Primordial gravitational waves: a probe of dark matter and leptogenesis

Tuesday 8 July 2025 17:00 (20 minutes)

Primordial gravitational waves (GWs) provide a unique way to look into the early Universe, revealing the connection among inflationary reheating, dark matter (DM) and baryogenesis. I will explore how distinct GW signatures can test new physics scenarios beyond the standard model, offering insights into the fundamental nature of the DM and leptogenesis. I will first discuss how inflationary GWs can probe the co-genesis of DM and high-scale leptogenesis, both produced via gravity-mediated processes at the time of reheating. I will then explore if future GW missions like LISA, ET etc. are able to probe a specific range of DM mass along with the scale of leptogenesis, with a moderately high signal-to-noise ratio (SNR). Since a non-standard epoch at the pre-BBN has non-trivial imprints on GW spectrum, we have considered an early matter domination epoch to explore an alternative detection of annihilating DM and axionic DM. This provides a new avenue for searching annihilating and axionic DM, beyond conventional laboratory searches. Moreover, using Fisher forecasts and Markov chain Monte Carlo (MCMC) analysis with mock data from upcoming interferometry missions, I will investigate the detection prospects of such signals in those missions.

Based on: https://doi.org/10.1007/JHEP12(2024)150.

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Session Classification: Parallel 3