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Parameters reconstruction of cosmic ray induced extensive air showers using radio detection

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We call cosmic rays the particle stream received on Earth with extraterrestrial origin. They have a wide energy spectrum and their flux decreases quickly with the energy. For the most energetic events (above 10^{17} eV), the mass composition is not well known, due to shower to shower fluctuations. The knowledge of the mass composition would allow us to constrain theoretical models which predict different types of source and acceleration mechanisms according to the mass of the particle. The only way to study such rare events is to observe the extensive air shower (EAS), composed of the secondary particles produced in the atmosphere after the interaction between the primary cosmic ray and the atmosphere's constituents. The EAS is mainly composed of electrons, positrons and photons. Different ways of detection exist to determine an EAS parameters. The fluorescence detectors receive the light emitted by the atmosphere constituants after being excited by the EAS charged particles. Cerenkov tanks sample the particles on the ground. Radio antennas record the electric field induced by the systematic deviations of the charged particles, caused by the Lorentz force, in presence of the geomagnetic field. These detection methods are able to reconstruct some of the EAS parameters such as the energy of the primary particle, the EAS core position on the ground and the atmospheric depth at which the number of particles is maximum. This latter quantity is strongly correlated to the primary mass. The radio signal is recently perfectly understood and its description via the simulation is successful. In this context, we show how the radio detection is able to reconstruct the EAS parameters on its own by comparing data to simulations.

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