Probing Magnetic Fields in the Intergalactic Medium Using Cross-Correlation Techniques: Insights, Challenges, and Future Prospects

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Abstract

In this presentation, I'll revisit and discuss a cross-correlation technique outlined in Amaral et al. (2021). This method utilized 1742 background Faraday Rotation Measures (RMs) extracted from distant radio galaxies found in the Taylor et al. (2009) catalogue. These RMs were cross-correlated with foreground tracers of large-scale structure to establish upper limits on magnetic fields within the intergalactic medium (IGM). I'll delve into the upper limits we derived and discuss the potential of this technique for future radio polarization surveys. It's important to note that the original study had limitations, including less precise RMs and a relatively low source count, which constrained our insights. In the second part of my presentation, I'll introduce our ongoing work, where we build upon the techniques from our earlier research and apply them to the LOFAR Two-metre Sky Survey (LoTSS) RMs published in O'Sullivan et al. (2023). These high-precision RMs, coupled with improved large-scale structure tracers (with more precise redshifts available), hold significant promise for deepening our understanding of the magnetized cosmic web. Furthermore, this new dataset increases our sample size from 1742 to 2461 LoTSS RMs (including 1949 sources with redshifts), concentrated in a smaller sky region (with a source count number density of 0.48 deg^{–2}). This enhancement boosts our statistical power and raises the potential for constraining magnetic fields in the less-dense IGM, particularly applicable to the sources detected as polarized at low frequencies in LOFAR. These sources likely inhabit lower-density environments characterized by reduced depolarization effects.

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