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Disentangling atmospheric cascades started by gamma rays from cosmic rays with CORSIKA

Monday 26 November 2018 16:00 (15 minutes)

In this work we test a multivariate method to differentiate between particle showers produced by cosmic rays and by gamma rays at TeV energies, using CORSIKA simulations. The aim is to solve the dominant hadron flux background problem when looking for gamma-ray signals measured by different experiments. The results of this work can be applied to the study of Gamma-Ray Bursts (GRBs). GRBs emit very energetic photons, which after interacting in the Earth's atmosphere, produce a large detectable electromagnetic cascade of secondary particles.
We simulate events produced by photons, the signal, and protons, the most abundant cosmic-ray background. We extract several parameters from fitting particle air-shower longitudinal profiles, characterizing the simulated showers. Some of the most important fit parameters are the shower maximum (Xmax), the width of the shower (FWHM), the asymmetry parameter, the maximum number of particles and the shower start. Experiments using fluorescence detectors can measure this longitudinal profile of the shower.
The method to differentiate showers is based on a multivariate analysis using the TMVA package, which improves individual cuts. We use a sample that covers an energy range from 100 GeV to 10 TeV with different spectra to train and test different multivariate methods. We find that the Boosted Decision Trees (BDT) method was the best for distinguishing signal from background. Using tight cuts on the BDT we obtain a 1000 background rejection capability.

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