Measurement of the light component (p+He) energy spectrum with the DAMPE space mission

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The standard paradigm of a single power-law cosmic-ray (CR) spectrum up to the knee energy (~ PeV) seems to be not valid anymore, due to several results obtained with direct CR measurements. A first deviation from the single power-law, the so-called "hardening", has been observed at some hundreds of GeV/n from several experiments in their measurements on hadronic spectra, along with a spectral softening found in the DAMPE proton and helium spectra, at ~ 15 TeV and ~ 34 TeV respectively. More measurements on these unexpected features are crucial in order to have a better understanding of CR acceleration and propagation mechanisms in our galaxy. The DAMPE experiment can give important contributions to this scenario. DAMPE is a space-based particle detector, collecting data in a Sun-synchronous orbit, at 500 km altitude, for more than 5 years. Science goals of the DAMPE mission include the study of the electron-positron energy spectrum, the study of galactic cosmic-rays, gamma-ray astronomy, and indirect dark matter search. Although it was mainly designed for precise measurements of electron and gamma-ray spectra, and for dark matter searches, DAMPE can measure cosmic rays up to a few hundreds of TeV with unprecedented energy resolution, thanks to its deep calorimeter. Since proton and helium are the most abundant component of CR, it is useful to measure their energy spectra both separately and together. Selecting H and He nuclei (light nuclei) together, instead of H or He alone, has advantages of almost no background and very high purity. Using looser analysis cuts allows collecting larger statistics thus extending the spectrum to higher energy, providing a link on the H + He spectra between direct and indirect measurements. Furthermore, the combined light nuclei spectrum can be used as a cross-check for the independent H and He analyses eventually confirming the observed hardening and softening features. In particular, in this work, the measurement of CR proton (H) + helium (He) flux with energy up to ~ 150 TeV will be presented, starting from the description of the data set used on this analysis, going on with the procedure used to select proton and helium candidates, moving then to the reconstruction of their energy, up to the computation of their combined energy spectrum. At the end there will be a comparison between p+He spectrum and the sum of p and He independent analysis, showing their consistency. Finally, the p+He DAMPE results will be compared with those obtained by both direct and indirect experiments.

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