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The Pierre Auger Observatory: the latest results and perspectives

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The Pierre Auger Observatory is the world's largest detector for the observation of ultra high energy cosmic rays (UHECRs). We use a series of fluorescence telescopes and a particle array at the surface to obtain detailed measurements of the energy spectrum, mass composition and arrival directions of primary cosmic rays with energies above 10^17 eV with accuracy not attainable until now.

The data collected at the Observatory over the recent 15 years show the suppression of the cosmic ray flux at energies above 5x10^19 eV. In addition, the UHECR mass measurements indicate a mixed composition, rather than a pure light or heavy one. This result suggests that the spectrum suppression may be related to a limit of cosmic ray acceleration at sources, rather than to a propagation effect. However, the composition measurement is heavily influenced by uncertainties in hadronic interaction properties at ultra-high energies. A precise measurement of the muon component of air showers is the key to disentangle the cosmic ray composition from the influence of interaction properties, which leads to a better understanding of the origin of the spectrum suppression. This is also a main motivation for the ongoing upgrade of the Observatory.

In addition, the Auger surface detector array is sensitive to showers induced by ultra high energy neutrinos of all flavours and photons. Recent neutrino and photon limits provided by the Observatory constrain models of the cosmogenic neutrino production as well as exotic scenarios of the origin of UHECRs, such as the decays of super heavy particles.

In this paper the recent results on measurements of the energy spectrum, mass composition and arrival directions of cosmic rays, and future prospects are presented.

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