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Current constraints and forecasts on the tilt and running of the primordial tensor spectrum

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Gravitational waves can be produced by a wide range of astrophysical phenomena, such as inspiral and merging of neutron stars and black holes, supernova of massive stars, accreting neutron stars, etc. This talk is focused, instead, on a stochastic background of gravitational waves (GWs) of cosmological origin, like the one predicted by inflation.

I start by considering a power law parametrization of the frequency spectrum of primordial tensor modes, with tilt n_T and tensor-to-scalar ratio r. I discuss the constraints that can be placed on these parameters by Cosmic Microwave Background (CMB) temperature and polarization anisotropies alone, and then show how such constraints become stronger if one takes into account the contribution of gravitational waves to the radiation energy density. GWs add to the effective number of relativistic degrees of freedom $N_{\rm eff} = 3.046 + N_{\rm eff}^{\rm GW}$, and then have an effect on the CMB angular spectra and the primordial abundances. More precisely, we find that the 95% CL limits on the tilt n_T at a pivot scale of 0.01 Mpc^{-1} go from $n_T = 1.7^{+2.1}_{-2.0}$ (Planck + BKP dataset, no $N_{\rm eff}^{\rm GW}$) to $n_T = 0.06^{+0.78}_{-0.56}$ (with $N_{\rm eff}^{\rm GW}$).

In the second part of the talk I discuss the forecasts on a spectrum described by a spectral index n_T and its running $n_{T,\rm run}$: our analysis considers a future COrE-like satellite mission combined with direct-detection experiments like AdvLIGO. When the contribution of primordial tensor modes to CMB spectral distortions of the μ-type is taken into account, we add the future measurements of the CMB spectrum by a PIXIE-like experiment.

For these forecasts two fiducial cosmologies are considered: at first a cosmology with no primordial gravitational waves, in order to see how well future experiments will be able to measure the tensor parameters. The second forecast takes as fiducial model one where the tensor-to-scalar ratio is of order 10^{-2} (a value that can be reached by futuristic ground-based experiments such as AdvACT), and the tilt and running are fixed by the consistency relations of single-field slow-roll inflation.

In the final part of the talk, I discuss the implications of our results for models of single-field slow-roll inflation.

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