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Astrophysical interpretation of energy spectrum and mass composition of cosmic rays as measured at the Pierre Auger Observatory

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The combined interpretation of the spectrum and composition measurements plays a key role in the quest for the origin of ultra-high-energy cosmic rays (UHECRs). The Pierre Auger Observatory, thanks to its huge exposure, provides the most precise measurement of the energy spectrum of UHECRs and the most reliable information on their composition, exploiting the distributions of the depth of maximum of the showers in the atmosphere.
A combined fit of a simple astrophysical model of UHECR sources to the spectrum and mass composition measurements is used to evaluate the constraining power of the data measured by the Pierre Auger Observatory on the source properties. We find that our data across the "ankle"feature are well reproduced if two extragalactic populations of sources are considered, one emitting a very soft spectrum which dominates the region below the ankle, and the other taking over at energies above the ankle, with an intermediate mixed composition, a hard spectrum and a low rigidity cutoff. Interestingly, similar results can also be obtained if the medium-mass contribution at lower energy is provided by an additional Galactic component.
The Pierre Auger Observatory upgrade, AugerPrime, will significantly improve the measurement of the mass composition beyond the present limit, which will allow us to perform a similar combined analysis with much larger statistics at the highest energies.

Submitted on behalf of a Collaboration?

Yes

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