In search of antimatter

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The first results from the Alpha Magnetic Spectrometer (AMS) have been released. This space 'camera' has recorded 20 billion cosmic particles in the first 18 months of operation – yet that is just a small step. "We have received around eight percent of the data to date," says Stefan Schael from RWTH Aachen University. The project, funded by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), is just at the beginning of its operating life. "We expect a lifespan of 15 to 20 years." One thing is already clear; the AMS has detected an exceptionally high number of positrons, or antimatter particles. This could be an indication of the existence of dark matter. The scientists next want to track down protons, helium, boron and carbon. Ultimately, the researchers want to find out what the Universe is made of. "The puzzle will only be solved once we understand all the pieces," says the German project leader.

The seven-ton instrument was launched on its journey to the International Space Station (ISS) on 16 May 2011, during the final flight of the Space Shuttle Endeavour. Vibrations during launch, a flight into space, then assembly on the outside of the Space Station – but the sensitive unit survived the trip undamaged. For project leader Stefan Schael, this is the first major technical accomplishment achieved by the AMS collaboration supported by NASA and DLR. The Institute of Physics at the RWTH and the Institute of Experimental Nuclear Physics at the Karlsruhe Institute of Technology have, among other things, jointly developed and built one of the detectors – the transition radiation detector. "The AMS is a complex instrument, but it has functioned like clockwork from the very first minute." It uses a magnet to deflect up to 2000 particles per second past detectors that acquire data on the energy, mass and electrical charge of each of these particles. As it does so, the device can take measurements in an energy range that could not previously be accessed directly – up to 2000 gigaelectron volts.

Mysterious Universe

The first results, published in the scientific journal Physical Review Letters, are already giving valuable clues. 400,000 positrons flew through the detectors in the last year and a half – a figure that gives the researchers hope that they are on the right track. Following the theory that equal proportions of matter and antimatter were formed in the Big Bang, there must be a large quantity of antimatter in space, but until now it has not been found. However, the AMS measurement results indicate that certain antimatter particles occur in larger quantities than expected. These positrons might have originated from the remains of a supernova in our vicinity, for example. "But we were able to see that the positron distribution is isotropic, so they are either coming from many pulsars or they originated from the annihilation of dark matter, assuming that it is evenly distributed." Future data from this sensitive instrument, which will be evaluated by Schael and his team, might shed some light on this in the coming years.

Schael expects to receive the next results in the summer. The International Cosmic Ray Conference, to be held in Brazil in July, is dedicating an entire science session to the AMS – here, new measurement results will be presented. "Positrons are just a small part of our programme," says Schael. For this reason, the researchers not only want to investigate higher energy ranges, but also analyse the proportion of protons and helium in the existing data, and investigate the ratio of boron to carbon. This means that the amount of data that the supercomputer at the Jülich Research Centre will have to process will not be reduced. The AMS is always at work in space – it will record another 16 billion cosmic ray particles per year.

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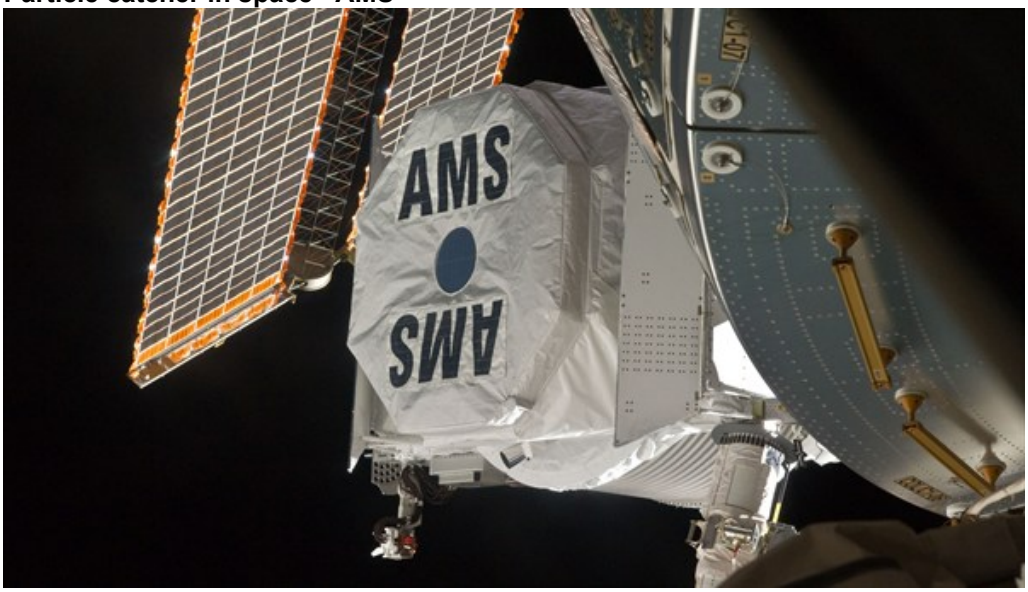
Particle catcher in space - AMS



The Alpha Magnetic Spectrometer (AMS) is mounted on the outside of the International Space Station (ISS). The instrument, which is partly funded by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), analyses around 16 billion cosmic radiation particles per year.

Credit: NASA.

AMS - experiment on the outside of the International Space Station

On 16 May 2011, the Space Shuttle Endeavour carried the Alpha Magnetic Spectrometer (AMS) to the International Space Station (ISS). The project, partly funded by DLR, was installed on the exterior of the station to capture cosmic radiation with its detectors.

Credit: NASA.

AMS-02 after installation on the ISS

AMS after installation on the International Space Station‘s Starboard Truss. To the right is the docked Space Shuttle Endeavour, which carried AMS into Earth orbit.

Credit: NASA.

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