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Status of the measurement of the nuclear components in cosmic rays with the AMS-02 experiment

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Summary. — The Alpha Magnetic Spectrometer (AMS-02) is a large-acceptance ($0.45\ \mathrm{m^2sr}$) magnetic spectrometer operating on board the International Space Station since May 2011. One of the main scientific objectives of the mission is the measurement of the nuclei fluxes in cosmic rays (CR). The identification of nuclei is achieved by the combination of independent measurements of the absolute charge, provided by different sub-detectors: the Silicon Tracker, the Time-of-Flight system (TOF), the Ring Imaging Cherenkov Counter (RICH), the Transition Radiation Detector (TRD) and the Electromagnetic Calorimeter (ECAL). In this contribution the results of nuclei fluxes already shown by the AMS collaboration are presented.

1. – Introduction

Cosmic rays (CR) are charged and neutral particles with galactic and extra-galactic origins reaching the Earth's atmosphere from all directions spanning a very wide energy range (from few MeV up to 10^{20} eV). CR elements such as Helium, Carbon and Oxygen are mostly of primary origin, *i.e.* accelerated by supernova remnant explosions. Elements such as Lithium, Beryllium and Boron are mostly of secondary origin, *i.e.* produced from the spallation of primary cosmic rays during the propagation in the interstellar medium. The relative abundance of the various components of galactic CRs and the ratio of secondary to primary species flux give information about their origin and propagation in the interstellar medium, providing new constraints for astrophysical models.

2. – Charge Measurement

The AMS-02 detector [1], with its large acceptance and long exposure time, is able to evaluate precise measurement of the hadronic component in CRs. The identification of nuclei is achieved by using the information of 7 Inner-Tracker (IT) layers and the 4 TOF planes. The high dynamic range of the microstrip silicon detectors of the Tracker

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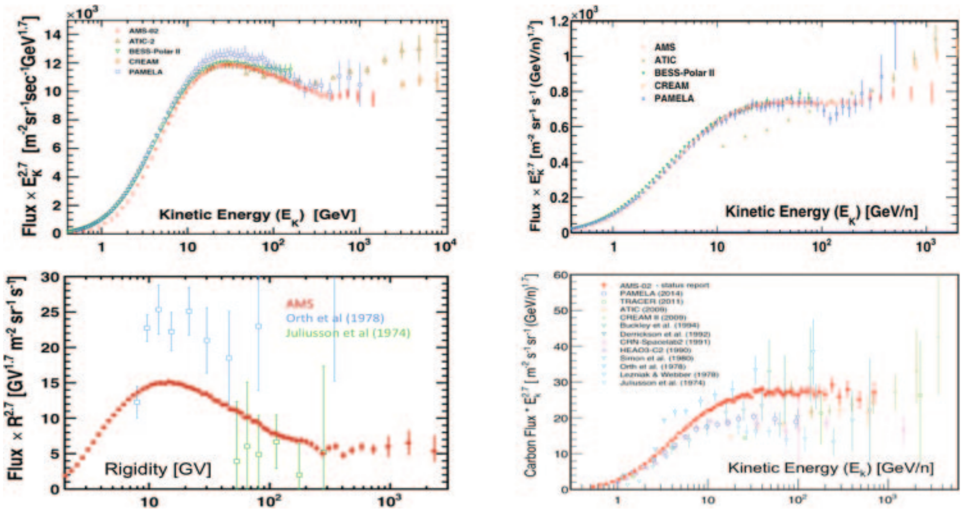

Fig. 1. – Proton, Helium, Lithium and Carbon fluxes, measured by AMS-02 and compared with the previous experiments: Top left: Proton flux, multiplied by $E^{2.7}$, from 1GV to 1.8 TV. Top right: Helium flux, multiplied by $E^{2.7}$, from 2 GV to 3 TV. Bottom left: Lithium flux, multiplied by $R^{2.7}$, from 2 GV to 3 TV. Bottom right: Carbon flux, multiplied by $E^{2.7}$, from 2 GV to 1.8 TV.

allows the charge measurement up to Fe ($Z = 26$), with a resolution better than 0.15 charge units for species with charge $Z \leq 9$ and better than 0.3 for those with charge $Z \leq 15$. Interactions within the material in the upper or lower part of the spectrometer are identified by means of redundant charge measurements, using the outer Tracker layers (L1 and L9), TRD, RICH or ECAL. The acceptance of AMS-02 has been evaluated using a Monte Carlo simulation (MC) of the entire detector. The simulation is validated, and if needed tuned, comparing the reconstruction and selection efficiencies estimated from flight data with those obtained from the simulation itself: any difference between the two evaluations of each efficiency is used to correct the estimated acceptance and to assess the systematic uncertainty on the measurement. The effect of finite resolution in the rigidity measurement (that would result in a bin-to-bin migration of events in the flux measurement) is taken into few per cent accuracy and corrected using different unfolding methods.

3. – Results

Figure 1 shows Proton, Helium, Lithium and Carbon fluxes measured by AMS-02 and compared with the previous experiments. The Proton and Helium fluxes, already published by The AMS Collaboration, have been measured respectively from 1 GV to 1.8 TV and from 2 GV to 3 TV [2,3]. A preliminary measurement of the Carbon flux and Boron/Carbon ratio up to 1.8 TV has been also provided [4,5]. Furthermore, due to the high statistics collected by the AMS-02 detector, a preliminary measure of the Lithium flux up to 3 TV is provided for the first time [6].

4. – Conclusions

AMS-02 will collect data till 2024, allowing accurate measurements of the nuclei in CR at the level of few per cents, which ultimately will provide important constraints on the composition and homogeneity of the interstellar medium in which CR propagate.

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