

OBJECTIVE

- Study of pattern of energy deposit from stable hadrons (protons, pions, kaons, neutrons, deuterons) in a high granularity calorimeter.
- classification of shower type and extraction of probabilistic information on particle ID.
- Determination of granularity threshold when that information is lost.

BACKGROUND and MOTIVATION

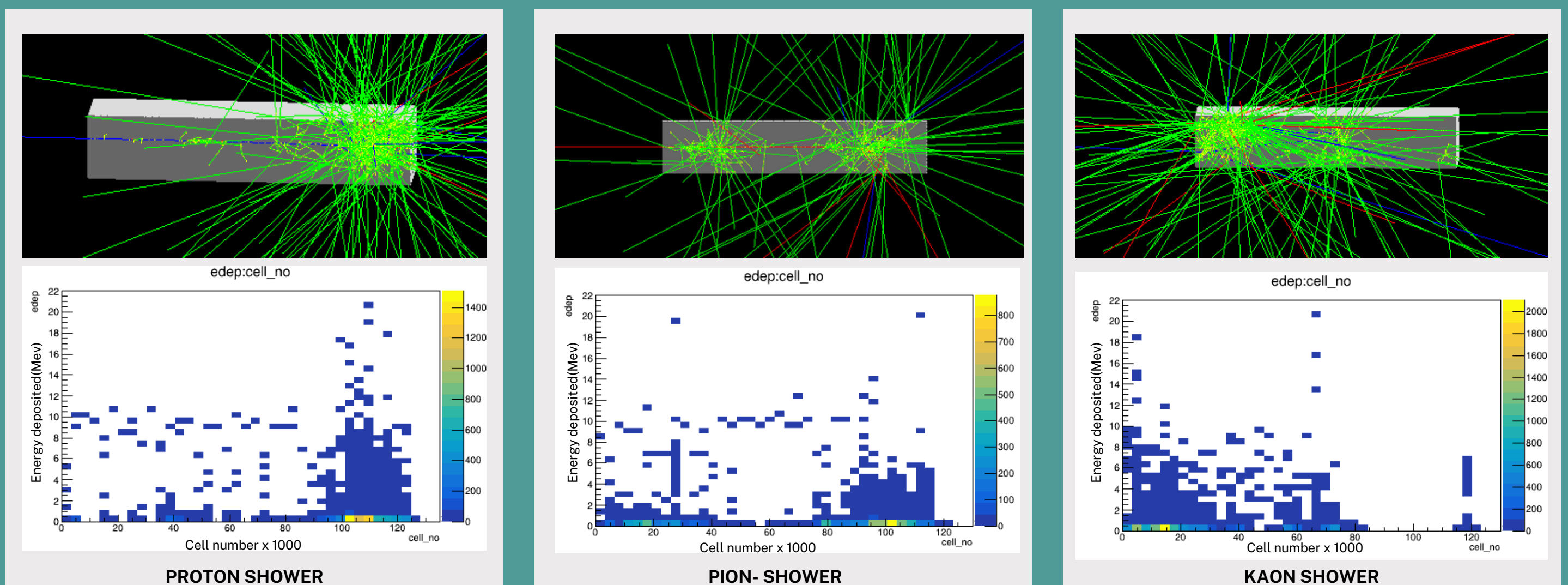
- The pattern and amount of energy deposits in highly segmented elements of detector could be used to infer the nature and evolution of complex showers.
- High granularity has been shown to be an important element in the design of hadron calorimeters, which enables the distinction of boosted heavy objects that decay into quarks and also allows to improve the detailed reconstruction of hadronic jets.

Decrypting the information of complex hadron shower through the codes produced in Geant4 and data generation:

The Shower simulation in Geant4 proceeds in **STEPS**. Therefore we could extract information like **Particle Id**, **Energy Deposit**, **Track Id**, **Parent Id** at each step in the shower development and we could also gather the corresponding cell number of calorimeter.

SIMULATION and ENERGY DEPOSIT

Incident particle energy : 10 Gev Particle direction : left to right Granularity : 50 x 50 x 50 cells (each 2 x 2 x 10 mm³)



Reconstruction Of Hadronic Shower (ONGOING) :

We are working on the algorithm to reconstruct the hadron shower in the detector with energy deposited in each cell, particle Id, and track Id extracted from simulation for each event.

Training Graphical Neural Network:

With data generated for energy deposit and reconstruction of Shower, a graphical neural network will be trained for classification of Shower and Particle Identification.



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FUTURE DIRECTIONS

To understand what limits the "perfect" reconstruction of each particle in hadron showers, and at what level the information on the identity and energy of all their constituents gets lost when we go from perfect resolution to realistic designs.