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Extragalactic Magnetic Fields and the Arrival Direction of Ultra-high-energy Cosmic Rays

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Ultra-high-energy cosmic rays (UHECR) are highly relativistic charged particles, first detected in 1960s. Even after a large number of events have been collected using the Pierre Auger Observatory and the Telescope Array, the two main experiments in operation, the fundamental question remains unanswered: Where do they come from? In this work, we focus on understanding how the extragalactic magnetic field (EGMF) affects the determination of the source distribution based on the arrival directions of UHECR. Using the CRPropa3, we simulated 10^{10} protons from sources uniformly distributed until 100 Mpc. The proton momentum is randomly oriented, and the energy spectrum follows a power-law with spectral index -1 between 32 and 1000 EeV. We compare the resulting anisotropy signal detected in three EGMF models with the data published by the Pierre Auger Collaboration. We show for the first time that the EGMF can imprint its structure in the arrival direction distribution of UHECR even if the original flux leaving the sources is isotropic. Particularly, we show that some EGMF models may generate anisotropies with a dipolar amplitude and direction similar to the measured by the Pierre Auger Observatory.

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