Effect of Geomagnetic field on secondary charged particles

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Introduction

A galactic cosmic ray (GCR) entering the atmosphere interacts with atmospheric nuclei and generate the particle cascade, which is called an air shower [1]. The detection of extensive air showers (EAS) created by GCR in the atmosphere has been accomplished mainly with two detection methods. The first method consists of detecting the particles using an array of particle detectors . The second method use telescopes to detect the fluorescence photons emitted by the particles in the shower as they travel through the atmosphere [2].The number of muons from a GCR on the ground depends on the mass composition of primary cosmic rays. The Monte Carlo (MC) prediction depends also on hadronic interaction models since it has information about the shower development at an early stage. The lateral distribution of muons contains information about the hadronic interactions.
We aim to use the air shower simulation AIRES and CORSIKA to study the radio emission from air shower for the development of future detectors.

Simulation of air showers with AIRES

AIRES uses the Sibyll 2.3d hadronic interaction model to study the air shower. The primary particle with high produces a cascade of secondary particles. The study of secondary particles can be done by applying threshold energies and different energy cuts. The secondary particles created in the shower in the lateral as well as longitudinal plane can be further analyzed. The effect of the geomagnetic field to the charged particles like electron,positron,muons, etc. reaching the ground surface has been studied by implementation of different values of geomagnetic field. The above phenomenon can be understood with the following figure 1

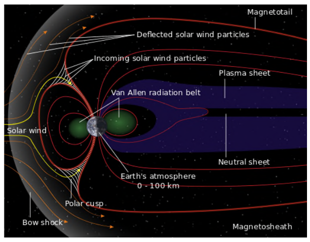

FIG. 1: Interaction of solar wind in earth atmosphere.

The following parameters has been employed for the analyses geomagnetic effects on charged particles.

1. Primary particle: Proton .
2. Primary energy: 1.00 TeV.
3. Primary zenith angle: 0.00 deg.
4. Primary azimuth angle: 0.00 deg.
4. Relative Thinning energy: 1.00E-03
5. Injection altitude: 100.00 km
6. Ground altitude: 399.89 m (985.00 g/cm^2).
7. Geomagnetic field: Intensity: 25.00 – 65.00 μT in steps

The Fig 2 represents the μ^+ and μ^- distribution in the ground from the top view due to inclined air shower for the different values of geomagnetic field.

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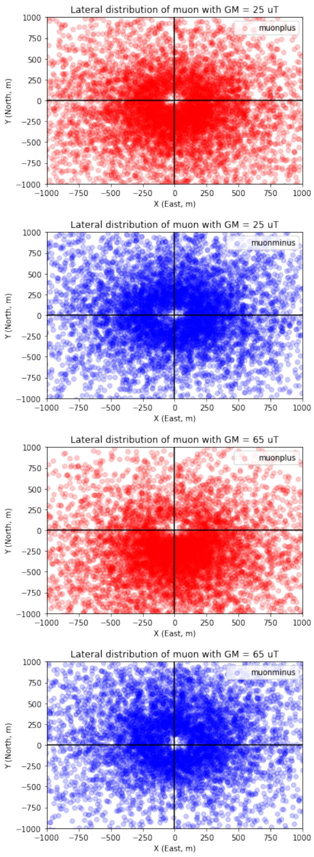

FIG. 2: The lateral distribution of μ^+ and μ^- at diffrent strength of geomagnetic field.

The mean of μ^+ and μ^- due to different geomagnetic field strength are listed in Table 1.

TABLE I: Geomagnetic field on the μ^+ and μ^- in the lateral distribution on the ground

GM Field (μT)	**Mean**			
	$\mu^+(x)$	$\mu^-(x)$	$\mu^+(y)$	$\mu^-(y)$
25	-134.84	-112.26	-236.309	-66.77
35	-127.33	-124.96	-305.01	-51.92
45	-124.19	-105.59	-334.78	-52.82
55	-118.32	-105.95	-397.76	-35.76
65	-106.54	-112.76	-426.45	-10.24

Result and discussion

The mean of secondary μ^+ and μ^- due to an air shower depicts that the charged particles changes its direction by applying the various geomagnetic field. The study of the GM field on the secondary particles through simulation is in its preliminary stage. There are many parameters like the particle energies, masses, incident angles, detector position and orientation, and the geographic location to be analyzed.

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