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Observing the unseen: Faraday rotation signatures and Parker bounds on primordial magnetic black holes

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Primordial black holes with magnetic charges may evade constraints from Hawking radiation, leading to their significant population even for masses below 10^{15}g, a range previously considered improbable. They could, therefore, potentially contribute to a component of dark matter in the universe.
This talk will focus on establishing Parker-type bounds on the population of primordial magnetic black holes (MBHs) while also examining their intriguing Faraday rotation signatures. We will present stringent constraints on the fraction of dark matter contained in them emanating from intergalactic magnetic fields in cosmic voids (f_{DM}
$lesssim 10^{-8}$) and cosmic web filaments (f_{DM}
$lesssim 10^{-7}$). These bounds notably surpass prior estimates.
By analyzing Faraday rotation effects, we observe substantial rotation measure values for extremal MBHs with charge $Q_{\text{BH}}^{\text{Ex.}}$
$gtrsim 10^{22}$ A-m or mass $M_{\text{BH}}^{\text{Ex.}}$
$gtrsim 10^{-6}$
$textupM_{\odot}$, making them detectable with current Earth-based observations. In a comparative analysis, we will find that the Faraday effect is significantly large compared to that of a neutron star. Additionally, the polarization angle maps exhibit unique characteristics that differentiate them from other astrophysical objects. In this context, we have established inequalities to provide a quantitative measure for discriminating between the sources of Faraday rotation.

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