Application of a MT method to cosmic-ray particle identification

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The purpose of this study is to construct a data analysis system that discriminate electrons from protons in cosmic-ray imaging calorimeters such as emulsion chambers (ECC) [1]. In event classification and background rejection for cosmic-ray observations, various data mining techniques such as artificial neural network and classification tree have been applied to conduct cosmic-ray particle identification. A Mahalanobis Taguchi (MT) method is an alternative to these data mining techniques. The MT method creates one standard multidimensional unit space from characteristic variables and makes the distance of each event to identify specific particles from all other species. In this study, we have applied the MT method to select electrons against the background protons for ECC based on Monte Carlo simulations (Epics, Geant4). For 1TeV electrons, we have simulated $1 \times 10^6$ proton events with a power-law index of -2.7 ranging from 1TeV to 1000TeV. As shown in Fig.1, we find no proton events survive with the electron residual ratio of 96%.


![Fig. 1: Distribution of the mahalanobis distance for 1TeV electrons and the background protons.](image)