Interpreting large-scale magnetic fields from Faraday rotation

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Résumé

Magnetic fields are ubiquitous, permeating across all scales from interstellar space to cosmic voids. Yet their origins and evolution remain as open questions. On galactic scales and beyond, Faraday rotation measure (RM) at radio wavelengths is commonly used to diagnose large-scale magnetic fields. It is common to infer the length scales on which the magnetic fields vary from the correlations in the observed RM. RM is a quantity derived from the polarised radiative transfer equations under restrictive conditions. In this talk, I will assess the usage of rotation measure fluctuation (RMF) analyses for magnetic field diagnostics in the framework of polarised radiative transfer. I will demonstrate how density fluctuations could affect the correlation length of magnetic fields inferred from the conventional RMF analyses. The spatial correlations are generally dissimilar along the line-of-sight and across the sky plane, hence the context of RMF must always be clarified when inferring from observations. In complex astrophysical situations, a covariant polarised radiative transfer calculation is essential to properly track the radiative and transport processes. Otherwise, the interpretations of magnetism in galaxy clusters and larger scale structures would be ambiguous. Lastly, I will discuss the implications of our work on future radio observations, particularly with the Square Kilometre Array (SKA).

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