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Scientists have discovered a connection between active galactic nuclei and the most energetic known cosmic rays

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The prestigious journal 'Science' have published the results of this research work, with members from 17 countries.

The so-called Pierre Auger Collaboration, with headquarters in Argentina and the participation of a research group of the University of Granada, has proved that there is an anisotropy in the arrival directions of the most energetic particles ever detected, correlated with areas in which there are galaxies with active nuclei in the centre

These conclusions have been obtained from the first data provided by the Pierre Auger Observatory of the Southern Hemisphere in Argentina (world's largest cosmic ray detector).

A group of scientists from 17 countries, formed by researchers of the University of Granada, has proved that the sources of the most energetic particles ever detected do not come from directions uniformly distributed in the firmament, but they aim at areas in which there are galaxies with active nuclei in the centre from a relatively close distance.

Scientists of the Pierre Auger Collaboration have announced in Malargüe (Mendoza, Argentina) that the Active Galactic Nuclei are probably responsible for the most energetic particles or cosmic rays that reach the Earth, thanks to the first results of the Pierre Auger Observatory of the Southern Hemisphere in Argentina (the largest cosmic ray detector in the world). These results have been published in the prestigious journal 'Science'.

The winner of the Nobel Prize, James W. Cronin, of the University of Chicago, who conceived in 1991 the Observatory Pierre Auger with Alan Watson, of the University of Leeds, present director and spokesman of the experiment, has mentioned that this group has "made an important movement to solve the secret of the origin of the most energetic cosmic rays, discovered by the French physicist Pierre Auger in 1938. The firmament in the Southern Hemisphere, observed with cosmic rays, is not uniform. This is a fundamental discovery, thanks to which the age of cosmic ray astronomy has started. In the next years, our data will make possible the identification of the sources of these cosmic rays and the way they accelerate particles."

At the speed of light

Cosmic rays are protons and atomic nuclei that ride the Universe practically at the speed of light. We are still ignorant of the acceleration mechanisms of particles at energies 100 million times higher than those obtained in the largest particle accelerator in the world. The Pierre Auger Observatory registers cosmic rays cascades with a network of 1,600 particle detectors, separated at 1.5 kilometres and covering a surface of 3,000 km2.

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nitrogen molecules of the atmosphere with the passing of the cascade. The network of particle detectors and the fluorescence telescopes are an excellent combination, which improves perceptibly the precision of previous instruments. The Observatory owes its name to the French scientist Pierre Victor Auger (1899-1993), who discovered in 1938 the atmospheric cascades produced by the interaction of cosmic rays in the atmosphere.

Active Galactic Nuclei (AGN) are some of the most violent objects in the Universe. There have been conjectures about its possible link with the production of high energy particles. Scientists think that most of the galaxies present black holes in the centre, with a mass of between one million and thousand million times the solar mass. The one of the Milky Way, our galaxy, has about 3 million solar masses. Galaxies with an active nucleus seem to be those which have suffered any collision with another galaxy or any important disturbance in the last hundred million years. The AGN capture the mass that falls in their gravity field releasing prodigious amounts of energy in particle jets. Auger's result shows that AGN can produce the most energetic particles in the Universe.

UGR participation

Spain is a full member of the Pierre Auger Collaboration since 2002, with the incorporation of the group of particle astrophysics of the Universidad de Santiago de Compostela. At present, five Spanish institutions have an active participation in the analysis of data of the Pierre Auger Collaboration. The group of Physics of High Energies and Astroparticles of the University of Granada, directed by Professor Antonio Bueno Villar, has collaborated actively in the development of the simulation programs of the operation of the 1,600 surface and data reconstruction detectors. This development is basic to understand the type of Physics we can develop with such instrument: "We are trying to determine more precisely the performance of our detectors as the million particles which form the atmospheric cascades go through them. It is essential to obtain a better measuring of the energy and the direction of the primary cosmic ray".

"We are a young group, formed by three doctors in 2003. It is the only group in Andalusia which is carrying out this type of research work. Despite being recent members of a well-established collaboration, such as this of the Pierre Auger Observatory, we are contributing visibly to its development, thanks to the enthusiasm and commitment of our young students. Shortly we will have two doctoral thesis in this field", says Antonio Bueno. Besides that, the group is also collaborating with another international experiment in the search for dark matter with detectors of liquid argon, which will be installed in the subterranean laboratory of Canfranc (Huesca). The central office of the BIC (Health Campus) has the only cryogenic laboratory for particle detectors in Spain.

Antonio Marín Ruiz | Quelle: alphagalileo

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