Geophysical Research Abstracts
Vol. 20, EGU2018-18049, 2018
EGU General Assembly 2018

Study of the atmosphere with a high resolution Cosmic Ray detector

Irma Riádigos, Damián García-Castro, Diego González-Díaz, Juan Antonio Garzón-Heydt, and Vicente Pérez-Muñuzuri

The TRAGALDABAS Collaboration. Faculty of Physics, Univ. of Santiago de Compostela (USC), Spain (irma.riadigos@usc.es)

Cosmic rays are permanently arriving at the Earth's atmosphere producing up to billions of secondary particles. The analysis of such particles reaching the Earth's surface may provide very valuable information about the atmosphere.

Some of the greatest cosmic ray experiments have long observed a strong correlation of the stratosphere's temperature with the arrival of high energy cosmic muons. Later on, studies of the influence of temperature have been performed for muons of different energies and angles of incidence. However, modern cosmic ray detectors are mostly devoted to the study of solar activity and other astrophysical phenomena, and therefore their goal is to remove those effects using simple techniques, or to use them to coarsely assess the instrument response. Our work is concerned with a deeper understanding of such atmospheric effects.

In order to achieve our goals, a medium-size tRPC detector ($1.2 \times 1.5\ m^2$) of high resolution ($\sigma_{x,y} \sim 3$ cm, $\sigma_t \sim 300$ ps, $\sigma_\theta \sim 2.5$º), called TRAGALDABAS, was installed in the Physics Department of the University of Santiago de Compostela (Spain). Timing resistive plate chambers (or tRPCs) are prime detectors when aimed at large area coverage with ultimate time-of-flight resolution. Due to its granularity and versatile trigger, this instrument is able to select high and low multiplicity events, by individually identifying and reconstructing each of its constituent tracks. In addition, ECMWF reanalysis datasets provide the temperature profiles up to several kilometers, as required for our research.

By studying in detail the relation between event rates and atmospheric temperatures for different pressure levels for a period of time of two years, we observe that our detector is able to respond to the seasonal variability of the atmosphere as well as to specific atmospheric events such as stratospheric warmings (SSW). Moreover, considering that event multiplicities correspond to different cosmic ray energy, they are affected in a different way by the layers of the atmosphere, hence giving us additional information about its behavior. Preliminary simulations of the muon rates obtained with a custom-developed simulation software agree well with the experimental data, giving consistency to our results.