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Covering the sphere at ultra-high energies: full-sky cosmic-ray maps beyond the ankle and the flux suppression

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Despite deflections by Galactic and extragalactic magnetic fields, the distribution of the flux of ultra-high energy cosmic rays (UHECRs) over the celestial sphere remains a most promising observable for the identification of their sources. This distribution is remarkably close to being isotropic. Thanks to a large number of detected events over the past years, a large-scale anisotropy at energies above 8 EeV has been identified, and there are also indications from the Telescope Array and Pierre Auger Observatory Collaborations of deviations from isotropy at intermediate angular scales (~20°) at the highest energies. In this contribution, we map the flux of UHECRs over the full sky at energies beyond each of two major features in the UHECR spectrum - the ankle and the flux suppression -, and we derive limits for anisotropy on different angular scales in the two energy regimes. In particular, full-sky coverage enables constraints on low-order multipole moments without assumptions on the strength of higher-order multipoles. Following previous efforts from the two collaborations, we build full-sky maps accounting for the relative exposure of the arrays and differences in the energy normalizations. These results are obtained by cross-calibrating the UHECR fluxes reconstructed in the declination band around the celestial equator covered by both observatories. We present full-sky maps at energies above ~10 EeV and ~50 EeV, using the largest datasets shared across UHECR collaborations to date. We report on anisotropy searches exploiting full-sky coverage and discuss possible constraints on the distribution of UHECR sources.

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