Determination of purity and efficiency of the clustering algorithm of neutron reconstruction with the HGND at the BM@N experiment

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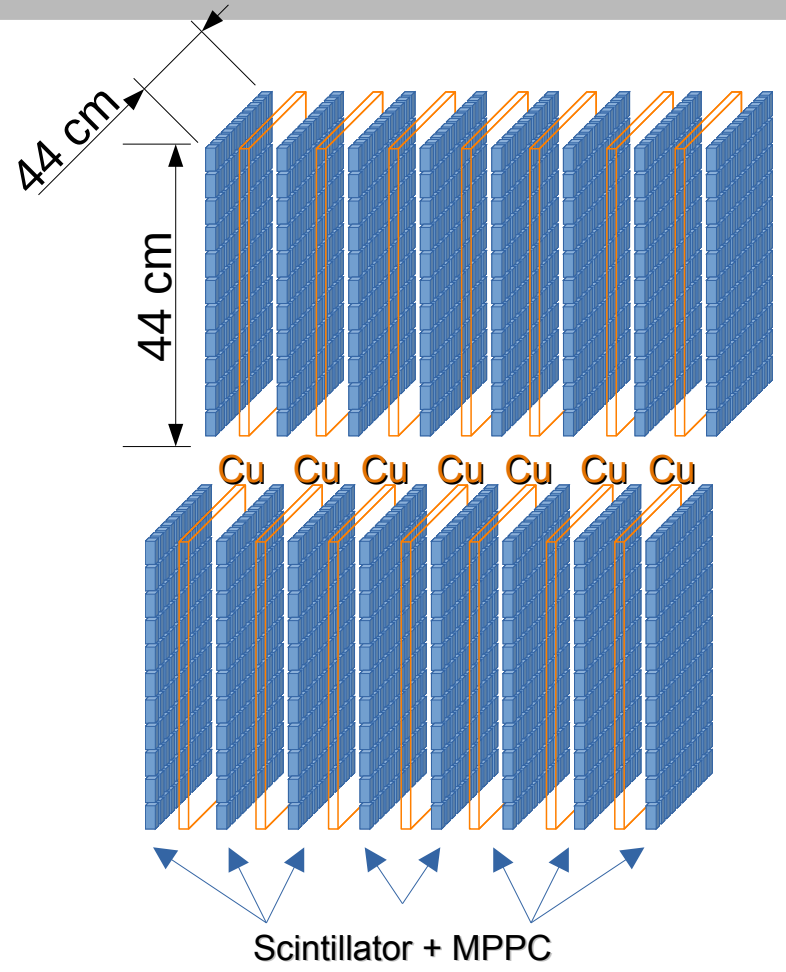
Outline

- HGND
- Cluster recognition
- Selection of neutron clusters
- Determination of efficiency and purity
- Energy reconstruction

Scheme of HGND

- Two parts
- 8 layers of scintillator 11x11 cells
- 7 layers of Cu convertor in between of scintillator layers
- MPPC connected directly to scintillator
- Time resolution ~130 ps

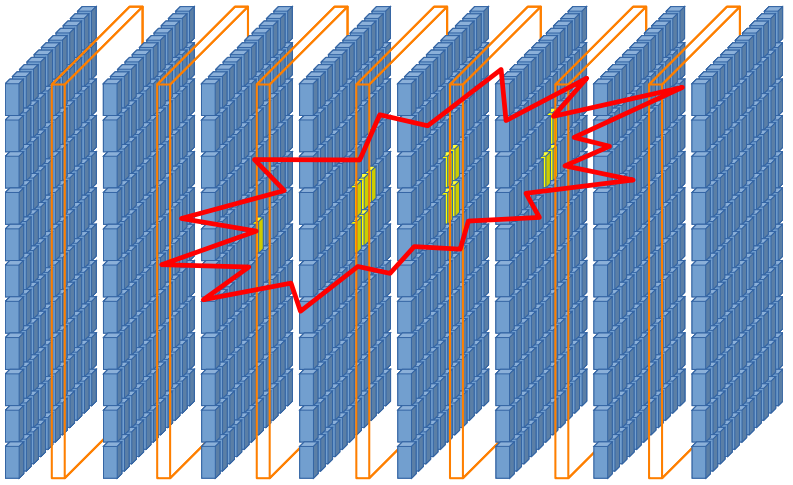


Parameters of simulation

- DCM – QGSM – SMM generator
- $\sqrt{s_{NN}}$ = 3.26 AGeV (3.8 AGeV beam energy)
- 10^6 events
- Δt of HGND cells 130 ps

Cluster recognition

- The particles traversing HGND can fire many cells in one event
- Analysis of data starts from combination of fired cells into clusters
- **Cluster** is a set of neighbouring fired cells with close timestamps
- **BmnNdetClusterFinder::FindClusters()**



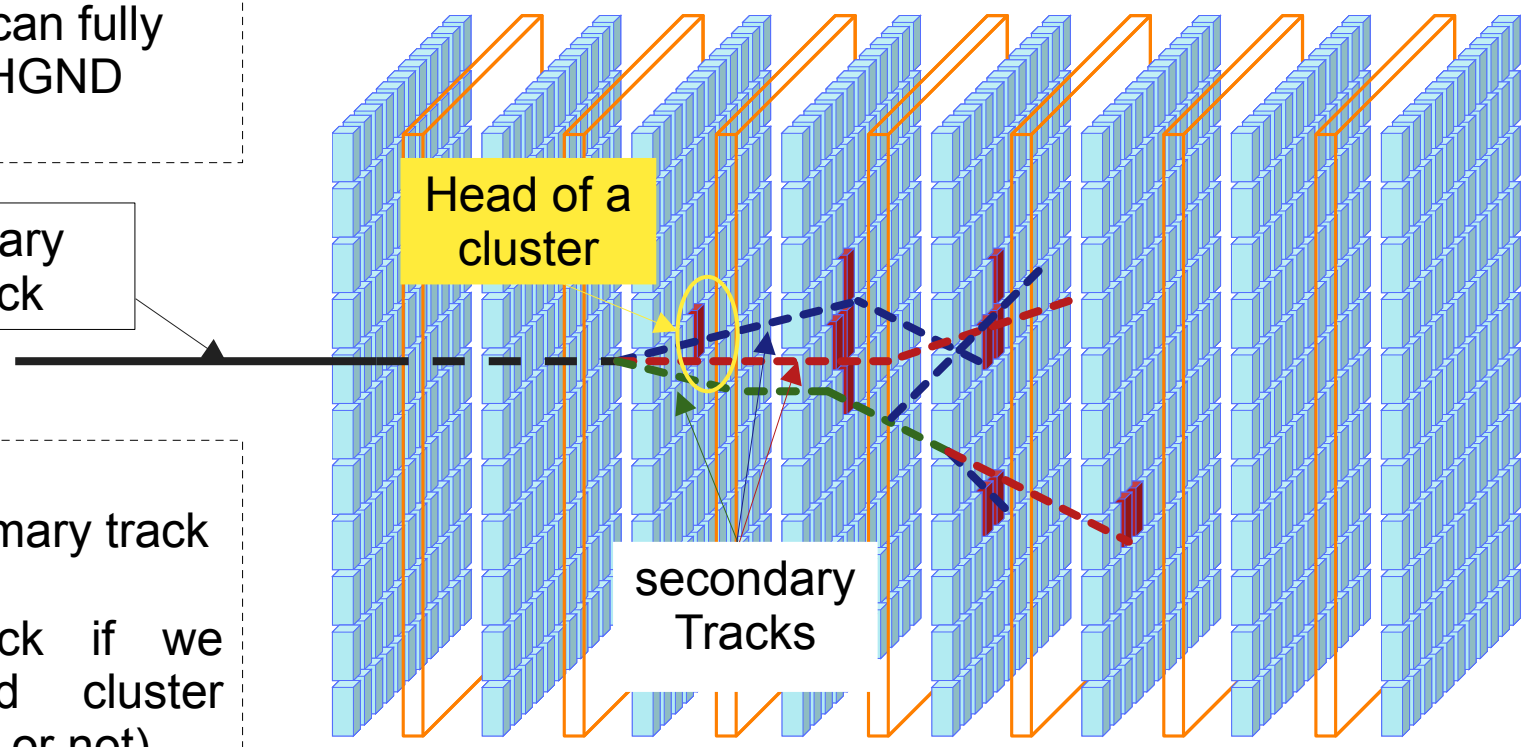
Selection of clusters

- Rejection of noise: deposited energy > 3 MeV
- Rejection of charged particles with veto on 1st layer
- Rejection of gammas with veto on 2nd layer
- Rejection of light particles (γ, e) with β<1 cut

- The clusters are combined into larger clusters if they have close timestamps (within time resolution of HGND)

Disentanglement of an event

In MC simulation we can fully disentangle event in HGND



correspondance
head of cluster ↔ primary track

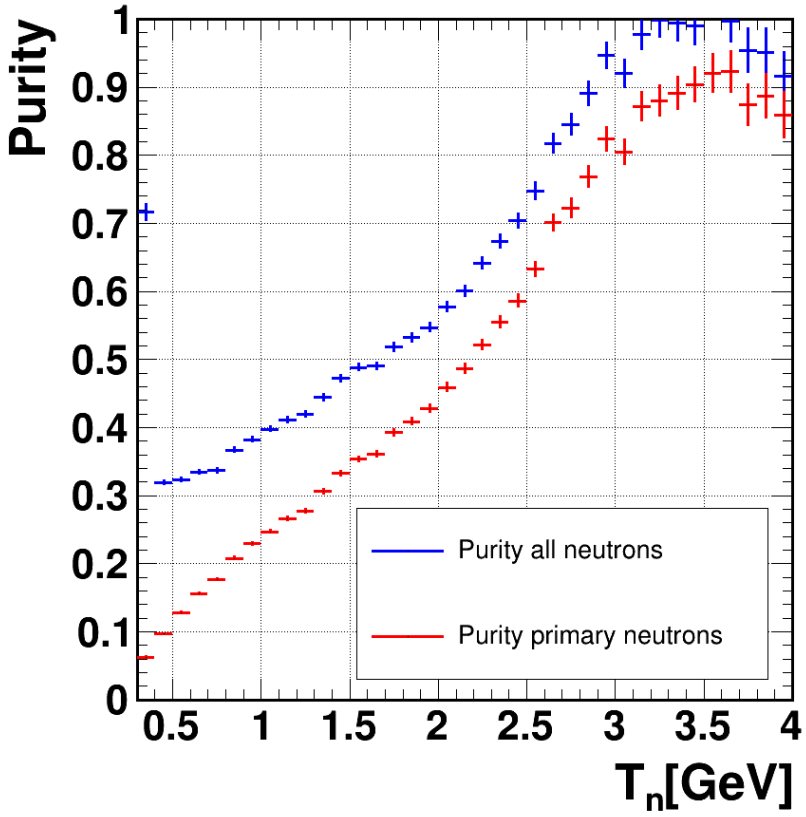
Now we can check if we correctly recognized cluster (produced by neutron or not)

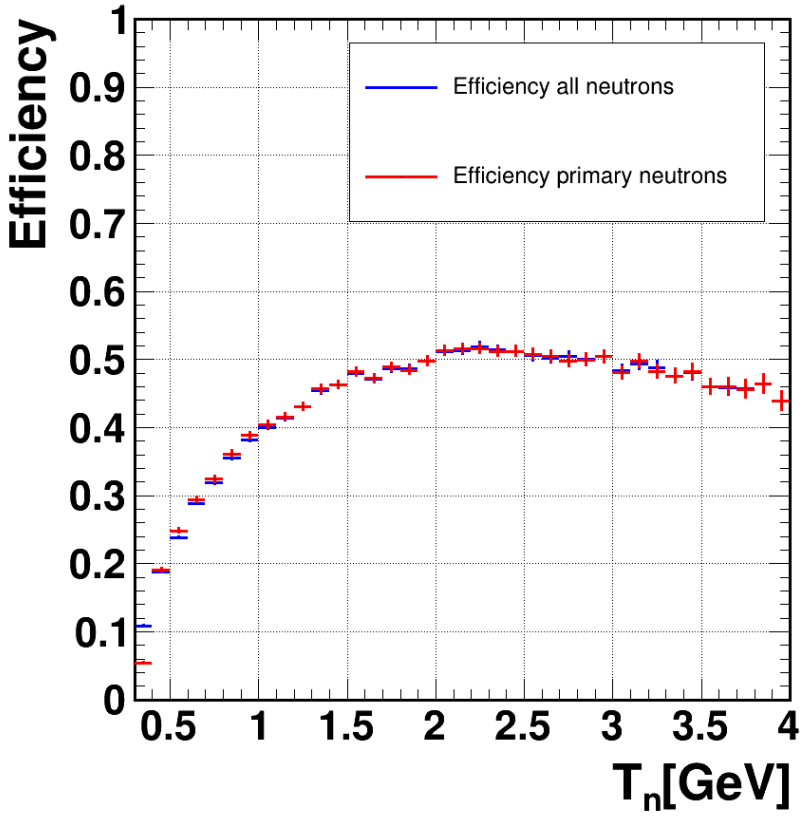
Definition of efficiency and purity

$$eff = \frac{N_{match}}{N_{simulated}} \qquad pur = \frac{N_{match}}{N_{reconstructed}}$$

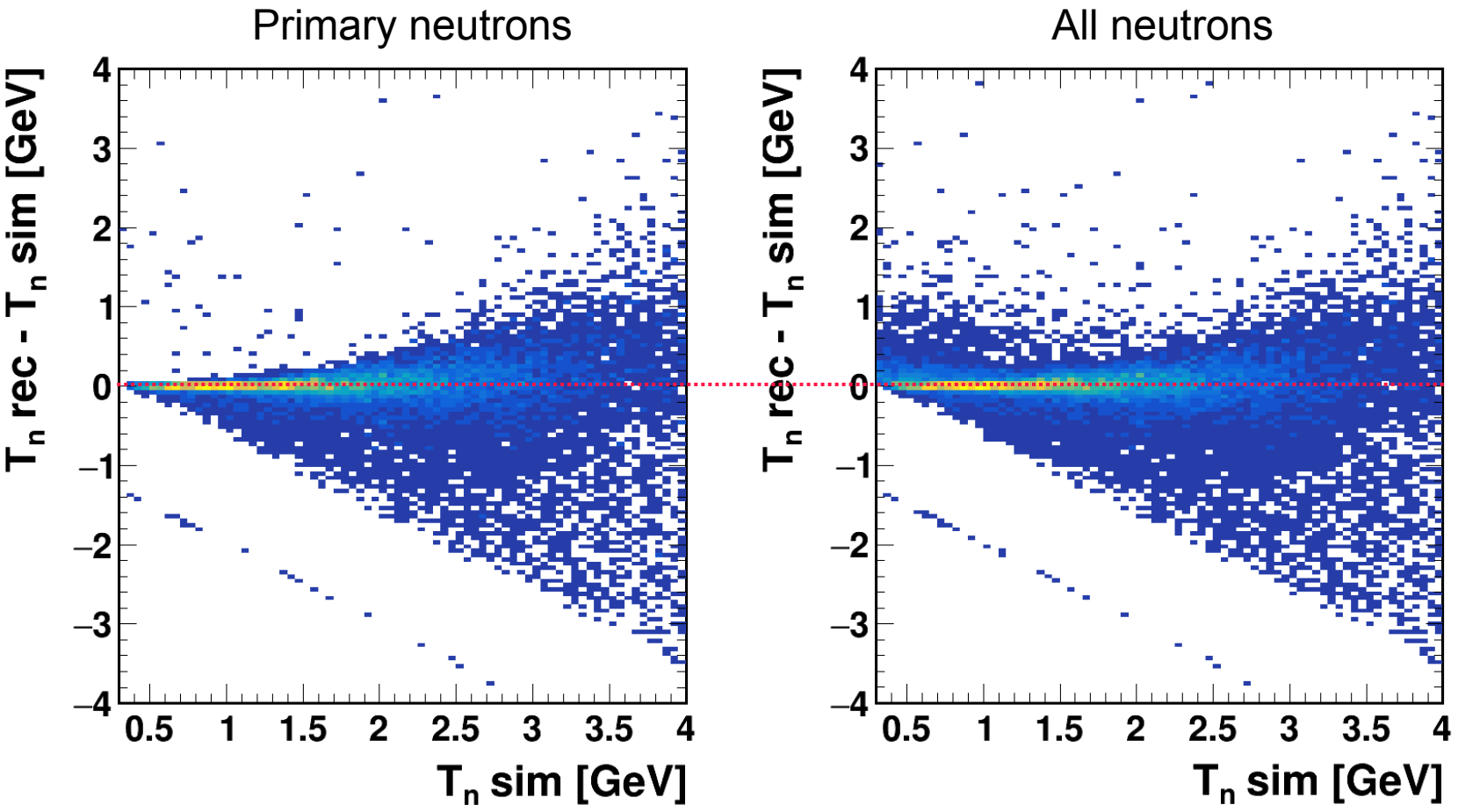
- **N match** – number of clusters which head cell is fired by a particle produced by a neutron
- **N simulated** – number of neutrons crossing HGND volume
- **N reconstructed** – number of clusters recognized as neutrons

Efficiency and Purity





Kinetic energy reconstruction



Conclusions

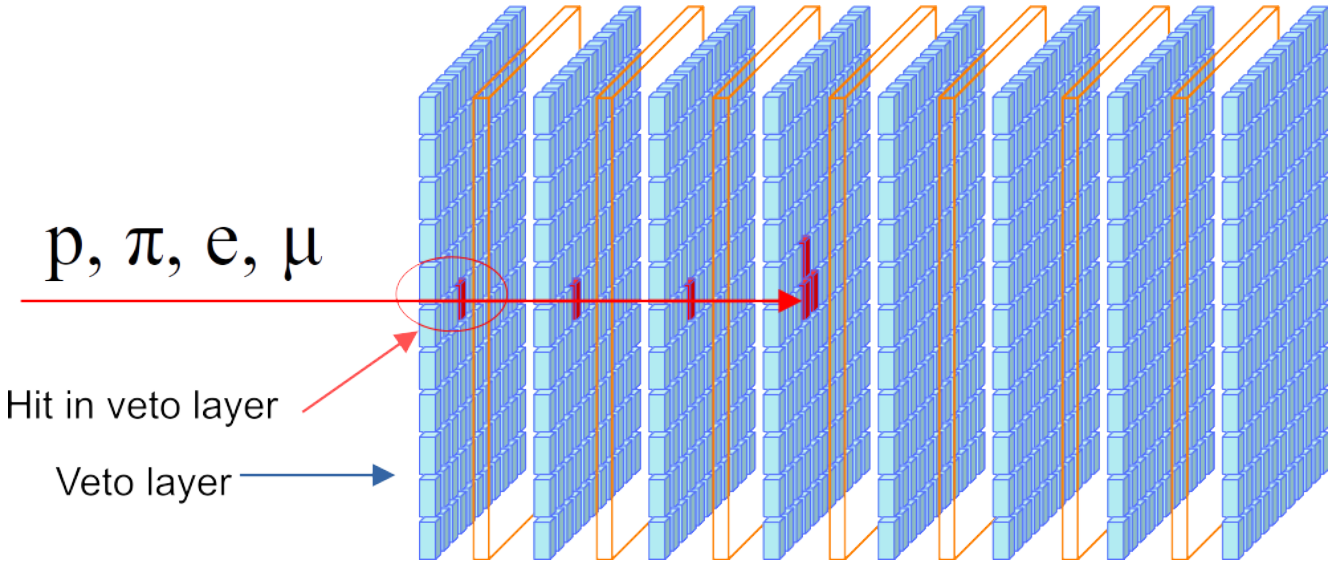
- The method of reconstruction of neutrons in HGND has been developed
  - **Efficiency** is 50 % at high Tn, 10% at low Tn
  - **Purity** is 90% at high Tn, 10% at low Tn
  - Energy of neutrons is reconstructed correctly
- Optimization of the algorithm of reconstruction needs to be done

Backup slides

Rejection of charged particles

Charged particles fire 1st layer

If cluster contains any cells of **1st layer**, the cluster is **rejected**



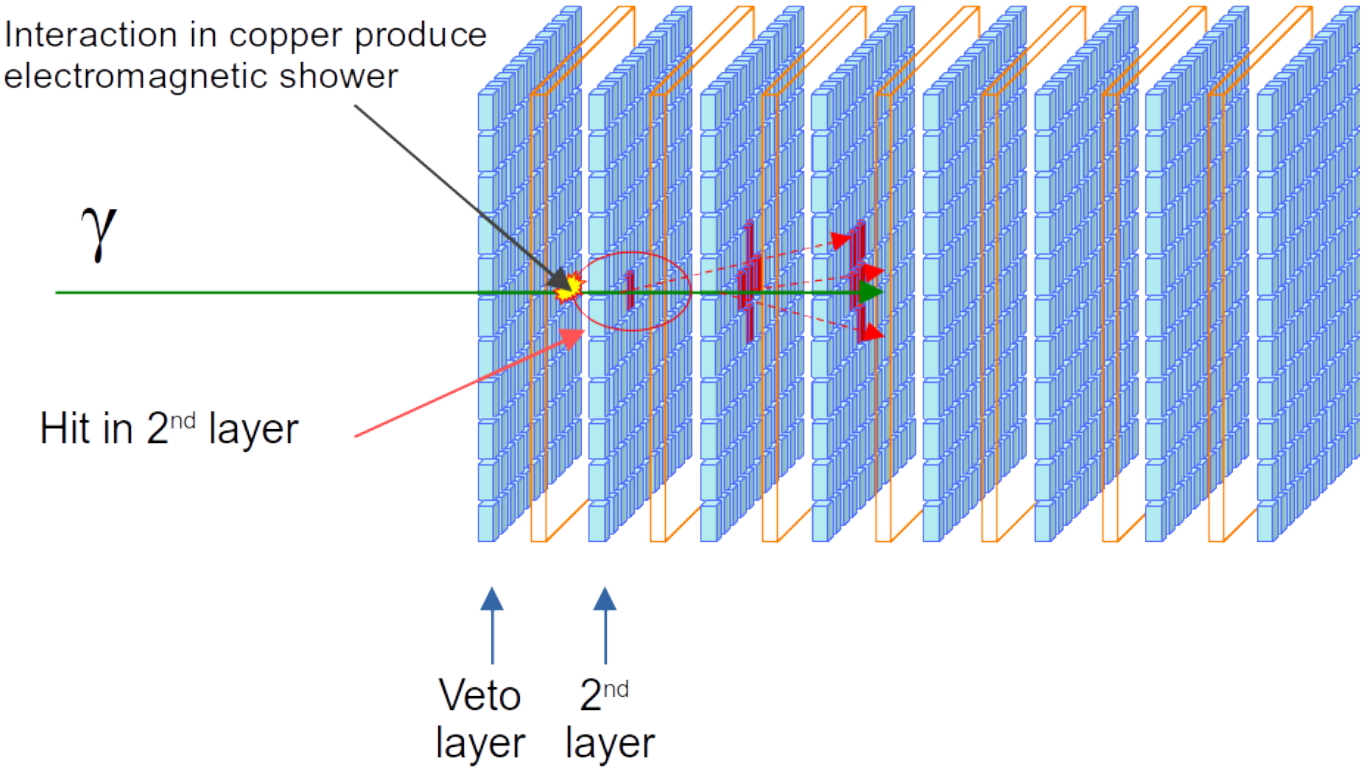
Rejection of γ - quanta

γ-quanta

don’t fire 1st layer,

do fire 2nd layer

If cluster contains any cells of **2nd layer**, the cluster is **rejected**

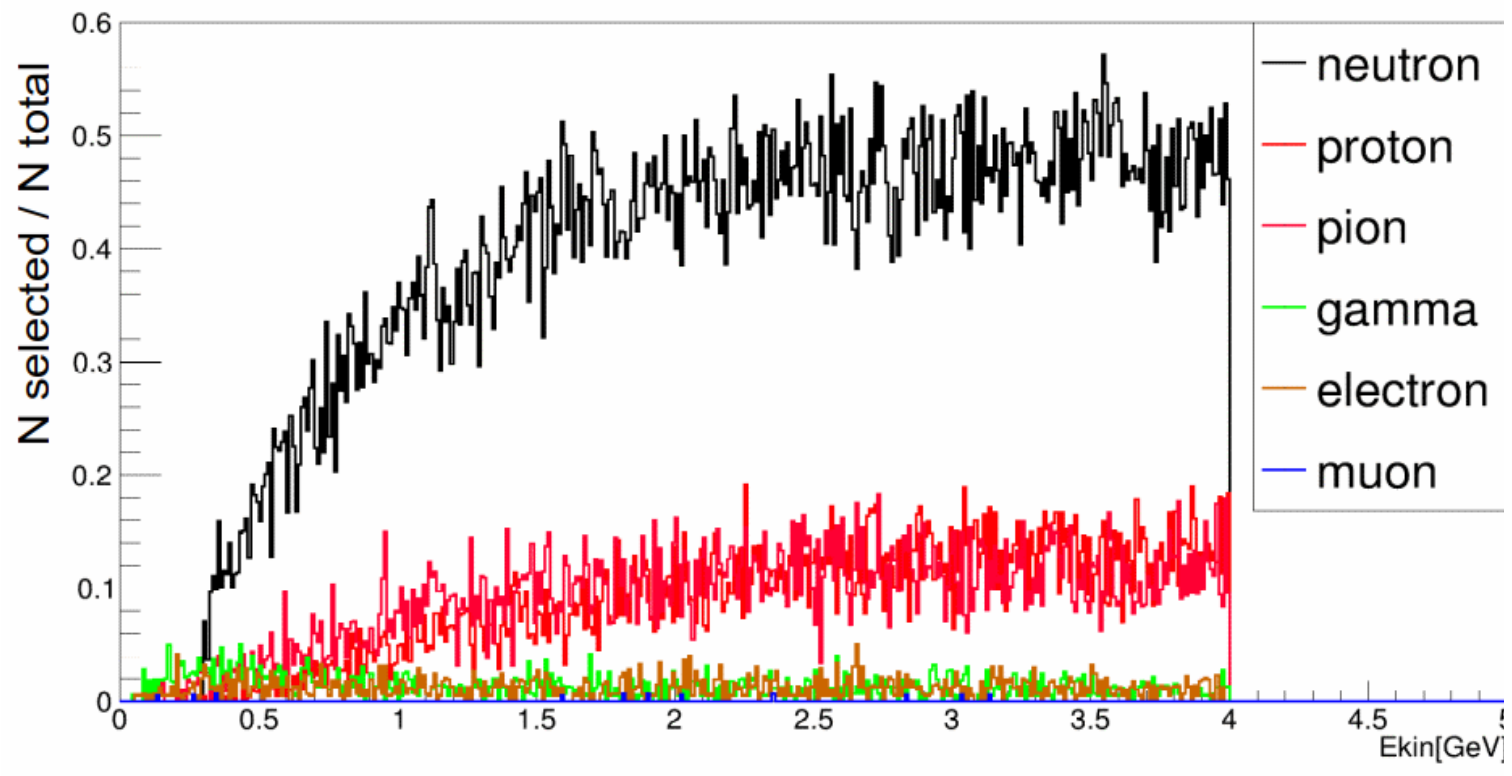


Veto on 1st, 2nd layers, cut β<1

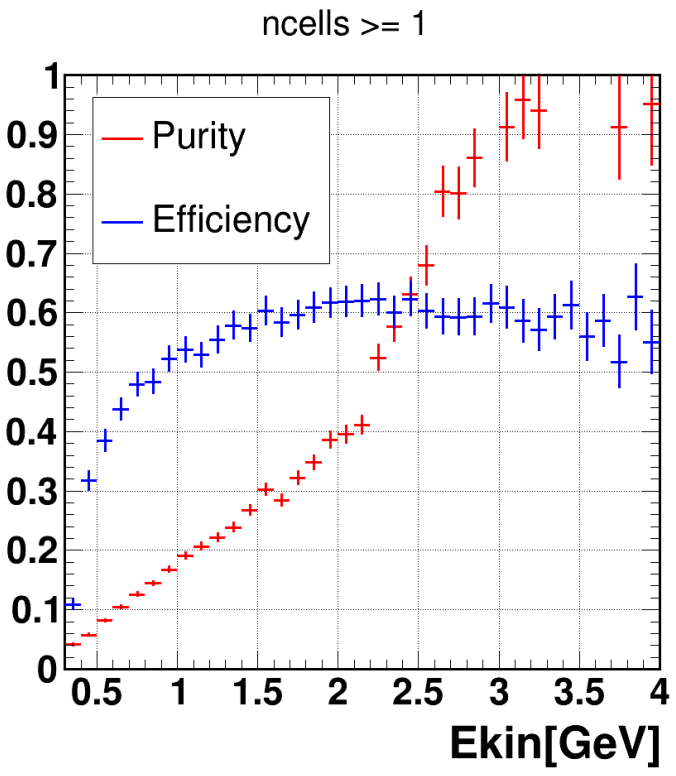
All clusters containing cells of 1 or 2 layer or β=1 are rejected

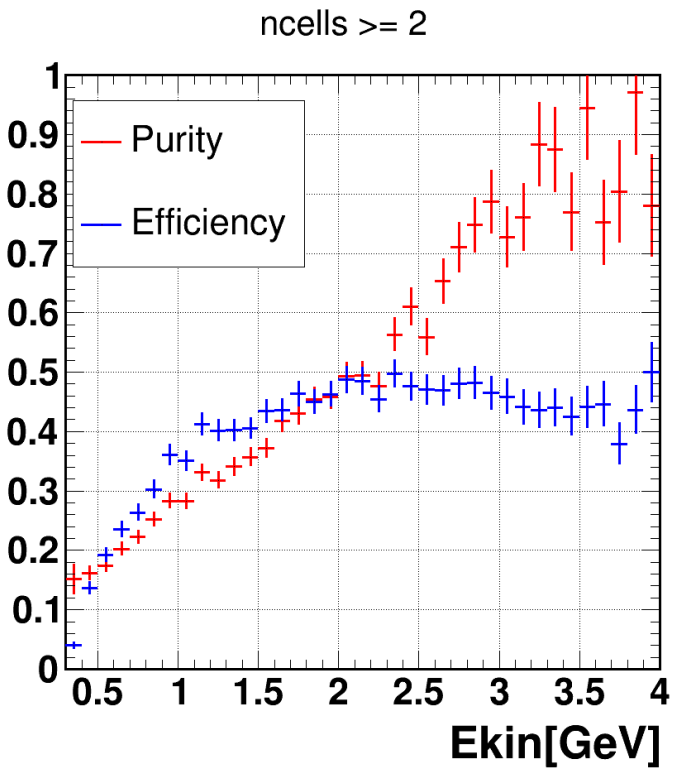
If at least 1 cluster evade rejection, the histogram is filled

γ-quanta, electrons are suppressed



Cut on number of cells





Number of reconstructed neutrons

Spectrum 1n