

Studies of the mass composition of cosmic rays and proton-proton interaction cross-sections at ultra-high energies with the Pierre Auger Observatory

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The Earth's atmosphere is constantly bombarded by charged particles with energies ranging from a few GeV to several hundred EeV. In the latter range, the flux of these so-called ultra-high-energy cosmic rays rapidly decreases, making their observation reliant on large ground experiments that detect their interactions with the atmosphere and the subsequent extensive air showers they produce. Operating for more than twenty years and covering an area of 3000 km² in the Argentine Pampas, the Pierre Auger Observatory offers an unprecedented opportunity to study these elusive particles at the intersection of astrophysics and particle physics. Addressing the mystery behind their origin inevitably raises the question of their composition, which is inferred from the measurement of the depth of the shower maximum by fluorescence detectors and strongly depends on the models used to describe underlying hadronic interactions. Specifically, these interpretations are sensitive to the particle interaction cross-sections at energies several orders of magnitude higher than those reached in terrestrial accelerators. In this contribution, we will first discuss the mass composition measurements obtained from data collected by the Pierre Auger Observatory, before investigating how modifying the proton-proton cross-section may affect their interpretation.

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