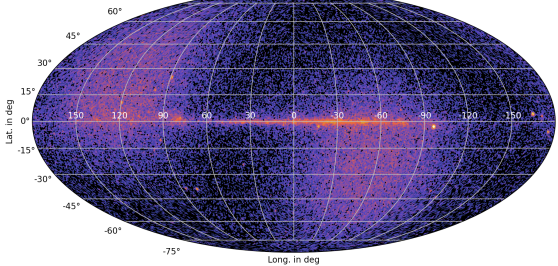
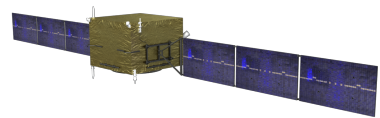




A deep learning method for the trajectory reconstruction of gamma rays with the DAMPE space mission

Parzival Nussbaum, Chiara Perrina, Jennifer Frieden

01.05.2024 EuCAIFCon

EPFL

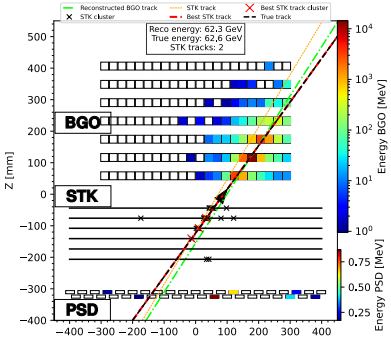
DARK MATTER DAMPE PARTICLE EXPLORER

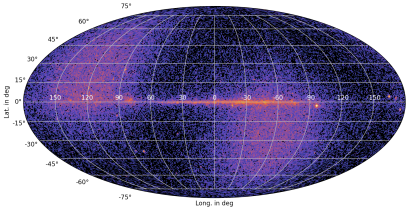
Standard approach to trajectory reconstruction

1. Shower profile $\Longrightarrow$ BGO reco track
2. Clustering the STK hits
3. Track-finding algorithm on clusters in the STK:
   - Seeding (calorimeter-seed or blind-seed).
   - Propagating using a **Kalman Filter**.
   - Filtering based on χ^2 and cluster count.
4. Multiple track candidates
   $\Longrightarrow$ metric (TQ) to choose the best track

Next generation experiments

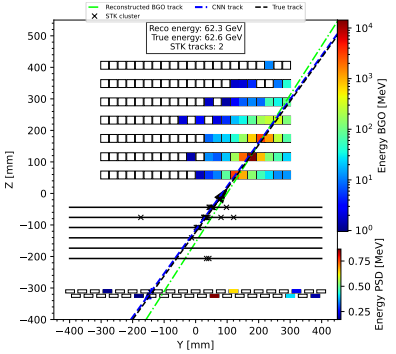
Standard reco is more challenging at higher energies since systematic uncertainties increase





CNN approach to trajectory reconstruction

1. Shower profile $\Longrightarrow$ BGO reco track
2. Clustering the STK hits
3. Hough transform of STK hits
4. CNN model prediction
   - Seeding (calorimeter-seed or blind-seed).
   - ~~Propagating using a **Kalman Filter**.~~
   - ~~Filtering based on χ^2 and cluster count.~~
5. ~~Multiple track candidates~~
   ~~$\Longrightarrow$ metric (TQ) to choose the best track~~



Results

- 300 times faster than standard reco
- One third of standard method precision
- Successful proof of concept on flight data