Charge Loss Correction in the Silicon-Tungsten Tracker-Converter for Proton-Helium Charge Identification in the DAMPE Detector

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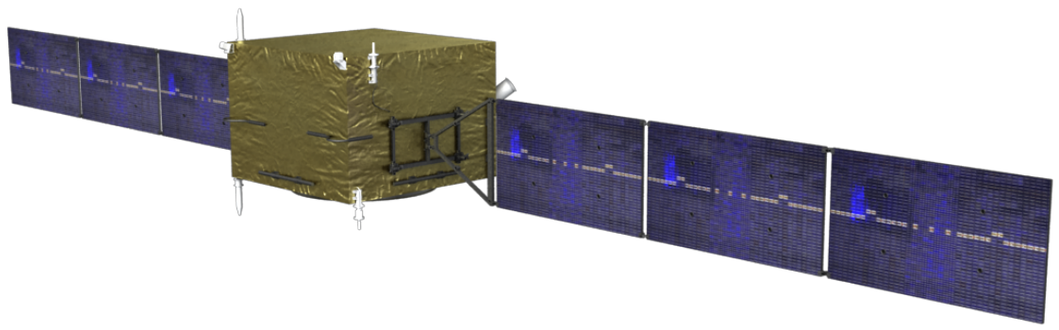
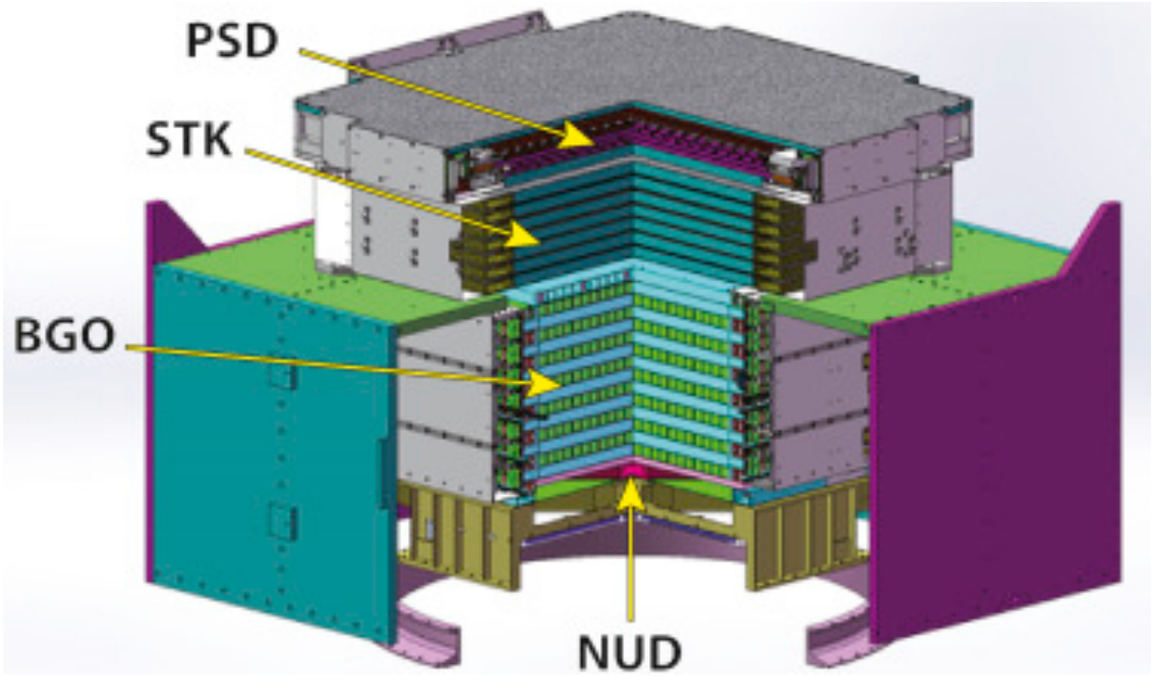
(on behalf of the DAMPE collaboration)

DArk Matter Particle Explorer (DAMPE)



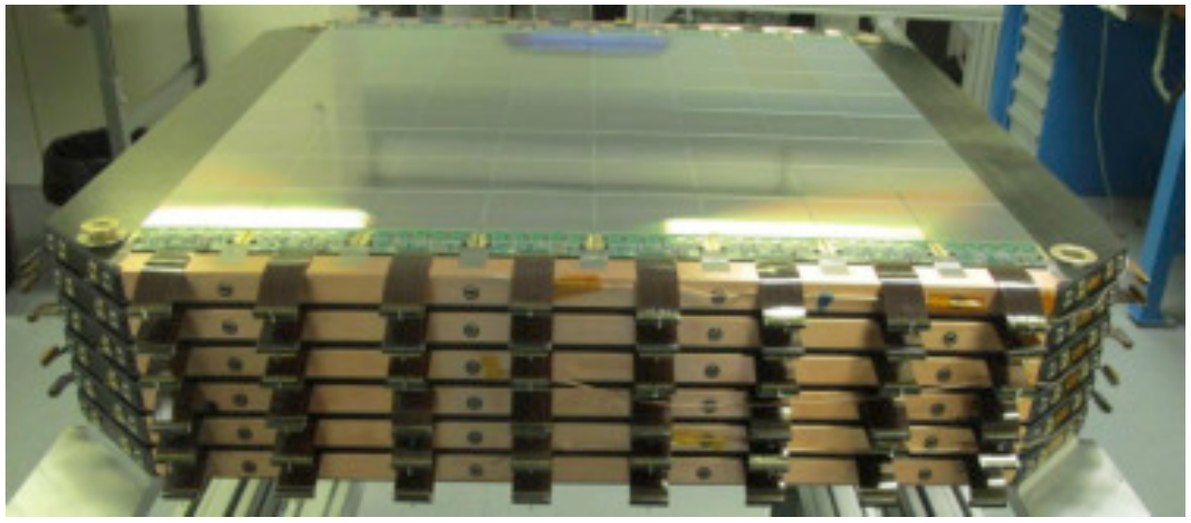


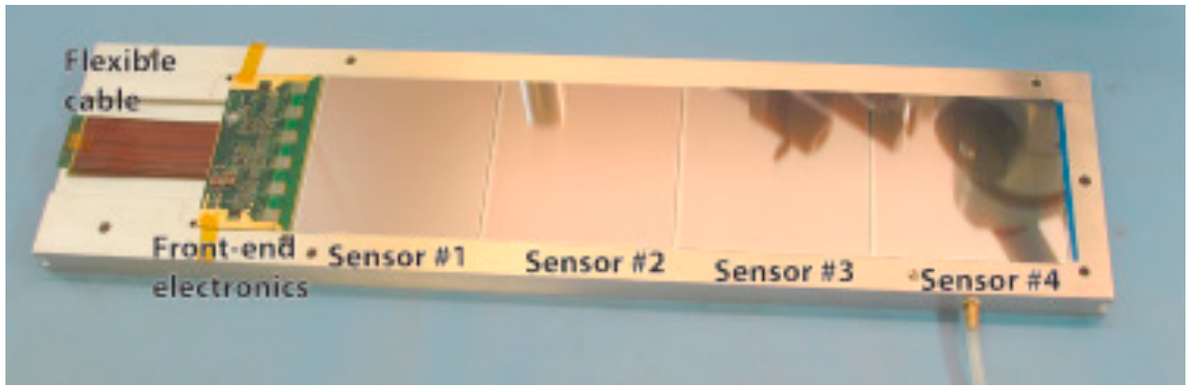
- Aim: Precise measurement of cosmic ray flux and chemical composition from 10 GeV to >100 TeV

The sub-detectors:

- Plastic Scintillator Detector
- **Silicon-Tungsten Tracker-Converter**
- Bismuth-Germanium-Oxide Electromagnetic Calorimeter
- Neutron Detector

Silicon-Tungsten Tracker-Converter (STK)



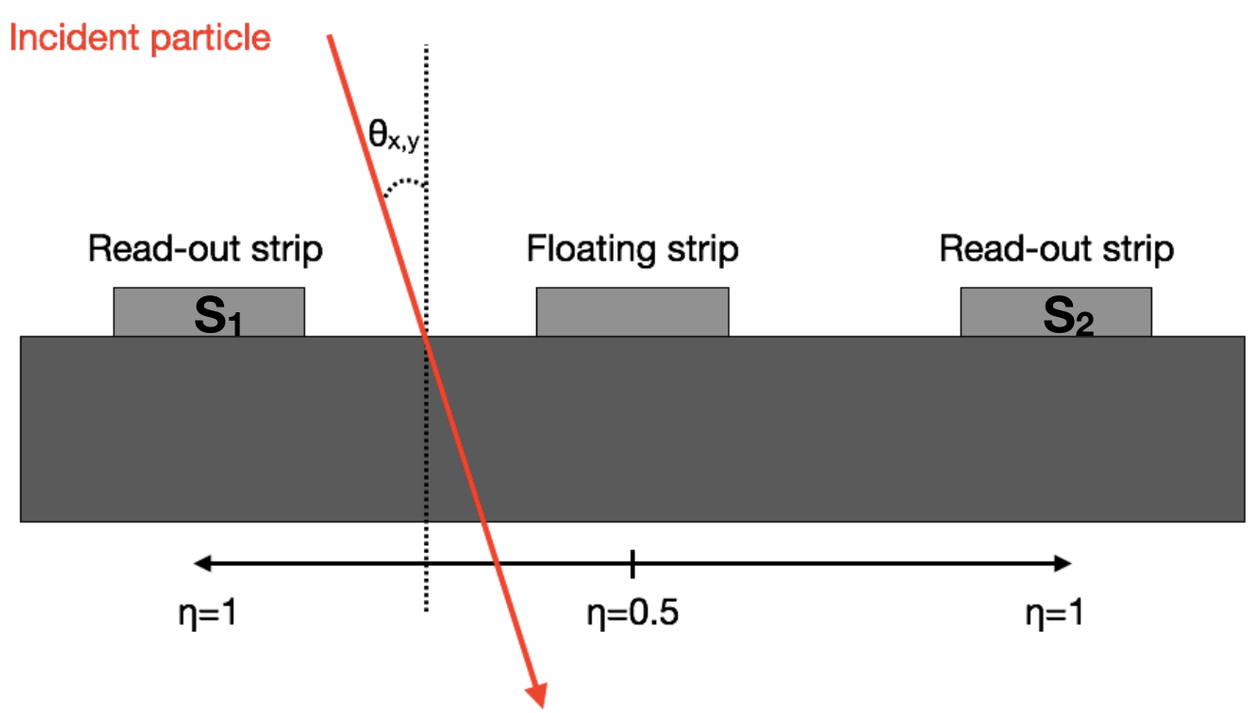


- Aim: charge measurement and tracking
- 12 layers (6 for X- and Y-coordinates each) of single-sided silicon microstrip detectors (SSDs)
- 3 tungsten layers for photon conversion
- One sensor module (ladder) has 4 SSDs with 768 strips
- Read-out is done only for every other strip

Charge Loss in the STK

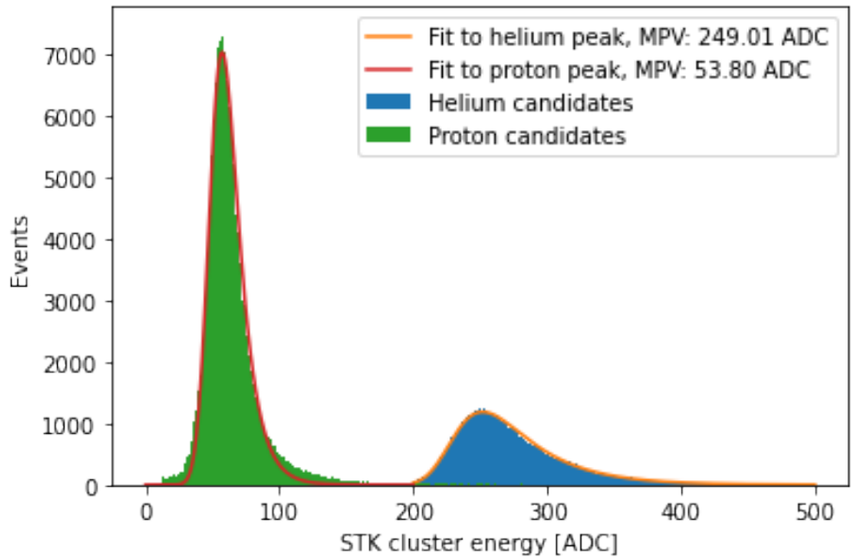
- Charge loss due to **position of impact** and **angle of incidence** on sensor
- This dependance can be defined using the η variable

$$\eta = \frac{S_1}{S_1 + S_2}$$

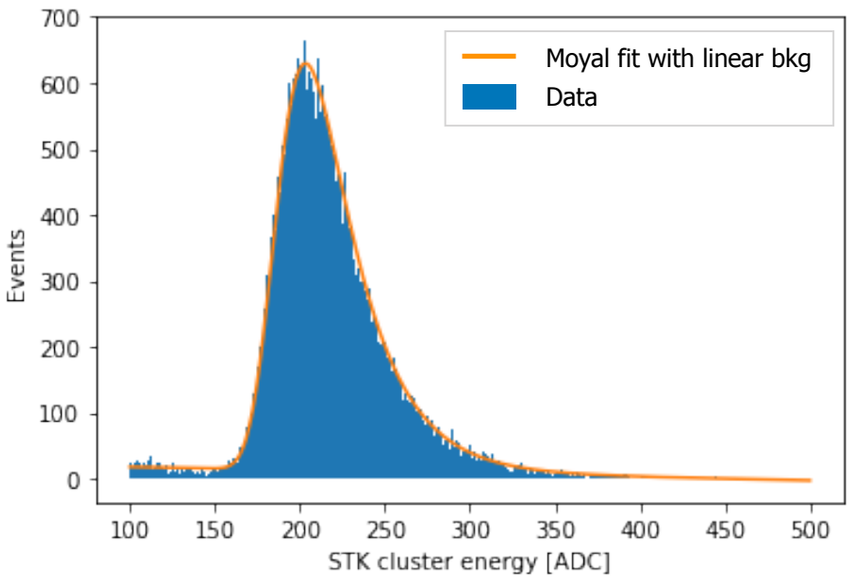


Charge Loss Correction: Development

1. The target STK energy is obtained from single-strip clusters



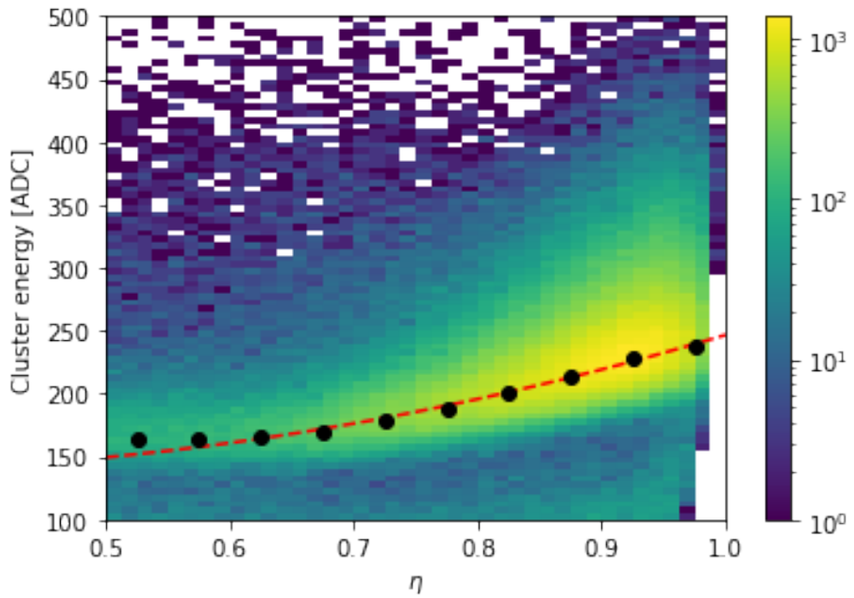
2. Fits are made to STK energy distributions for pre-selected helium candidates in bins of η, θ and number of strips



STK energy for clusters with 0.8 < η < 0.85, 23.33○ < |θ | < 29.17○ and nstrips = 2

3. The peaks of the fits for every slice in η are fitted using a quadratic function

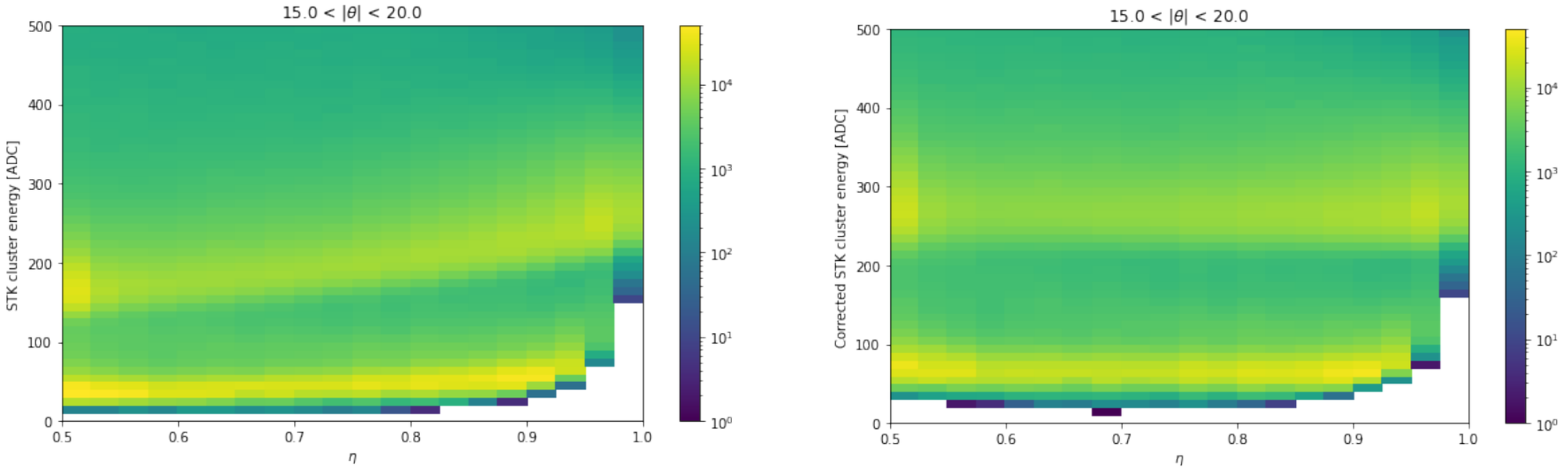
$$f(\theta_{x,y}, n_{\text{strips}}) = a\eta^2 + b\eta + c$$



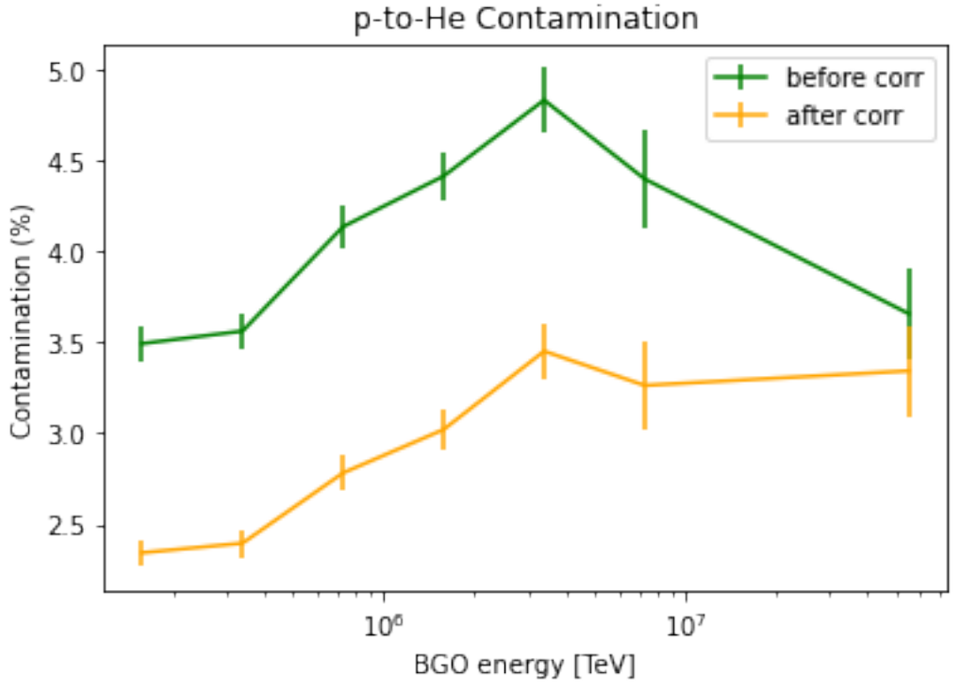
4. The correction factors are multiplied to the STK cluster energy

$$\text{Correction param.}(\eta) = \frac{E_{\text{He, 1-strip}}}{f(\theta_{x,y}, n_{\text{strips}})}$$

Charge Loss Correction: Results



STK cluster energy vs. η before (L) and after (R) charge loss correction



Proton contamination in helium candidate events in bins of deposited energy in the calorimeter

- It greatly improves the charge discrimination between proton and helium candidates in MIP tracks — **reduces proton contamination 1.5 times** than before correction
- It can also be applied for heavier ions (successful application to carbon in preliminary studies)