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Exploring the Ultra-High-Energy Universe: Highlights from the Pierre Auger Observatory

Friday 18 July 2025 11:30 (30 minutes)

The Pierre Auger Observatory is the world's largest facility dedicated to studying ultra-high-energy cosmic rays (UHECR). Located in Argentina, it spans 3,000 square kilometers and utilizes a hybrid detection system comprising over 1,600 water Cherenkov detectors and fluorescence telescopes. Since its inception in 2004, the Observatory has provided groundbreaking insights into the energy spectrum, mass composition, and arrival direction anisotropies of cosmic rays.
Phase I data analysis (with data from 2004 - 2022) has revealed critical features such as large-scale anisotropies, spectral features such as the instep and the suppression of flux at the highest energies, thus advancing our understanding of the origin and propagation of UHECR. The hybrid detection approach has enabled precise measurements of air showers and muon content, offering constraints on hadronic interaction models. Furthermore, searches for neutral particles have been performed, contributing to multi-messenger astrophysics. The ongoing AugerPrime upgrade aims to refine mass composition studies by integrating scintillator detectors, improved electronics, underground muon detectors and radio antennas, enhancing sensitivity to primary cosmic-ray properties. This presentation will highlight key scientific achievements from Phase I and discuss the transformative potential of AugerPrime in addressing fundamental questions about the origin of UHECRs.

Collaboration(s)

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