Summary

Properties of Light Primary and Secondary Cosmic Rays He-C-O and Li-Be-B Measured with the AMS on the ISS

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Abstract

We present precision high statistics measurements of the primary cosmic rays Helium, Carbon, and Oxygen and the secondary cosmic rays Lithium, Beryllium and Boron by the Alpha Magnetic Spectrometer in the rigidity range from 2 GV to 3 TV, based on 150 billion cosmic ray events collected by AMS during the first 8.5 years of operation aboard the International Space Station. The properties of the He-C-O and Li-Be-B fluxes are discussed. Comparisons with other measurements are shown.

Primary cosmic rays (p, He, C, O, Ne, …, Fe) are mostly produced during the lifetime of stars and are accelerated in supernovae shocks, whose explosion rate is about 2-3 per century in our Galaxy. Secondary cosmic rays (Li, Be, B, ...) are produced by the collision of primary cosmic rays with the interstellar medium.

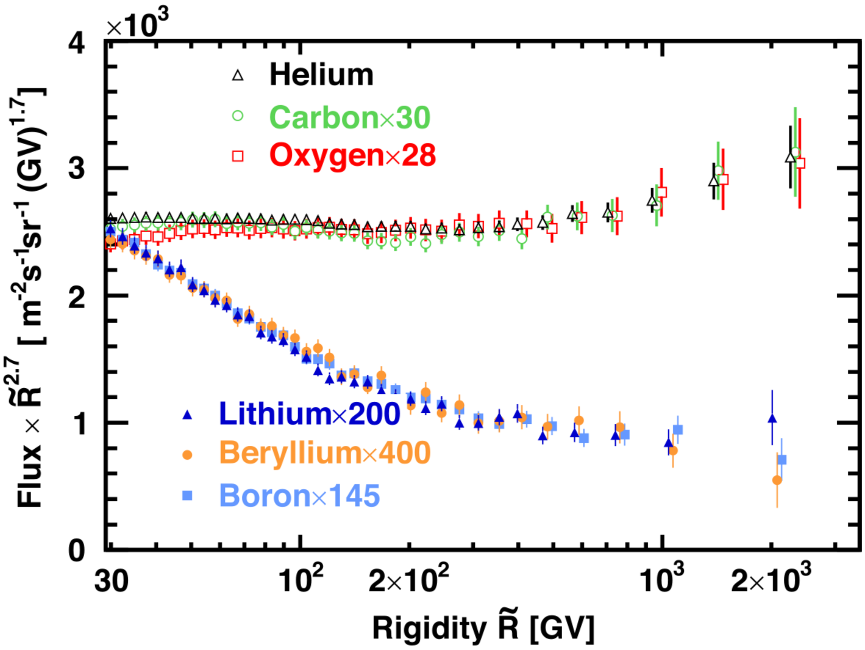

Figure 1: Comparison of the secondary cosmic ray fluxes with the AMS primary cosmic ray fluxes multiplied by rigidity to the power of 2.7 with their total error as a function of rigidity above 30 GV. For display purposes only, the C, O, Li, Be, and B fluxes were rescaled as indicated. For clarity, the He, O, Li, and data points above 400 GV are displaced horizontally.

The precise measurements by AMS of the lithium, beryllium, and boron fluxes from 1.9 GV to 3.3 TV show that the Li and B fluxes have identical rigidity dependence above 7 GV and all three fluxes have identical rigidity dependence above 30 GV with the Li/Be flux ratio of 2.0 ± 0.1. The three fluxes deviate from a single power law above 200 GV in an identical way. Independently, the primary cosmic rays He, C, and O also deviate from a single power law above 200 GV, but their rigidity dependence is distinctly different from the secondary cosmic rays (Fig. 1).

In particular, above 200 GV, the spectral indices of secondary cosmic rays harden by an average of 0.140 ± 0.025 more than the primaries (more than 5σ effect). This additional hardening of secondary cosmic rays is consistent with expectations when the hardening is due to the propagation in the Galaxy.