

WHAT ARE COSMIC RAYS?

Summary

Cosmic rays are atomic nuclei of various elements, depleted of electrons, arriving at the Earth's atmosphere from outside of our Solar System. We can measure them directly sending detectors on balloons and satellites. They are mainly protons, alfa particles and other nuclei. The amazing thing is their enormous energy range: from 10^7 eV up to 10^{20} eV. No particles existing on the Earth or the Sun have such enormous energies! The cosmic ray flux decreases strongly with particle energy, so that direct measurements can be done only up to $\sim 10^{14}$ eV; above this energy the flux becomes too small to be detected. However, cosmic particles, entering the atmosphere, collide with the air nuclei and produce a cascade of new particles (mainly electrons, positrons and gamma rays) hitting almost simultaneously the Earth surface. This phenomenon was discovered

by the French physicist Pierre Auger in 1936 and is called an extensive air shower. The bigger the energy of the primary (cosmic) particle the more particles are in the shower. For the highest particle energies this number reaches tens of billions ($\sim 10^{10}$) particles at the Earth's surface covering an area of several kilometers across. Relatively small detectors can be installed at distances of the order of tens of meters up to 1 km between them to register simultaneous arrival of shower particles. The world biggest array of detectors (the Pierre Auger Observatory) has been currently built in Argentina for studying the showers produced by the highest energy cosmic rays. By measuring their fluxes the long-standing puzzle about their origin will be solved – are the cosmic rays sources within our Galaxy or in objects different than normal (as our) galaxies.