

# Extragalactic magnetic fields and directional correlations of ultra-high-energy cosmic rays with local galaxies and neutrinos

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Deflections of ultra-high-energy cosmic rays (UHECRs) in extragalactic magnetic fields (EGMFs) decrease the expected directional correlations between UHECR arrival directions on the one hand and UHECR source positions and neutrino arrival directions on the other hand. We use the recently observed correlation between UHECRs and local star-forming galaxies by the Pierre Auger Observatory to put limits on the EGMFs between these galaxies and the Milky Way [1]. In addition, using the same methods, we investigate whether correlations between UHECR and neutrino arrival directions can be expected [2]. We take into account deflections in extragalactic and Galactic magnetic fields, energy-loss interactions with background photon fields and UHECR spectrum and composition measurements. For a source density of star-forming galaxies we show that strong EGMFs ( $B > 10 \text{ nG Mpc}^{1/2}$ ) are required to reproduce the level of anisotropy that Auger has observed. For more numerous sources, e. g. spiral galaxies, weaker EGMFs are allowed. However, this would suggest that UHECR acceleration occurs in many regular galaxies, which is rather difficult to motivate. We demonstrate that even for the weakest EGMFs the non-observation of neutrino multiplets strongly constrains the possibility to find neutrino-UHECR correlations. For star-forming galaxies, or more numerous sources, no neutrino multiplets or neutrino-UHECR correlations are currently expected.

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[1] A. van Vliet, A. Palladino, A. Taylor and W. Winter, in preparation.

[2] A. Palladino, A. van Vliet, W. Winter and A. Franckowiak, Mon. Not. Roy. Astron. Soc. 494, 4255 (2020).

## Subcategory

Theoretical Results

## Keywords

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## Collaboration

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