

NOVEMBER 2017

» FOCUS



DAMPE: LOOKING FOR DARK MATTER IN COSMIC RAYS

The scientific journal Nature has published the first results of the DAMPE (DArk Matter Particle Explorer) experiment, in orbit on a satellite since December 2015. The experiment measures the flow of very high energy cosmic electrons and positrons (from 55 GeV to 4.6 TeV). For the first time, the direct measurement of these particles in space highlights and measures a sharp change, a "break", in their flow according to energy. At energies exceeding 0.9 TeV, the electron and positron flow changes and "dips", decreasing more rapidly with increasing energy. This phenomenon had recently been measured only by ground experiments, with indirect observations, much greater uncertainty and still partly preliminary results.

DAMPE, the first Chinese astrophysical satellite, is one of the five space mission projects of the Strategic Pioneer Program on Space Science of the Chinese Academy of Science (CAS). It is an international collaboration involving more than 100 scientists, technicians and students from Chinese, Italian and Swiss institutions led by the CAS Purple Mountain Observatory (PMO). Italy is involved with a research group of approx. twenty scientists form the Perugia, Bari and Lecce divisions of the National Institute for Nuclear Physics and the Universities of Perugia, Bari and Salento.

The detector has been designed to measure the flows of electrons, photons, protons and nuclei, with a greater precision and energy range than the already active experiments. The importance of the recent DAMPE measurement is related to the research and study of the electron and positron sources at TeV energies, whether they are objects of an astrophysical nature - for example, pulsars - or whether their presence is partly due to dark matter, as it would seem possible given the characteristics of the positron flow observed up to those energies by the AMS-02 experiment on the International Space Station. Launched on 17 December 2015 from the Chinese Jiuquan Satellite Launch Center in the Gobi Desert,



NOVEMBER 2017

» FOCUS

DAMPE orbits at a distance of approx. 500 km, from which it tries to detect possible signals of the presence of dark matter by studying the characteristics of ordinary cosmic particles. In its first 530 days of scientific activity, starting from 8 June of this year, it has detected 1.5 million cosmic electrons and positrons with energies exceeding 25 GeVs: data characterised by an unprecedented energy resolution and level of contamination from background particles. Thanks to these characteristics, the detector is able to measure the direction of arrival of the cosmic photons with great accuracy and, at the same time, to differentiate the nuclear species that make up the cosmic rays and their trajectory. DAMPE is also capable of measuring the flow of nuclei in the range between 100 GeV and 100 TeV, thus providing new data and information to understand the origin and propagation of high energy cosmic rays.

DAMPE has a total weight of approx. 1900 kg, of which 1400 kg are represented by the four scientific experiments, including the heart of the detector, the silicon tracker, entirely built by Italian researchers with the coordination of the INFN. The technology of this detector - originally developed in the 80's for elementary particle physics experiments in accelerators - was used for the first time in space by Italian physicists with the AMS-01 experiment, which flew for ten days on the Discovery Space Shuttle in 1998. This was followed by other experiments - such as PAMELA and FERMI on satellites, and AMS-02 on the ISS - all operating since many years in orbit around the Earth. DAMPE is part of a programme of space missions, such as those mentioned above, but also of terrestrial ones such as CTA-MAGIC, AUGER and Advanced VIRGO, or submarine observatories, such as Km3net, with the aim of studying all the messengers of the cosmos. It will thus be possible to study the most hidden properties of the universe with a strongly synergistic approach.