Study of the effect of seismically-induced geoelectric and geomagnetic fields on secondary particle detection at a LAGO site

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Presentation. The LAGO project is an extended Astroparticle Observatory made up of different Water Cherenkov Detector located throughout Latin America. One of its main objectives is the study of phenomena related to atmospheric radiation at ground level. Different studies have observed a relation between the onset of seismic activity and a change in local geoelectric and geomagnetic fields.

Relevance. Ecuador is a region of high seismic and volcanic activity. A detector placed at the LAGO site in USFQ could be used to observe the effects that the onset of earthquakes can produce on particle detection via the changes in electric and magnetic fields.

Tools We use the LAGO-ARTI package, which, among others includes the CORSIKA code to perform simulations of extensive air showers and obtain the results for arrival of secondaries at ground level.

Work. In this work, we perform simulations both for the entry of a single proton and for one hour of particle flux in conditions of change of vertical geomagnetic and geoelectric fields in relation to conditions baseline conditions for a fair-weathered day above the city of Quito: $Bx = 11.031\,\mu\mathrm{T}, Bz = 4.081\,\mu\mathrm{T}$. The change in geolectric field is $\Delta B_z = 0.25\,\mu\mathrm{T}$, while the change in geomagnetic field is $\Delta E_z = 10\,\mathrm{V/cm}$.

Results. Results for one hour flux of particles consistently show changes in the distribution in accordance with what can be expected for changes in the magnetic and electric fields on the path of charged particles. The effect of magnetic fields appear to change the form of the distribution, while the change in electric field seems to reduce the amount of particles available that arrive at ground level.

Shower initiated by a Single Proton

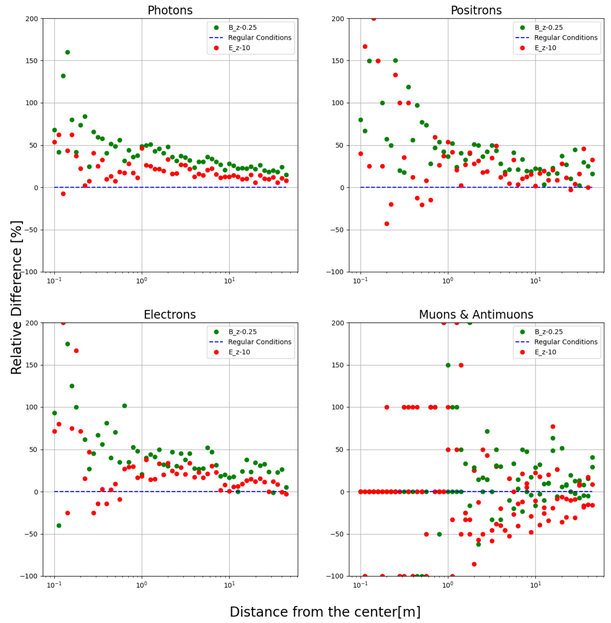

Figure: Relative difference of distributions of secondary particles at ground level from regular conditions for showers initiated by a single proton. Photons, Electrons and Positron all show high changes at distances closer to the detector Changes in the muonic component appear to lack this consistency and could be attributed to randomness

One Hour flux of particles

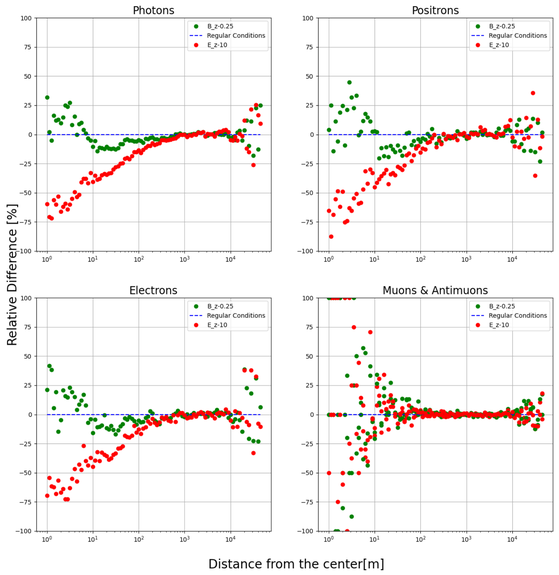

Figure: Relative difference of distributions of secondary particles at ground level from regular conditions for one-hour flux of particles. The magnetic and electric field change distributions reproduce different but consistent form of change for photons, positrons and electrons. Changes in the muonic component appear to lack this consistency.