The analysis strategy for the measurement of the electron flux with CALET on the International Space Station

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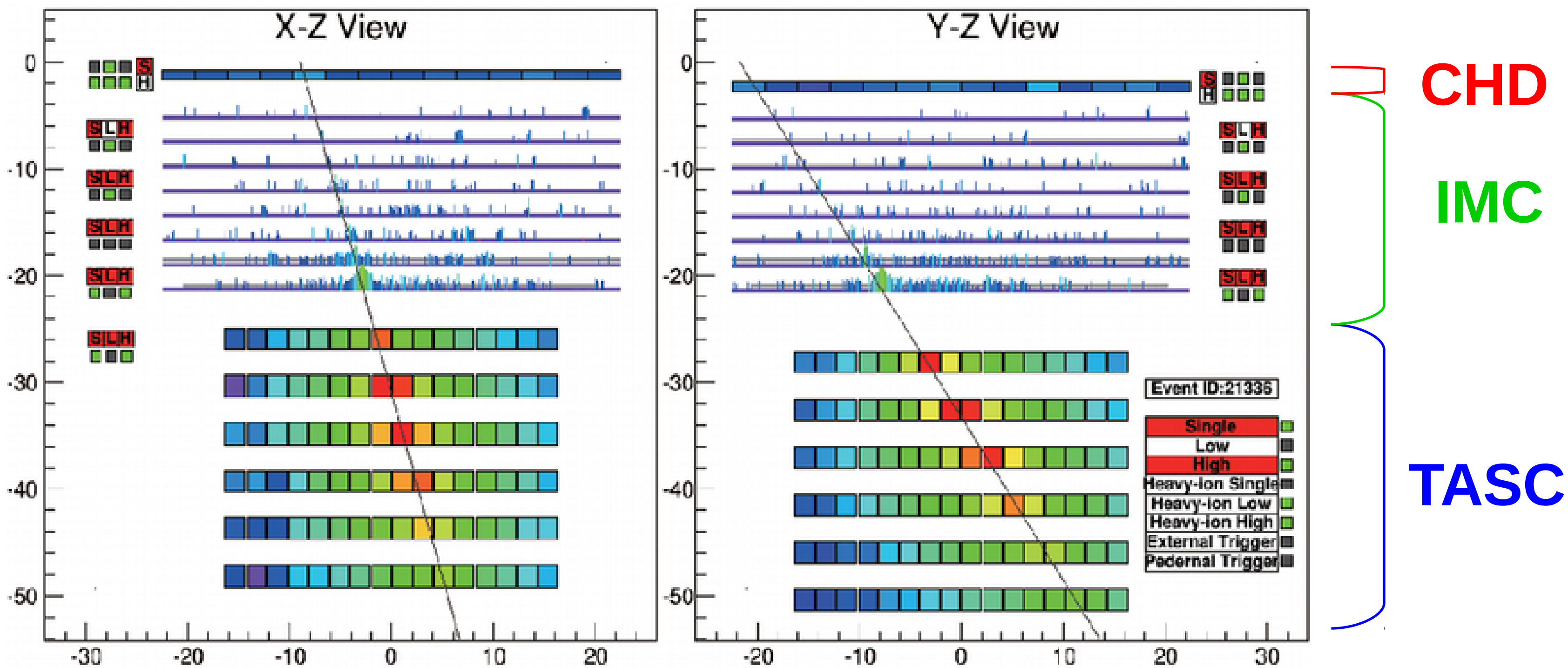
Scientific goal and detector overview

The primary scientific goal of the CALET experiment on the ISS is the **measurement of the electron+positron flux up to the multi-TeV region**

This is possible thanks to the excellent performances of the calorimeter:

Geometric factor	Energy resolution (e^-+e^+)	Proton Rejection Factor
0.1 m^2sr	2%	10^5



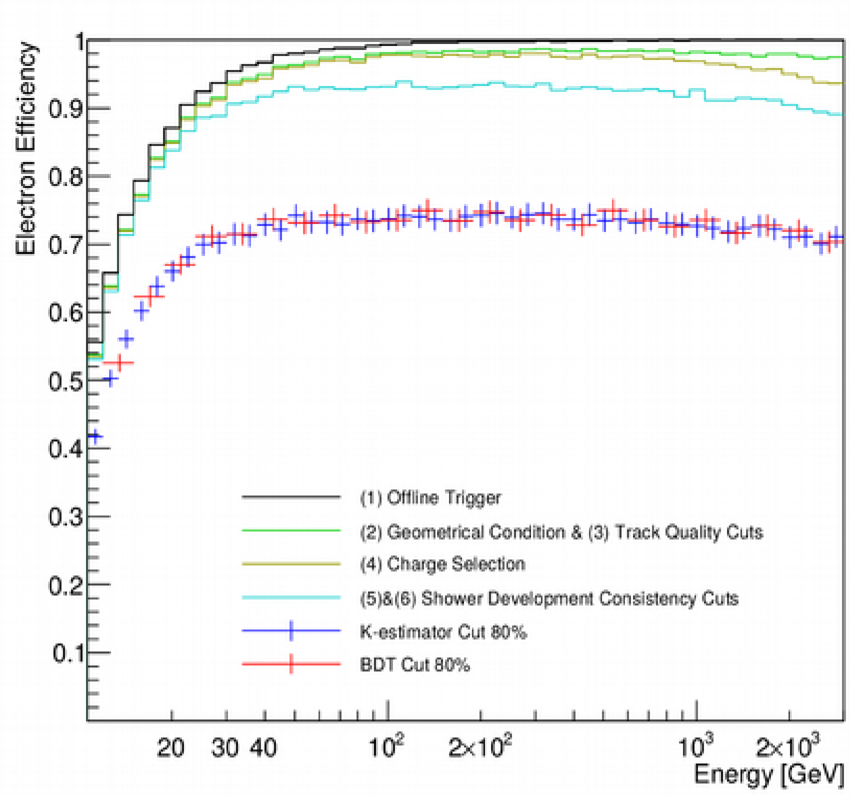
3.05 TeV Electron Candidate

Analysis Strategy
(a) Selection

The electron analysis strategy is divided in two main steps:

(a) a **group of selections** to obtain a well reconstructed sample of electron candidates, removing contamination from events outside acceptance and particles with charge Z>1

→Above 30 GeV, the selection efficiency is higher than 95% for electrons and smaller than 1% for protons



(1) Offline trigger confirmation

→select a flat region of discriminator efficiency

(2) Geometrical condition

→ select tracks inside acceptance

(3) Track quality

→ensure an accurate track reconstruction

(4) Charge selection

→remove contamination from He and nuclei

(5) Longitudinal shower likelihood

→ suppress contamination from proton

(6) Lateral shower concentration

→suppress contamination from proton and events outside the detector acceptance

Analysis Strategy
(b) Rejection

The electron analysis strategy is divided in two main steps:

(b) a **proton rejection cut** to further suppress the proton background
→ The residual proton contamination (<5 % for E < 1 TeV and and <20% for E > 1 TeV, [<10% for the optimized BDT analysis using 13 parameters]) is subtracted from the final measurement

Rejection by single cut (below 500 GeV)

Based on the variable

$$K = \log_{10}(F_E) + \frac{1}{2} R_E$$

where:

- F_E is the fraction of energy deposited in the last TASC layer
- $R_E = \sqrt{\frac{\sum_j \{\Delta E_j \cdot (x_j - x_c)^2\}}{\sum_j \Delta E_j}}$

Rejection by MVA Cut (above 500 GeV) using Boosted Decision Tree

BDT estimator is built using 9 parameters, including F_E, R_E and several variables connected with the longitudinal fit in IMC and TASC.

Longitudinal Fit in IMC

$$\frac{dE}{dt} = e^{p_0 + p_1 t}$$

Longitudinal Fit in TASC

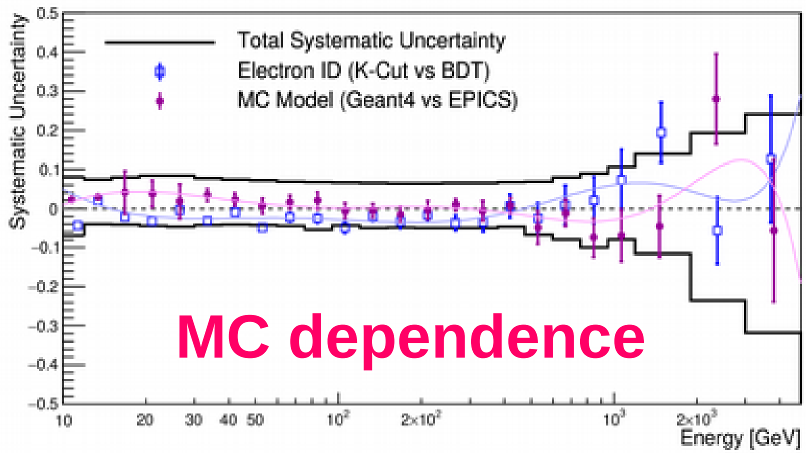
$$\frac{dE}{dt} = E_0 \frac{b^{(\alpha+1)}}{\Gamma(\alpha+1)} t^{\alpha} e^{-bt}$$

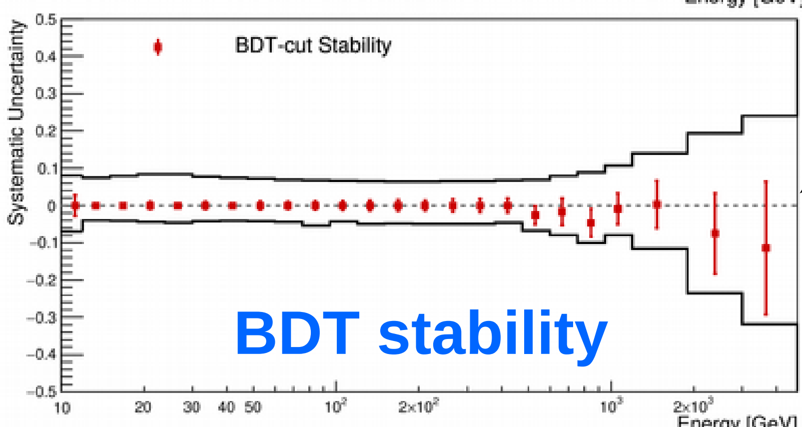
In an optimized BDT analysis that is currently under study, we use 13 parameters and a single bin above 500 GeV (properly applying energy-dependent corrections to variables).

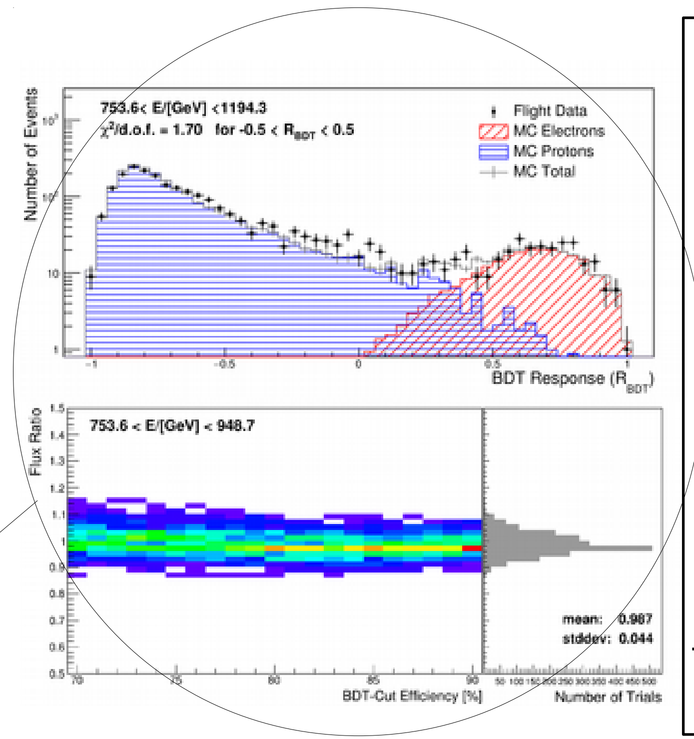
Systematic Uncertainties

Systematic uncertainties can be divided in two groups:

- **Normalization uncertainties**, *i.e.* detector acceptance, longterm stability, radiation environment, and live time, for a total of 3.2%
- **Energy-dependent uncertainties**, *i.e.* trigger efficiency, track reconstruction, charge selection, **MC dependence**, and **BDT stability**







BDT stability was investigated varying the electron selection efficiency at 1% step, using 100 different training/test samples for each efficiency

For each energy bin, the RMS obtained by the corresponding histogram is used as the best estimation of the uncertainty relative to BDT stability