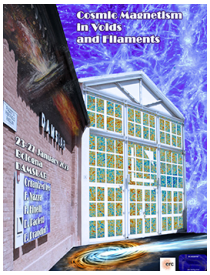

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Density Perturbations sourced by Primordial Magnetic Fields

Tuesday, 24 January 2023 10:30 (20 minutes)

A new kind of density perturbations can be sourced by primordial magnetic fields (PMF) via their Lorentz force in the early Universe, particularly around the epoch of recombination (z~1100). PMF-induced density perturbations are expected to be quite distinct from standard adiabatic perturbations. We present 3D MHD simulations to follow the growth and characteristics of these density perturbations alongside evolving PMFs for a range of magnetic field strengths. Our simulations cover the drag-dominated, transition and turbulent-decay phases of the cosmic magnetised baryon fluid across recombination (z~3000–300). The variation in the r.m.s. amplitudes, distribution functions and power spectra of both PMFs and their density perturbations can be traced over this redshift range. We find that over-densities from PMFs can grow to appreciable values but remain below unity, for ~0.1 nG magnetic fields, whether scale-invariant or casual. This leads to density clumping factors growing relatively slowly and remaining below unity over the PMF range ~0.02—0.2 nG. Further implications for PMF constraints from the CMB, for any Hubble tension and non-Gaussianity are discussed.

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