Sci & Tech

AMS announces new results in search for dark matter

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GENEVA, Sept. 18 (Xinhua) -- The Alpha Magnetic Spectrometer (AMS) team led by Nobel laureate Samuel Ting announced on Thursday new results in the search for dark matter, shedding more light on the dark matter existence.

Based on 41 billion analyzed primary cosmic ray events, the AMS team measured the positron fraction -- which is the ratio of the number of positrons to the combined number of positrons and electrons -- in the energy range 0.5 to 500 GeV, with the latest data showing that the positron fraction increases as the energy intensifies until the fraction reaches a maximum and begins to decrease.

Being different from the ordinary cosmic ray collisions resulting in the positron fraction decreasing steadily with energy, the latest results suggested that the excess of the positron fraction originated from the collision of dark matter in space and were consistent with the existence of a dark matter particle (neutralino) of mass on the order of 1 TeV.

Researchers found out that the energy at which the fraction starts to quickly increase is 8 GeV, indicating the existence of a new source of positrons, and the energy at which the positron fraction ceases to increase has been measured to be 275+32 GeV, which is the first experimental observation of the positron fraction maximum after half a century of cosmic rays experiments.

The AMS team has also determined the exact rate at which the positron fraction increases with energy, and noted that the fraction shows no observable sharp structures.

The above precise measurements of the positron fraction are seen as vital to understand the origin of dark matter.

Moreover, AMS also reported the precise measurements of the electron flux and the positron flux, i.e. intensities of cosmic ray electrons and positrons, and these measurements showed that the behavior of electrons and positrons are significantly different from each other both in their magnitude and energy dependence.

Particularly speaking, between 20 and 200 GeV, the rate of change of the positron flux is surprisingly higher than the rate for electrons, which is an important proof that the excess seen in the positron fraction is due to a relative excess of high energy positrons, as expected from dark matter collisions, and not the loss of high energy electrons.

The latest results were to be published in the journal Physical Review Letters.

Cosmic rays are charged high-energy particles that permeate space. The AMS, a particle physics detector installed on the International Space Station (ISS), is designed to study them before they have a chance to interact with the Earth's atmosphere.

An excess of antimatter within the cosmic ray flux was first observed around two decades ago. One possibility for the origin of the excess of positrons in space, predicted by a theory known as supersymmetry, is that positrons--the antimatter counterpart of the electron--could be produced when two particles of dark matter collide and annihilate.

It was introduced that dark matter collisions will produce an excess of positrons and this excess can be most easily studied by measuring the positron fraction.

However, the AMS measurement cannot yet rule out the alternative explanation for the observed excess of the positron fraction.

The team said that to determine if it is from dark matter or from astrophysical sources such as pulsars, measurements are underway by AMS to determine the rate of decrease at which the positron fraction falls beyond the turning point, as well as the measurement of the anti-proton fraction.

Dark matter is one of the most important mysteries of physics. Accounting for over a quarter of the universe's mass-energy balance, it can be observed indirectly through its interaction with visible matter but has yet to be directly detected.

Launched to the ISS on May 16, 2011 by the shuttle Endeavor in its last mission, the AMS started to send data back to the earth on May 19 that year.

The first results were announced by the AMS team in 2013, reporting an excess of positrons in the cosmic ray flux.

After 40 months of operations in space, AMS has collected 54 billion cosmic ray events. To date 41 billion of the total have been analyzed, and 10 million of these have been identified as electrons and positrons.

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