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Arrival Directions of Cosmic Rays above 32 EeV from Phase One of the Pierre Auger Observatory

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The Pierre Auger Observatory has gathered an unprecedented dataset of ultrahigh-energy cosmic rays, thanks to its large aperture and more than 15 years of activity. We present here the highest energy events observed by the Observatory between 2004 and 2020, i.e., before the AugerPrime upgrade. With a cumulative exposure of ~120000 km2 sr yr, we collected more than 2600 events above 32 EeV. This energy region is the one of greatest interest for small- and intermediate-scale anisotropy searches. Firstly, because we expect the magnetic field deflection to be the smallest; secondly, the interaction of UHECRs with background photons, possible only at these energies, would limit the region where their sources lie. We present here a compendium of anisotropy studies, both blind and targeted, and show that evidence in excess of isotropy at intermediate angular scale is obtained at the 4-sigma significance level for cosmic-ray energies above ~40 EeV.

Summary

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