GENERATION OF LARGE-SCALE PRIMORDIAL ELECTROMAGNETIC FIELDS AND THEIR NON-CLASSICAL ORIGIN

SEMINAR

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Abstract

The universe is pervaded by magnetic fields across a vast range of scales, from planets and stars to galaxies and galaxy clusters. Observationally, magnetic field strengths span from several μ G in galaxies and clusters, up to a few Gauss (G) for planets, and as high as 10^{12} G for neutron stars. Gamma-ray studies and Faraday rotation experiments further constrain the intergalactic medium (IGM) magnetic field between 10^{-10} and 10^{-22} G. While classical magnetohydrodynamics can amplify minuscule seed fields to explain present-day galactic and cluster magnetism, the large-scale primordial electromagnetic fields potentially stretching over Mpc distances require generation mechanisms operating in the early universe. Inflationary magnetogenesis, realized through breaking the conformal invariance of the Maxwell term via non-minimal coupling to scalar fields during inflation, provides a compelling scenario for producing such fields. Inflation, which underpins the observed large-scale structure of the universe, is fundamentally a quantum process. Crucially, it not only seeds primordial magnetic fields but also generates gravitational waves, both of which serve as potential observables probing quantum signatures from the early universe. This discussion presents an integrated approach to analyzing primordial electromagnetic and gravitational fields, introducing experimentally viable observables to quantify their non-classical, quantum origin.

Venue

PAMU Seminar Room

A.N. Kolmogorov Building, ISI, Kolkata

Date & Time

15 October, 2025
03:00 PM

Everyone is invited to attend