Abstract

Imaging Air Shower Cherenkov Telescopes (IACTs) detect the Cherenkov light flashes of Extended Air Showers (EAS) triggered by very high-energy γ-HESS; wave imaging on the Earth's atmosphere. Due to the overwhelming background from hadron induced EAS, the discrimination of the rare γ-events is rather difficult, in particular at energies below 100 GeV. The influence of the Geometric Field (GF) on the event distribution can further complicate the discrimination and, in addition, also systematically affect the γ-energy and energy resolution of an IACT. Here we present the results from the analysis of Magic (MC) simulations for the MAGIC telescope site. Additionally, we show that measurements of radio-pulses from the Crab nebula are affected even for a low GF strength of |B| ≥ 33 μT.

Introduction

...charged secondary particles of the EAS are deflected by the GF resulting in a broadening of the EAS, the east-west separation of electrons and protons in EAS due to the Lorentz force can be too negligible compared to the deflection due to the Coriolis force [3]. The Cherenkov images on ground can be affected in a way that is consistent with the peak of IACT surfaces [2] as well as if a hadron production capability is expected to be determined. The total amount of induced EAS is expected to be more visible than hadron induced EAS, as the shape is usually more regular and the scattering angles occurring in nuclear interactions are typically larger than that produced by the deflection of secondary charged particles due to the influence of the GF.

Monte Carlo Simulation

...Monte Carlo data were produced to study the influence of the GF on the performance of the MAGIC telescope. The MAGIC data were produced following the standard Monte Carlo production of the MAGIC telescope, using three steps [4]. The CORSIKA program version 8.619 [5] is used to simulate the development of γ-rays as well as hadrons and electromagnetic cascades. The air shower generation parameters are the primary energy and the zenith angle of the primary. The simulation program computes the primary and the secondaries, their energy, their zenith and azimuth angles, their deflection due to the geographical coordinates, and their scattering due to the atmospheric particles. The CORSIKA program includes the absorption and the image parameter calculation (Hillas analysis) [6] before using the MAGIC Analysis and Reconstruction Software (MARS) [6].

Results & Discussion

...only few selected results can be discussed here and a more detailed analysis can be found in [8].

Influence of the GF on the Image Orientation

...Due to the influence of the GF on the development of EAS the major shower axis can be rotated and does not point anymore towards the camera center as expected for showers coming from a point-like source pointed at by the telescope.

The effect of the rotation depends on various parameters, like the γ-ray energy, the impact parameter, and the position of the impact point with respect to the telescope.

Influence of the GF on the Image Parameter ALPHAX

...Due to the influence of the GF the ALPHAX plots for different camera events show substantial differences. The γ-effects are visible in real data even for a very low value of the GF strength (|B| ≥ 33 μT).

Influence of the GF on the Energy Reconstruction & Detection Efficiency

...The Cherenkov light distribution is generated from showers close to the threshold energy can be tailored out such that most of the events do not exceed the trigger level, the detection efficiency for γ-rays can vary up to 25% [2]. For higher energies (≈ 300 - 1000 GeV), the detection efficiency is affected only at very large zenith angles (≈ 40° - 60°), whereas the threshold energy is significantly increased. The total integrated angular width of shower images can be reduced by up to ≈ 20% [10].

Considering GF Effects in Real Data

...50 min of live-time (≈ 100%) Crab Nebula data from February 2007 were analyzed considering GF effects. The standard MAGIC analysis was performed to extract the γ-ray signal from the data.