The Abdus Salam International Centre for Theoretical Physics
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ICTP COLLOQUIUM

Wednesday, 22 October at 16.30

Budinich Lecture Hall, ICTP Leonardo Building (entrance level)

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"Polarisation of the Cosmic Microwave Background: Toward an Observational Proof of Cosmic Inflation"

Abstract:

Statistical properties of the observed fluctuations of temperature and polarisation anisotropies of the cosmic microwave background are remarkably consistent with the basic predictions of cosmic inflation driven by a single energy component. The observed fluctuations are Gaussian and adiabatic, and the strength of fluctuations weakly depends on spatial scales. The WMAP experiment has confirmed these predictions with precision, and the Planck experiment has further tightened the limits on deviations from Gaussianity and adiabaticity of fluctuations. So, has inflation really happened? We do not know yet. A definitive observational proof of inflation must come from a convincing detection of signatures of nearly-scale-invariant primordial gravitational waves generated during inflation. The so-called B-mode polarisation of the cosmic microwave background is the most promising method known to date to detect such gravitational waves. In this presentation, we first briefly review the physics of E- and B-mode polarisation of the cosmic microwave background. We then discuss how to measure these signals in the data in the presence of Galactic foreground and gravitational lensing. A simple analysis shows that it is possible to detect a faint B-mode signal at the level of the tensor-to-scalar ratio of 0.001, i.e., two orders of magnitude below the current limit set by the temperature anisotropy data. This is likely the smallest tensor-to-scalar ratio we would ever reach using the cosmic microwave background. Detection of nearly scale-invariant B-modes at this level or above provides a definitive proof of inflation happening at "high-scales," i.e., energy scales close to a grand unification scale, 10^{16} GeV. Finally, we comment on the recent claim of a detection of the primordial B-mode polarisation by the BICEP/Keck Array collaboration.
