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Studies of the UHECR mass composition with the FD and SD of the Pierre Auger Observatory

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The Pierre Auger Observatory is the largest detector of ultra-high energy cosmic rays (UHECR) built so far. With the Fluorescence Detector (FD) of the Auger Observatory, a direct measurement of the depth of maximum of shower profiles, X_{\max} , is performed using the ultraviolet light emitted by nitrogen as the shower develops in the atmosphere. With data on X_{\max} collected during more than a decade of operation we report on the inferences on the mass composition of UHECRs in the energy range $E = 10^{17.2} - 10^{19.6}$ eV and on the measurements of the proton-air cross section for energies up to $10^{18.5}$ eV. The FD operates only during moonless nights and has a duty cycle of around 15%, thus to gain a larger statistics other mass sensitive observables measured with the Surface Detector (SD), having almost 100% duty cycle, can be used. Here we present the results on X_{\max} (SD) obtained using the information on the particle arrival times recorded by the SD stations allowing us to extend the X_{\max} measurements up to 10^{20} eV. The inferences on mass composition, in particular using the data of the SD, are subject to systematic uncertainties due to uncertainties in the description of hadronic interactions at ultra-high energies. We discuss this problem with respect to the properties of the muonic component of extensive air-showers as derived from the SD data.

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