

Update on the indication of a mass-dependent anisotropy above $10^{18.7}$ eV in the hybrid data of the Pierre Auger Observatory

Tuesday, 4 October 2022 12:00 (20 minutes)

We test for a large-scale anisotropy in the mass of arriving cosmic-ray primaries as a function of galactic latitude. The sensitivity to primary mass is obtained through the depth of shower maximum, X_{\max} , extracted from hybrid events measured over a 14-year period at the Pierre Auger Observatory. The sky is split into distinct on- and off-plane regions using the galactic latitude of each arriving cosmic ray to form two distributions of X_{\max} which are compared using an Anderson-Darling 2-samples test. A scan over roughly half of the data is used to select a lower threshold energy of $10^{18.7}$ eV and a galactic latitude splitting at $|b| = 30^\circ$, which are set as a prescription for the remaining data. With these thresholds, the distribution of X_{\max} from the on-plane region is found to have a $9.1 \pm 1.6^{+2.1}_{-2.2}$ g/cm² shallower mean and a $5.9 \pm 2.1^{+3.5}_{-2.5}$ g/cm² narrower width than that of the off-plane region and is observed in all telescope sites independently. These differences indicate that the mean mass of primary particles arriving from the on-plane region is greater than that of those from the off-plane region. Monte Carlo studies yield a 5.9×10^{-6} random chance probability for the result in the independent data, lowering to a 6.0×10^{-7} post-penalization random chance probability when the scanned data is included. Accounting for systematic uncertainties leads to an indication for anisotropy in mass composition above $10^{18.7}$ eV with a 3.3σ significance. Furthermore, the result has been newly tested using additional independent FD data recovered from the quality selection process. This test disfavors the null hypothesis of the on- and off-plane regions being uniform in composition at 2.2σ which is in good agreement with the expected sensitivity of the dataset used for this test. Possible interpretations, accompanying results and plans for further tests will be presented.

Primary authors: Dr MAYOTTE, Eric (Colorado School of Mines, University of Wuppertal); Dr FITOUSSI, Thomas (Karlsruhe Institute of Technology)

Co-author: THE PIERRE AUGER COLLABORATION

Presenter: Dr MAYOTTE, Eric (Colorado School of Mines, University of Wuppertal)