Data from ISS Alpha Magnetic Spectrometer suggests possibility of unknown source of positrons

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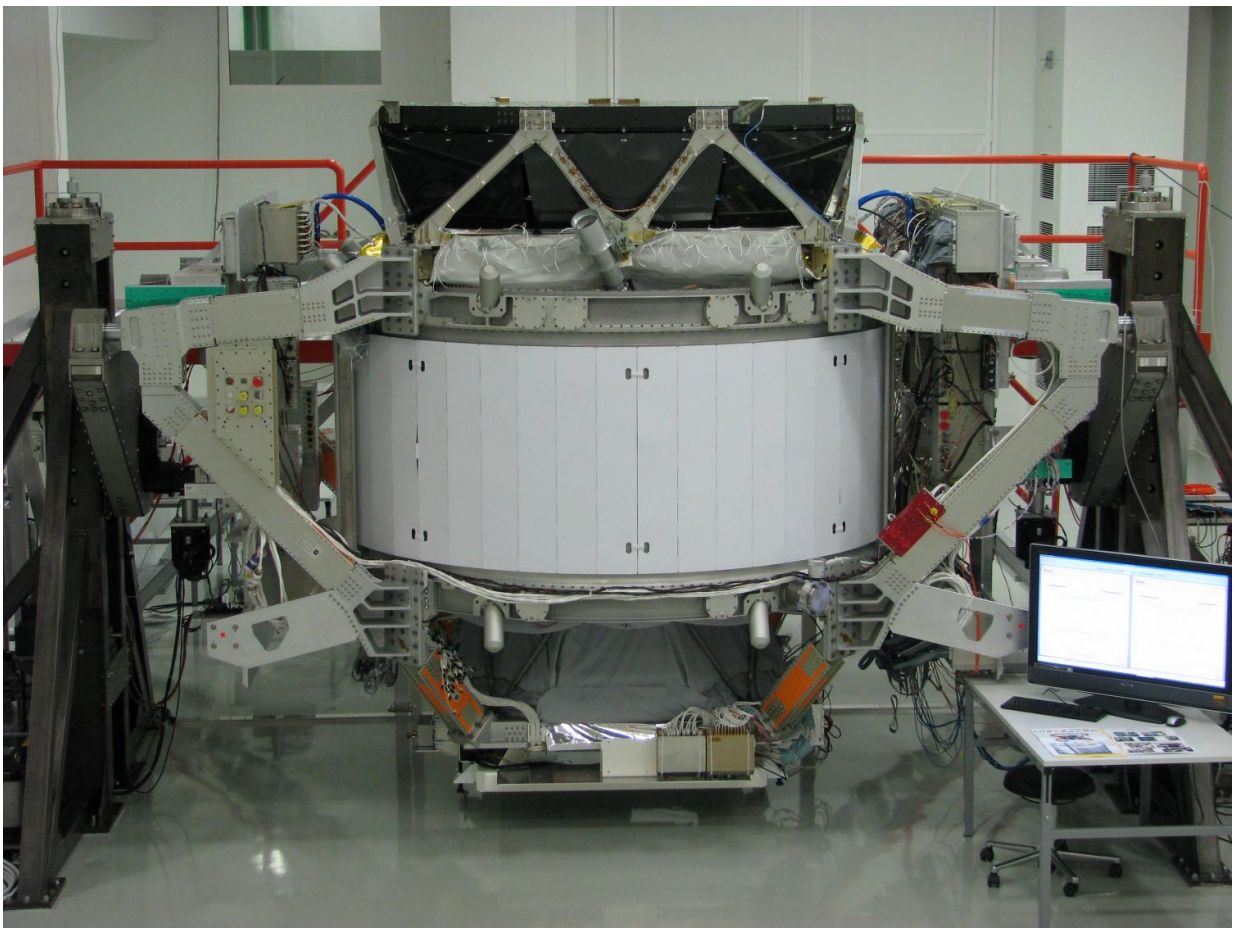

AMS-02 during integration and testing at CERN near Geneva. Credit: NASA

(Phys.org)—A team of researchers known as the Alpha Magnetic Spectrometer (AMS) Collaboration has found evidence of a possible unknown source of positrons making their way through the universe to Earth. In their paper published in *Physical Review Letters*, the team offers a report on cosmic ray strikes that have been reported by the AMS aboard the International Space Station and why they believe the data suggests that some of the recorded strikes could not be attributed to primary cosmic rays colliding with gas atoms in space.

Over the past five years, the AMS has been listening for cosmic ray strikes on its sensors, recording approximately 80 billion hits. Among those rays are two types of particular interest to the collaboration—primary and secondary. Primary cosmic rays are believed to be created by supernovae or other large explosions. Secondary rays are believed to come about due to primary rays colliding with gasses as they pass through the vast reaches of space. Space researchers study the two types to learn more about the nature of the universe—of particular importance is the ratio of one of the type of rays reaching us as compared to the other. They refer to this as the B/C ratio—primary rays have a carbon nuclei while secondary rays have boron nuclei. A high B/C ratio in a given energy range, for example, would suggest that the rays pass through a lot of gas as they make their long journey.

The data from the AMS is highly prized because prior to its installation, researchers had to rely on high-altitude balloon sensors, which, the team notes, had error rates as high as 15 percent. With the new data from AMS, the team has been able to see that the B/C is proportional to the energy of the nucleon raised to the -1/3 power, which is what Andrey Kolmogorov, a Russian mathematician predicted back in 1941. But the data also conflicts with other theories surrounding uncharacteristic observations that have shown more positrons (anti-electrons) striking the Earth relative to high speed electrons. The data from AMS essentially rules out the possibility that they are either primary or secondary rays

though, which suggests that they must be from an unknown source, possibly dark matter or pulsars.

More information: M. Aguilar et al. Precision Measurement of the Boron to Carbon Flux Ratio in Cosmic Rays from 1.9 GV to 2.6 TV with the Alpha Magnetic Spectrometer on the International Space Station, *Physical Review Letters* (2016). DOI: 10.1103/PhysRevLett.117.231102

ABSTRACT

Knowledge of the rigidity dependence of the boron to carbon flux ratio (B/C) is important in understanding the propagation of cosmic rays. The precise measurement of the B/C ratio from 1.9 GV to 2.6 TV, based on 2.3 million boron and 8.3 million carbon nuclei collected by AMS during the first 5 years of operation, is presented. The detailed variation with rigidity of the B/C spectral index is reported for the first time. The B/C ratio does not show any significant structures in contrast to many cosmic ray models that require such structures at high rigidities. Remarkably, above 65 GV, the B/C ratio is well described by a single power law $R\Delta$ with index $\Delta=-0.333\pm0.014(\text{fit})\pm0.005(\text{syst})$, in good agreement with the Kolmogorov theory of turbulence which predicts $\Delta=-1/3$ asymptotically.