A review of the progress of LHAASO charged cosmic ray measurement

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Large High-Altitude Air Shower Observatory (LHAASO) is a hybrid detector experiment, including one square kilometer array of scintillator detectors and muon detectors, a 78,000 square meter water Cherenkov detector array and 18 wide field of view Cherenkov telescopes. Multi-parameter observation of showers allows LHAASO to measurement the single elements energy spectrum, elemental composition and anisotropy with high resolution, which give us an excellent opportunity to understand the origin, acceleration and propagation of high energy cosmic rays. The one quarter, the half, the three quarter and the full array of LHAASO have started running in September 2019, in January 2020, in December 2020 and in July 2021, respectively. We use the moon shadow displacement measured by LHAASO to establish an absolute energy calibration method for the ground-based detector array. Accurate measurement of the single element energy spectrum near the knee region and different component group of anisotropy will be achieved by LHAASO, which are essential to reveal the acceleration and propagation mechanism of high energy cosmic rays. This paper will introduce the progress of proton, proton and helium, and all particle energy spectra near the 'knee' region measured by LHAASO, as well as cosmic ray anisotropy and cosmic ray composition.
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