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The energy spectrum of the H+He mass group of cosmic rays in the TeV region measured with HAWC

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The investigation of the energy spectrum and the mass composition of cosmic rays in the 1 TeV - 1 PeV energy range is an important topic in astroparticle physics, as it can provide clues to understand the origin, acceleration mechanism and propagation of high-energy cosmic rays in our galaxy, as well as to find out the link between the TeV and the PeV cosmic-ray radiation. At HAWC, extensive air showers from TeV cosmic rays are recorded at a rate of 25 kHz using a 22000 m^2 array of 300 water Cherenkov detectors, each of them instrumented with 4 photomultipliers. The instrument measures different shower observables such as the arrival direction, the core position at ground, the lateral age and distribution and the primary energy, which allow to perform a variety of studies on the energy spectrum, composition and arrival direction of TeV cosmic rays. In this work, we have estimated the energy spectrum of H+He nuclei of cosmic rays between 6 TeV and 158 TeV. The spectrum was obtained by applying a Bayesian unfolding method on a subsample of air-shower data, which has a purity of 82% of H+He induced events. The spectrum was corrected for the contamination of heavy cosmic-ray nuclei. The subsample was extracted from the measured data by applying an energy dependent cut on the shower age of the events that was derived from Monte Carlo simulations with QGSJET-II-04. We found the existence of a cut in the spectrum of H+He cosmic ray nuclei close to 24 TeV with a statistical significance of 4.1σ.

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