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Energy spectrum and mass composition of cosmic rays from Phase I data measured using the Pierre Auger Observatory

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The Pierre Auger Observatory concluded its first phase of data taking after seventeen years of operation. The dataset collected by its surface and fluorescence detectors (FD and SD) provides us with the most precise estimates of the energy spectrum and mass composition of ultra-high-energy cosmic rays yet available. We present measurements of the depths of the shower maximum, the main quantity used to derive species of primary particles, determined either from the direct observation of longitudinal profiles of showers by the FD, or indirectly through the analysis of signals in the SD stations. The energy spectrum of primaries is also determined from both FD and SD measurements, where the former exhibits lower systematic uncertainty in the energy determination while the later exploits unprecedentedly large exposure. The data for primaries with energy below 1 EeV are also available thanks to the high-elevation Auger telescopes of FD and the denser array of SD, making measurements possible down to 6 PeV and 60 PeV, respectively.

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