Direct measurement of proton spectrum in cosmic rays with the space calorimeter CALET

Lorenzo Pacini

Supervisors: Prof. Oscar Adriani

The direct measurement of individual particle spectra (both electron and nuclei) of cosmic-ray spectrum is one of the instrumental challenge for the space experiments. A precise knowledge of particle spectra and composition in this spectral region would allow to address key items in the field of high-energy cosmic rays physics, such as the unambiguous identification of the acceleration sites, the clear understanding of the acceleration mechanisms, accurate modeling of particle propagation and confinement within the Galaxy. These measurements are also crucial to search for signals from dark matter and contributions from nearby astrophysical sources like pulsars.

The CALorimetric Electron Telescope (CALET) is a Japanese led international space mission supported by JAXA (Japanese AeroSpace Agency) in collaboration with the Italian Space Agency (ASI) and NASA. The apparatus was launched to the International Space Station on 19 August 2015. Its main objective is to perform precise direct measurements of the electron+positron spectrum in cosmic rays at energies up to 10 TeV, nuclei spectra with Z = 1 - 40 up to 1 PeV and to detect gamma ray emissions up to 10 TeV with high energy resolution. The instrument consists of a charge detection device composed of two layers of plastic scintillators, a finely-segmented sampling calorimeter with scintillating fibres and a homogeneous calorimeter made of PWO scintillating bars.

For such a calorimeter, in order to optimize energy resolution for protons and nuclei, an off-line signal compensation method was developed. As well as the energy resolution, the trigger efficiency of the apparatus is one of the fundamental parameter for the flux calculation. In this work I will presented some studies of this items using both simulations and flight data. Three different simulations of the CALET apparatus, based on EPICS, FLUKA and GEANT4 physics packages respectively, was developed. A comparison between the different simulations is finally given.

REFERENCES

“The CALorimetric Electron Telescope (CALET): High Energy Astroparticle Physics Observatory on the International Space Station”, Shoji Torii for the CALET collaboration, ICRC2015 581

“A multidimensional unfolding method based on Bayes’ theorem”, G. D’Agostini, Nucl. Instr. and Meth. in Phys. Res. A 362 (1995) 487-498

“MEASUREMENT OF THE ISOTOPIC COMPOSITION OF HYDROGEN AND HELIUM NUCLEI IN COSMIC RAYS WITH THE PAMELA EXPERIMENT”, O.Adriani at al., The Astrophysical Journal, 770:2 (9pp), 2013 June 10