Present status of the search for gravitational waves from inflation

Alexei A. Starobinsky

Landau Institute for Theoretical Physics RAS, Moscow-Chernogolovka, Russia

The measurement of a small deviation of the primordial spectrum of scalar (density) perturbations in the Universe from the exactly flat (Harrison-Zeldovich, $n_s = 1$) one in the WMAP and Planck CMB experiments confirms the general prediction of the early Universe scenario with the de Sitter (inflationary) stage preceding the radiation dominated stage (the hot Big Bang) and strongly restricts the class of viable inflationary models [1]. Thus, the status of the inflationary paradigm is changing from "proving" it in general and testing some of its simplest models to applying it for investigation of the actual history of the Universe in the remote past and particle physics at super-high energies using actual observational data. Another generic observational prediction of the inflationary scenario is the existence of primordial tensor perturbations (primordial GW background) [3] which power is suppressed compared to that of scalar ones by at least the first power of $|n_s - 1|$ and may be more. The announced discovery of primordial GW through the measurement of the B-mode of the CMB linear polarization in the range of multipoles $\ell = 50 - 150$ in the BISEP2 experiment [2], while formally being in agreement with this prediction, still corresponds to a too large amount of GW which contribution is not seen in the WMAP and Planck results for CMB temperature anisotropy. This suggests that the BISEP2 polarization result is partly, if not mostly, due to secondary foregrounds (mainly polarized galactic dust emission) that has been recently quantitatively confirmed by the Planck team [4]. Thus, it is premature to say that primordial GW have already been discovered. Much more future work is needed for this. On the other hand, I argue that the value $n_s \approx 0.96$ obtained in [1] leads to the conclusion that, under natural assumptions, the expected amount of primordial GW is not too small to be unmeasurable, being suppressed parametrically by no more than $|n_s - 1|^2$ compared to the power of scalar perturbations, like what happens in the $R + R^2$ inflation [5].

References

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