PRECISION MEASUREMENT OF THE MONTHLY PROTON, HELUM, CARBON AND OXYGEN FLUXES IN COSMIC RAYS WITH THE ALPHA MAGNETIC SPECTROMETER ON THE INTERNATIONAL SPACE STATION - EXECUTIVE SUMMARY -

M. Palermo (University of Hawaii at Manoa) **on behalf of the AMS Collaboration**.

Cosmic rays entering the heliosphere are subject to diffusion, convection, adiabatic energy losses, and magnetic drift, as described by the Parker equation [1]. The temporal evolution of these processes lead to cosmic ray intensity variations at Earth's orbit around the Sun. These variations correlate with solar activity, which has several cycles [2].

The transport of cosmic rays within the heliosphere is rigidity dependent, hence particles with same rigidity should show the same behavior in time. However, models based on the Parker equation have shown that particles with the same rigidity might exhibit a different time behavior due to differences in their velocities (i.e. different mass-to-charge-ratio) and different rigidity dependence of their Local Insterstellar Spectrum (LIS) [3]. AMS has already reported the measurement of proton and Helium monthly fluxes over a time period of 6 years[4]. These measurements have shown a significant long-term time dependence in the p/He flux ratio at rigidities below 3 GV. Since protons and Helium nuceli have a different mass-to-charge ratio it was not possible to disentangle the contribution of the LIS and of the velocity dependence. Therefore, the simultaneous measurement of different particles with similar mass-to-charge ratio, such as He, Carbon and Oxygen, provides unique information to understand the propagation of cosmic rays inside the heliosphere.

The precision measurement of time structures in 8.5 years, from Bartels rotation 2426 to 2540, of the proton, helium, carbon, and oxygen fluxes at rigidities from 1 to 60 GV based on 6.3×10^9 nuclei collected with the Alpha Magnetic Spectrometer aboard the International Space Station is presented. The amplitude of the time variations of the fluxes decreases with increasing rigidity. The time variations are observed up to $\sim$50 GV for helium, $\sim$25 GV for carbon and oxygen, and they are observable in the whole rigidity range for proton. The C/O flux ratio is constant in time between 2 and 60 GV. However, the He/(C+O) and p/(C+O) flux ratios show significant time variations with decreasing amplitudes with increasing rigidity up to $\sim$2.5 GV and up to $\sim$4 GV, respectively. Since He, C and O have similar mass-to-charge ratios, the observation that the C/O flux ratio is constant in time implies that the C and O LIS have a very similar rigidity dependence above 2 GV, while the observation that the He/(C+O) flux ratio is not constant in time implies that the He and (C,O) LIS have different rigidity dependences above 2 GV.

[1] E. N. Parker, Planetary and Space Sci. **13**, 9 (1965).

[2] M. S. Potgieter, Living Reviews in Solar Phys. **10**, 3 (2013).

[3] C. Corti, M. S. Potgieter, V. Bindi, C. Consolandi, C. Light, M. Palermo, and A. Popkow, Astrophys. J. **871** (2019) 253; N. Tomassetti, F. Barão, B. Bertucci, E. Fiandrini, and M. Orcinha, Adv. Sp. Res. **64** (2019) 2477; M. D. Ngobeni, O. P. M. Aslam, D. Bisschoff, M. S. Potgieter, D. C. Ndiitwani, M. Boezio, N. Marcelli, R. Munini, V. V. Mikhailov and S. A. Koldobskiy, Astrophysics and Space Sciences **365** (2020) 182.

[4] M. Aguilar *et al.*, Phys. Rev. Lett. **120** (2018) 051101.