residuals with respect to this model are shown in the lower panel. The error bars show $\pm 1\,\sigma$ diagonal uncertainties, including cosmic variance (approximated as Gaussian) and not including uncertainties in the foreground model at $\ell \geq 30$. Note that the vertical scale changes at $\ell = 30$, where the horizontal axis switches from logarithmic to linear.

Planck (2018)

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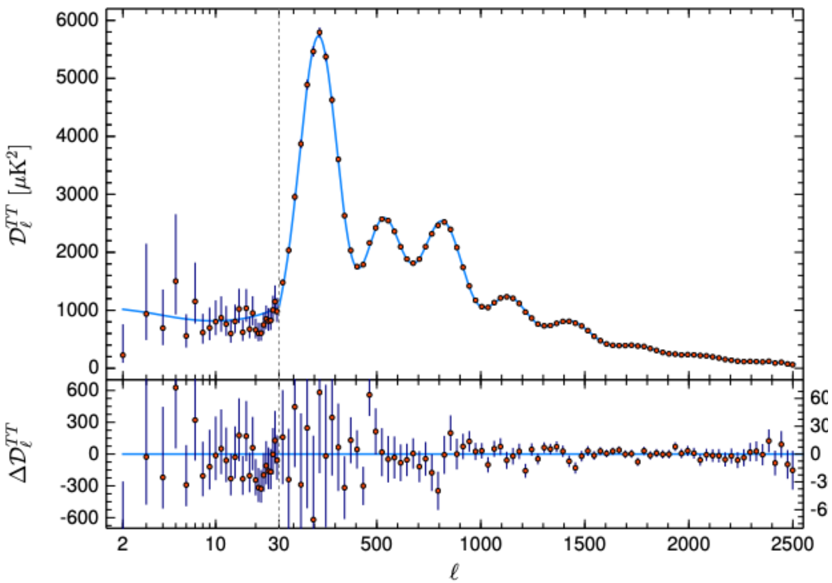

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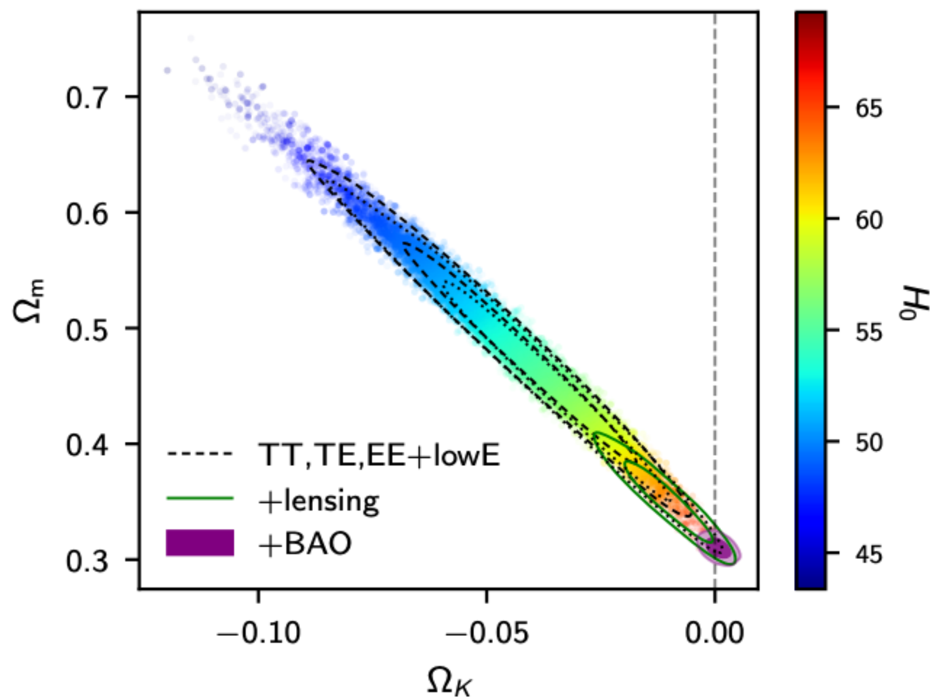


Planck (2018)

Motivation

Problem: Fourier basis in curved space

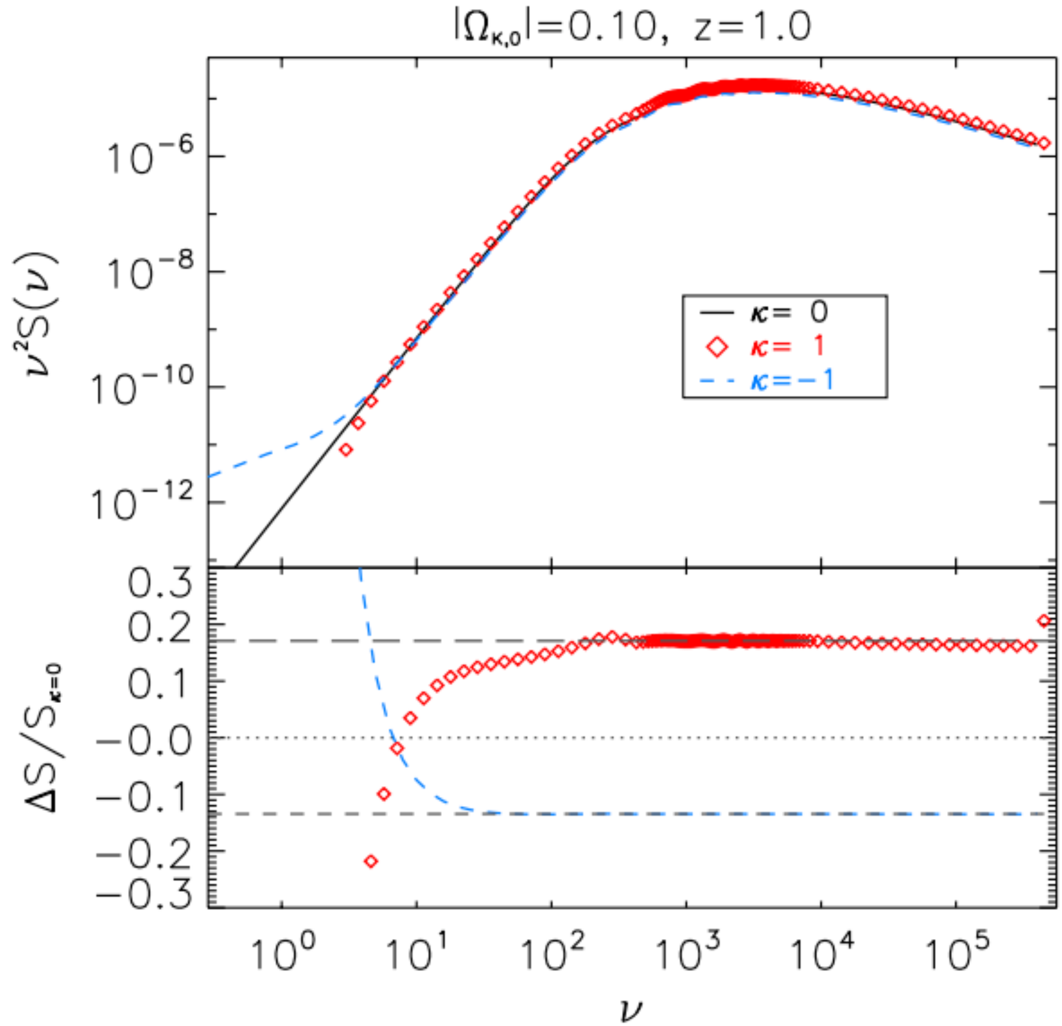
$$\Delta\Psi = -k^2\Psi,$$

$$\nu^2 S(\nu) = \nu\sqrt{\nu^2 - \kappa}\frac{P(k)}{a_0^3}.$$

$$a_0 = \frac{c}{H_0\sqrt{|\Omega_{K,0}|}}$$

Motivation

Power spectrum:

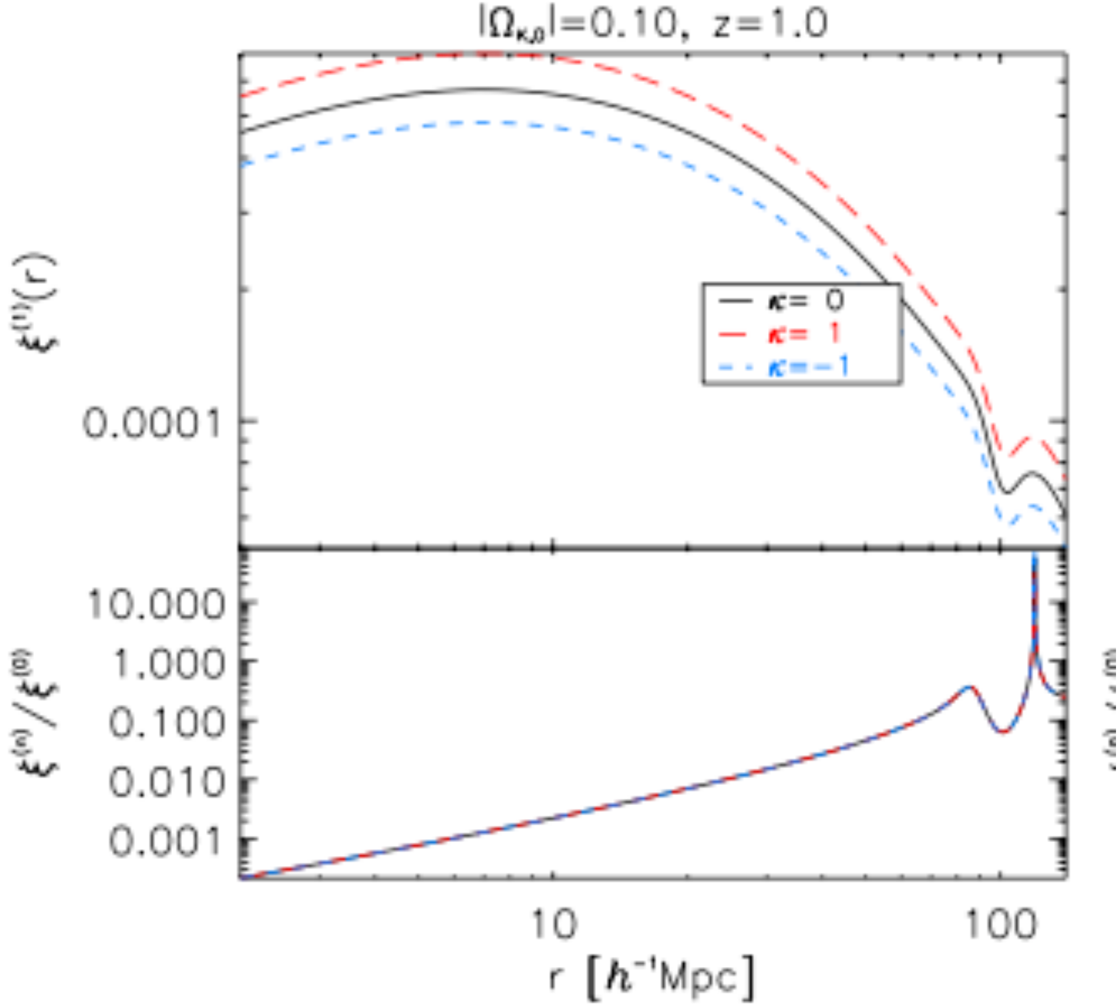


Modification of the link between 2pcf and power spectrum

$$S_\kappa(\chi)^2 = S_\kappa^2(\chi_1)C_\kappa^2(\chi_2)+S_\kappa^2(\chi_2)C_\kappa^2(\chi_1)+\kappa S_\kappa^2(\chi_1)S_\kappa^2(\chi_2)\sin^2\gamma-2S_\kappa(\chi_1)S_\kappa(\chi_2)C_\kappa(\chi_1)C_\kappa(\chi_2)\cos\gamma. \quad (18)$$

$$\xi(\chi) = b_1 b_2 D_1 D_2 4\pi \int \nu^2 \mathcal{S}(\nu) X_0^{(\kappa)}(\nu,\chi)\mathrm{d}\nu,$$

Dipole of the 2pcf in redshift space:



Next

-Generate Monte Carlo realisations of the matter density field in curved space

-Quantify the effect of curvature on RSD analysis

-Quantify the effect of curvature on BAO analysis

-Constrain curvature with LSS