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Anisotropy searches at the highest energy cosmic rays with the Pierre Auger Observatory Phase I

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Ultra-high-energy cosmic rays (UHECRs) provide a unique window into the most energetic processes in the universe, yet their origins remain unknown. The near-isotropic distribution of arrival directions observed by the Pierre Auger Observatory suggests that a dominant Galactic source is unlikely, prompting investigations into nearby galaxy groups and clusters as potential origins of UHECRs. However, the presence of intergalactic and Galactic magnetic fields complicates the identification of these sources. To address this challenge, various methodologies have been developed to search for sources on small and intermediate angular scales. These include blind, model-independent searches for overdensities, correlation analyses with astrophysical structures, and cross-correlation studies with catalogs of candidate sources.
In this contribution, we present the principal results from studies conducted at small and intermediate scales throughout the entire Phase I operation of the Pierre Auger Observatory, the largest detector of UHECRs in the world. Over the course of eighteen years, spanning from 2004 to the upgrade to AugerPrime, the Observatory accumulated a detection exposure of approximately 135,000 km^2 sr yr, yielding high-quality data that enabled significant results. These include the detection of the dipole anisotropy and investigations on angular scales of tens of degrees with the highest-energy event dataset.

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