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

Executive Summary

Eric Mayotte[a] for the Pierre Auger Collaboration[b]

[a] Bergische Universität Wuppertal, Physics, Gaußstraße 20, Wuppertal, Germany
[b] Observatorio Pierre Auger, Av. San Martín Norte 304, 5613 Malargüe, Argentina

What is this contribution about?

This contribution presents a test for a hypothesized mass-dependent anisotropy in the flux of UHECRs in the direction of the Galactic plane using the depth of shower maximum, X_{max}, from 14 years of data.

Why is it relevant/interesting?

It serves as a **model-independent verification of a mixed composition** above the ankle and **provides a completely new way to view the UHECR flux**. It also indicates that the Galactic magnetic field could have an observable impact on mass-dependent anisotropies.

What has been done?

Hybrid events measured at the Pierre Auger Observatory are used to build X_{max} distributions for events near to and far from the Galactic plane which are then compared using an Anderson-Darling test. A scan over a subset of the data is used to select an optimal threshold energy of $10^{18.7}$ eV and a Galactic latitude splitting at $|b| = 30°$, which are then set as a prescription for the remaining data which independently confirm the results of the scan. The significance of the study is then estimated using Monte-Carlo methods and the contributing systematic uncertainties. The robustness of the result is additionally confirmed using a variety of methods.

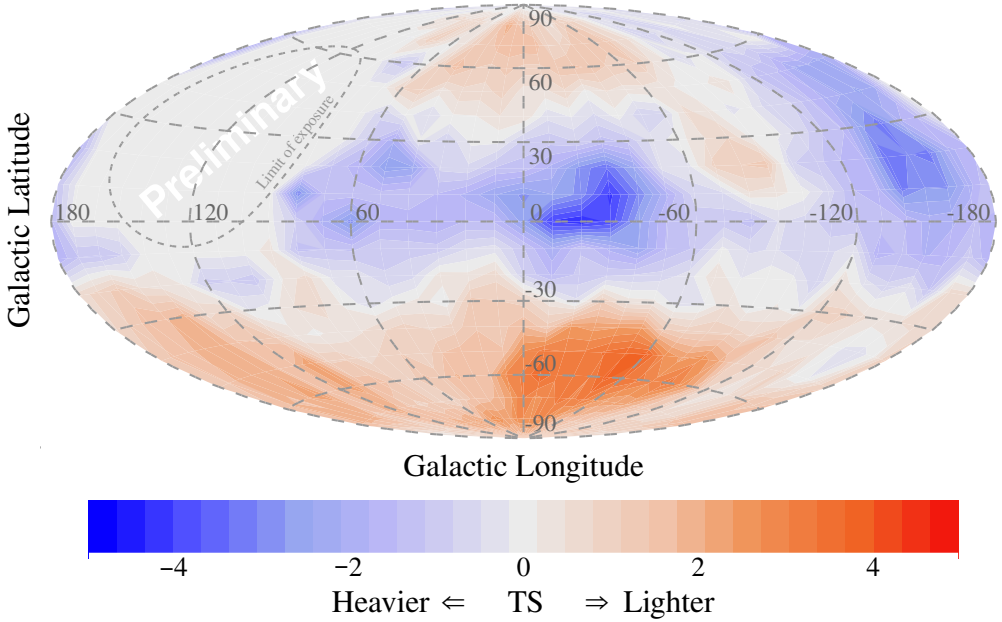

Figure 1: A sky map of relative cosmic ray composition for $E \geq 10^{18.7}$ eV with a 30° sampling radius. Directions in the sky from which arriving UHECR have a heavier (lighter) composition relative to the rest of the sky are shown in blue (red). A heavier mean composition for UHECRs arriving from directions near to the Galactic plane is visible.

What is the result?

The hybrid data from the Observatory shows that **UHECRs with energies greater than $10^{18.7}$ eV arriving from within 30° of the Galactic plane** have a shallower and narrower X_{max} distribution than the rest of the sky. This result indicates that **UHECR arriving near to the Galactic plane are on average of heavier mass** than those arriving far from it. **The result is significant to at least 3.3 σ including all systematic uncertainties**. The result is independently confirmed over the full zenith range and by all telescopes.