Cosmic Ray helium spectrum measured by the DAMPE experiment

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This contribution focuses on the measurement of the Galactic Cosmic Ray (GCR) helium energy spectrum obtained by analysing the on-orbit data collected by the DAMPE (DArk Matter Particle Explorer) satellite in more than 5 years. DAMPE is a Space mission project promoted by the Chinese Academy of Sciences (CAS), in collaboration with Universities and Institutes from China, Italy and Switzerland. The satellite hosting the DAMPE detector has been successfully launched on December 17th, 2015, and is currently smoothly operating and collecting data. The main goals of the mission are: indirect search of Dark Matter, looking for signatures in the electron and photon spectra with energies up to 10 TeV; high energy gamma-ray astronomy; analysis of the flux and composition of primary Cosmic Rays (CR) in the energy range from a few tens of GeV up to hundreds of TeV. Here we present the helium spectrum measured by DAMPE and discuss the observed features in the light of the current models about the origin, acceleration and propagation of Galactic Cosmic Rays. We describe the main steps of our analysis, starting from the description of the event selection criteria adopted up to the evaluation of the main contributions to the systematics which affect our result. The outcome is validated through independent analyses performed within the DAMPE Collaboration, which give consistent results within the overall uncertainties. More in detail, we measured the helium spectrum in the energy range from 70 GeV to 80 TeV and observed a *spectral hardening* at TeV energies confirming the results previously presented by other experiments. However, the most important feature of our result is the clear evidence of a *spectral softening* at tens of TeV. In order to quantify these features, we performed a fit of the spectrum with a Smoothly Broken Power-Law (SBPL) function in two different energy ranges, one in the hardening region and the other one in the softening region. Hence, we found a break energy for the hardening corresponding to ~ 1.25 TeV with a significance of ~ 24.6 σ, while the softening break energy is found to be ~ 34.4 TeV with a significance of ~ 4.3 σ. The proton energy spectrum measured by DAMPE presented a softening break energy of ~ 13.6 TeV, that combined with the current result about helium could suggest a charge-dependent softening energy even if a mass-dependence of the structure cannot be ruled out.
This result can play a key role in the understanding of the main mechanism of generation and propagation of CRs through the Galaxy.