MPAS ECAL Clustering Status

CALICE-UK MAPS ECAL Meeting

at Rutherford Appleton Laboratory

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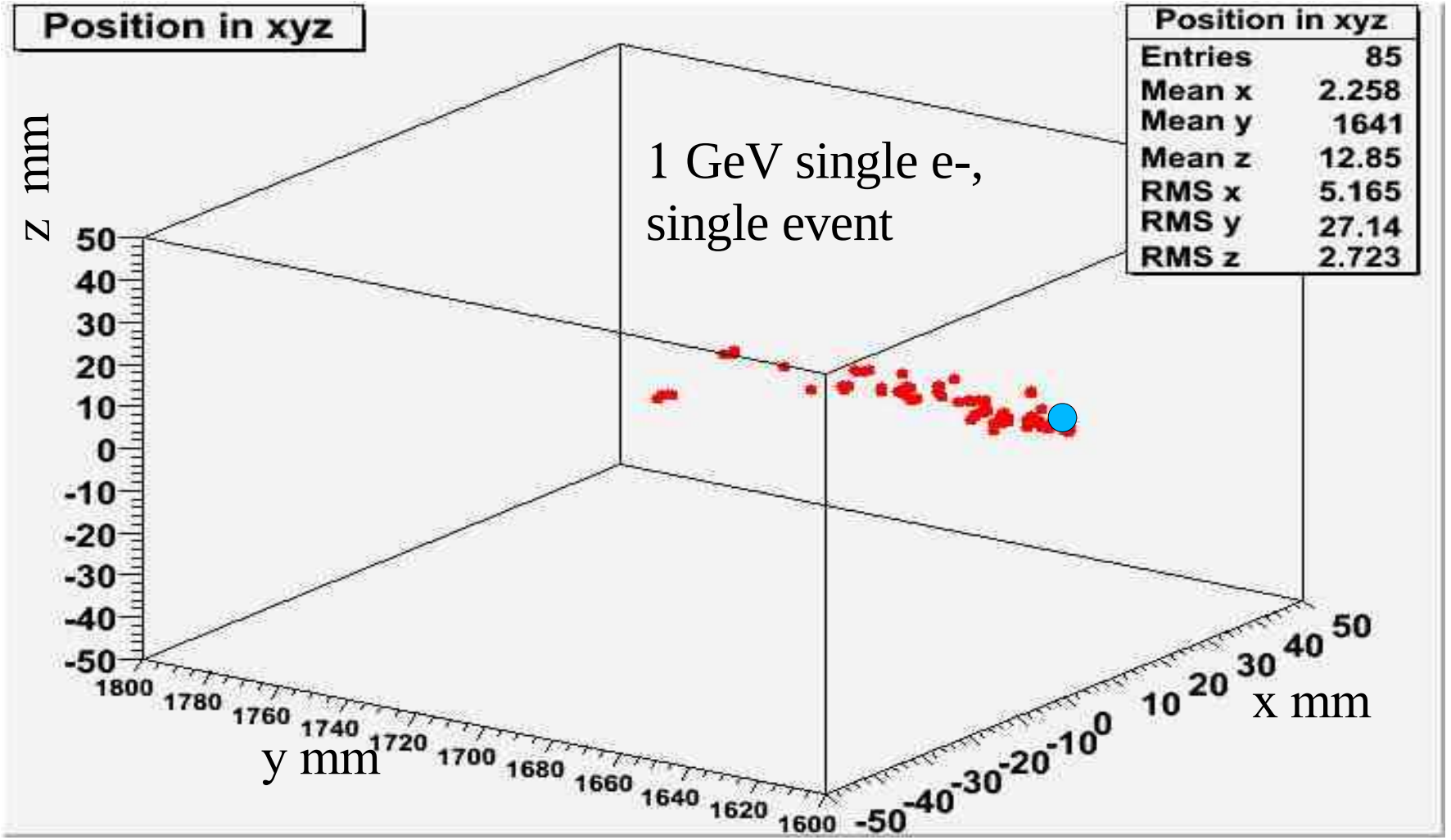
Baseline of MAPS ECAL primary electron clustering algorithm [method (1)]

Red variables need be optimized.

1. Finding initial group of hits within particular one of inner XX layers.
   - Requiring more than other XX hits are within circle of XX mm radius.
2. Searching hits in outer layers which has located within XX cm hemisphere from initial hit.
   - Deciding direction of cluster: From the center of gravity in the initial grouping within inner layer to the center of gravity in the hemisphere.
3. Adding all hits in 30 layers within cylinder of Moliere radius order.

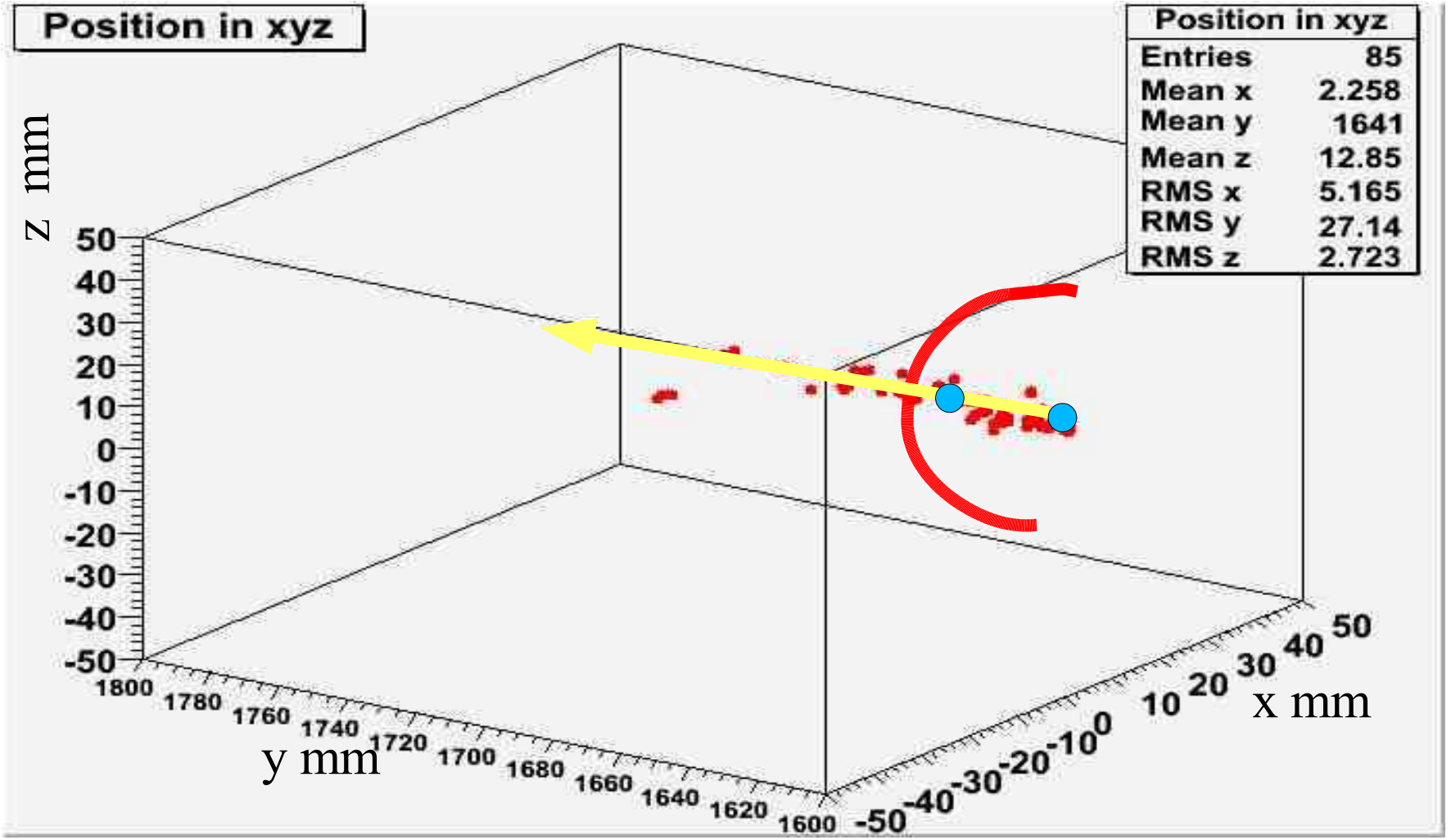
Clustering algorithm (1.1)

1. Finding initial group of hits within particular one of inner XX layers.
   - ➔ Requiring more than other XX hits are within circle of XX mm radius.



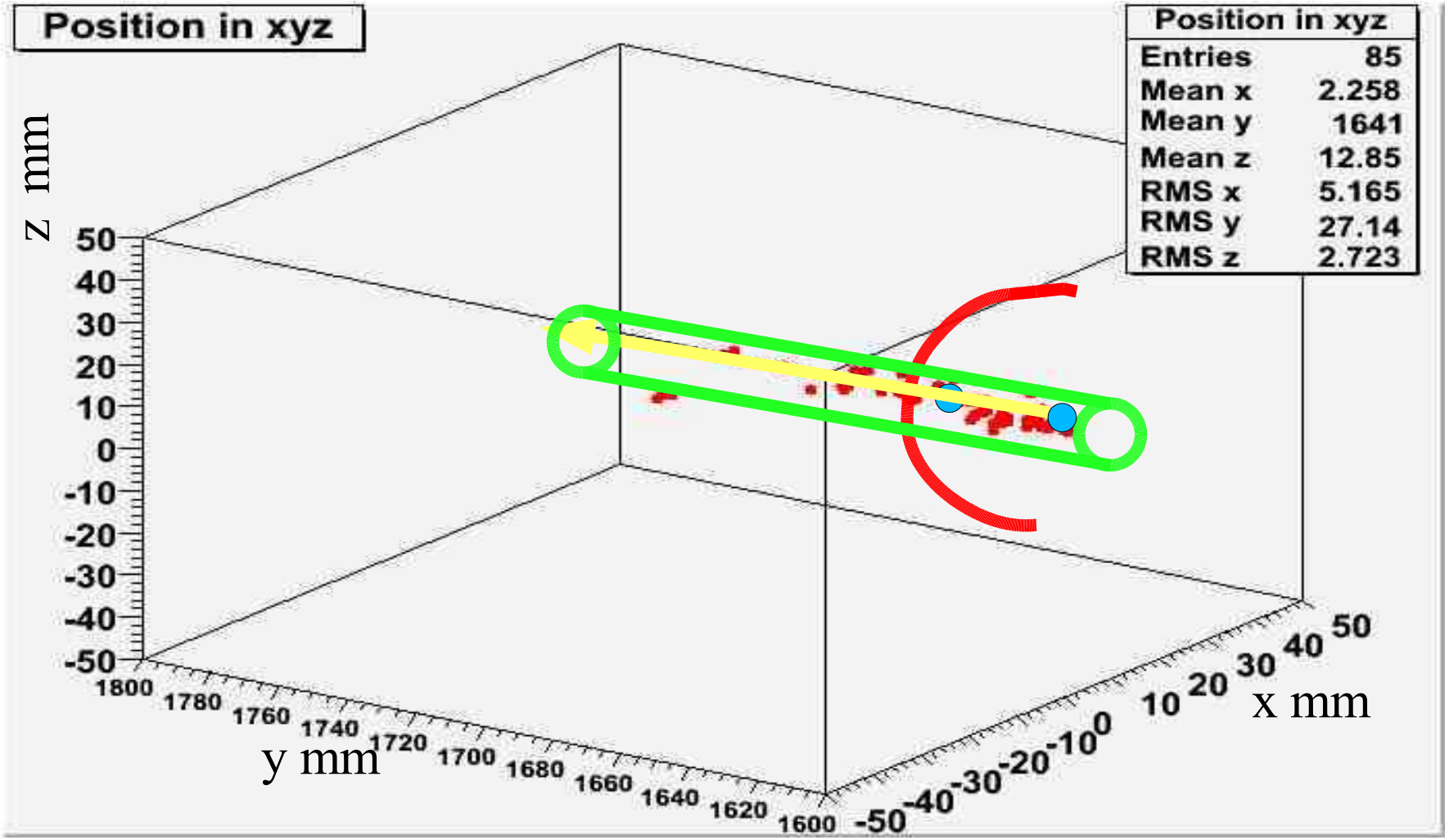
Clustering algorithm (1.2)

2. Searching hits in outer layers which has located within XX cm hemisphere from initial hit
   - ➔ Deciding direction of cluster: From the center of gravity in the initial grouping within inner layer to the center of gravity in the hemisphere.



Clustering algorithm (1.3)

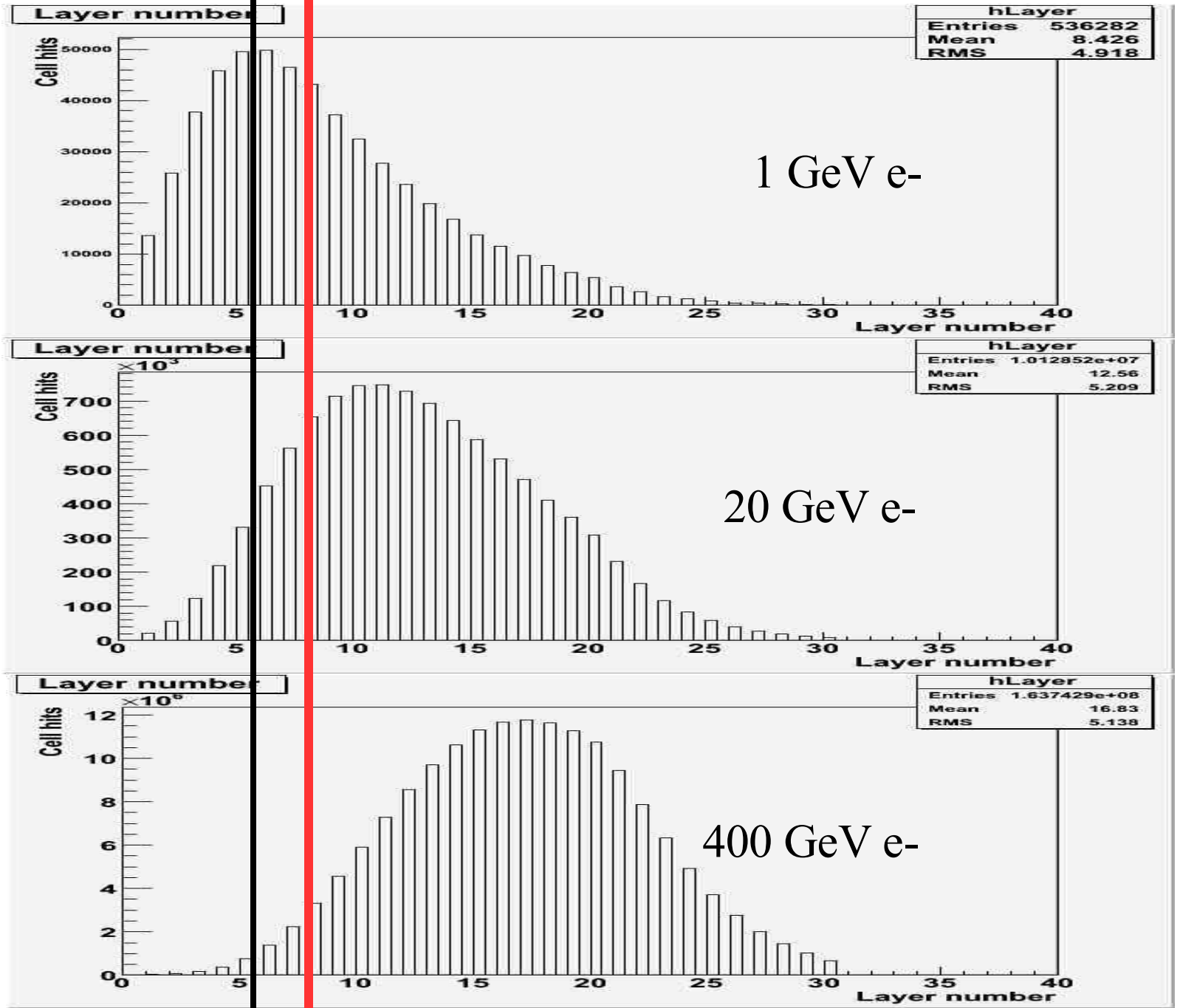
3. Adding all hits in 30 layers within cylinder of Moliere radius order.



Longitudinal shower shapes

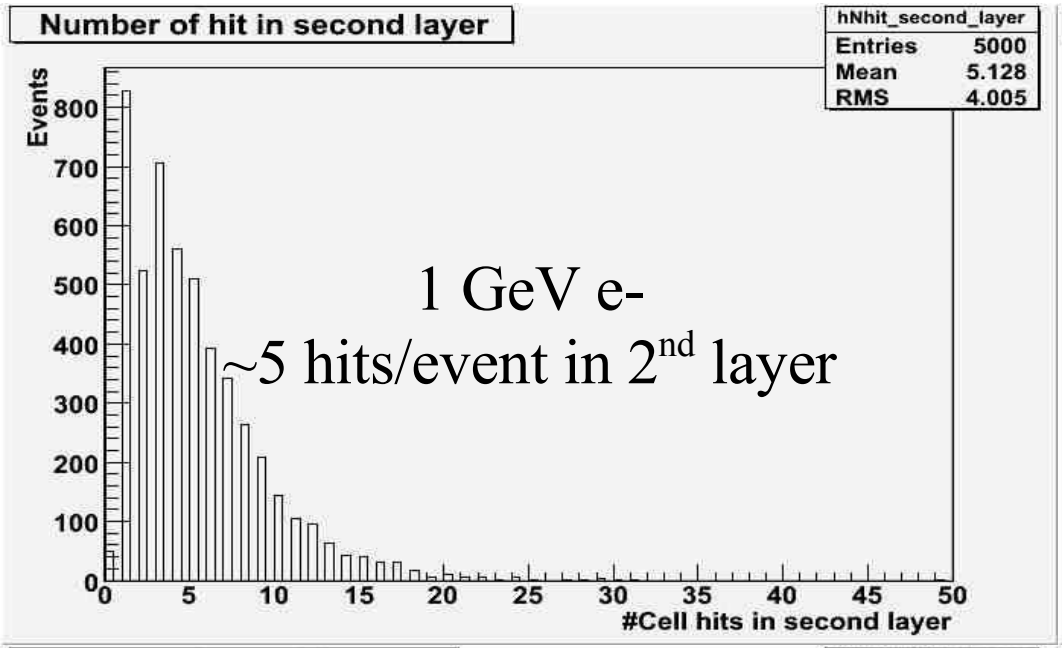
Inner 7 layers

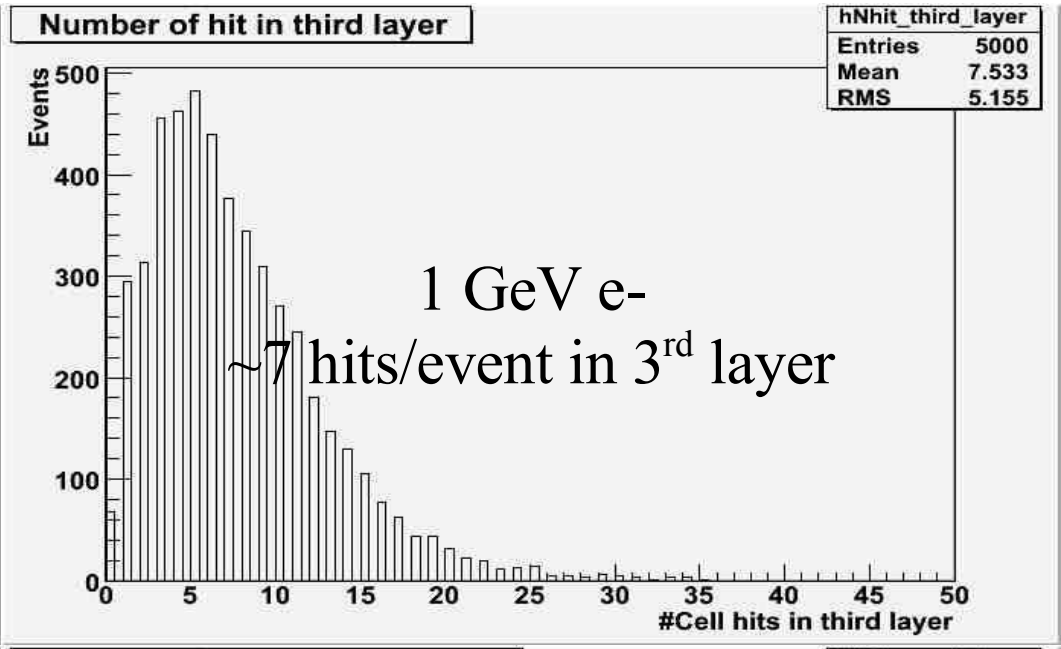
Inner 5 layers

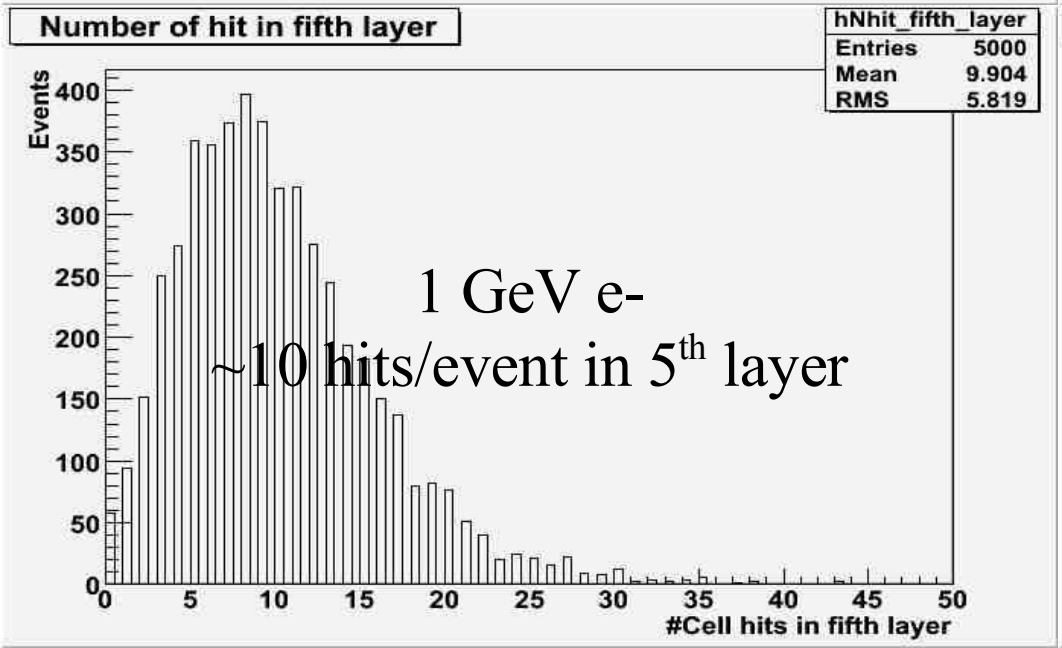


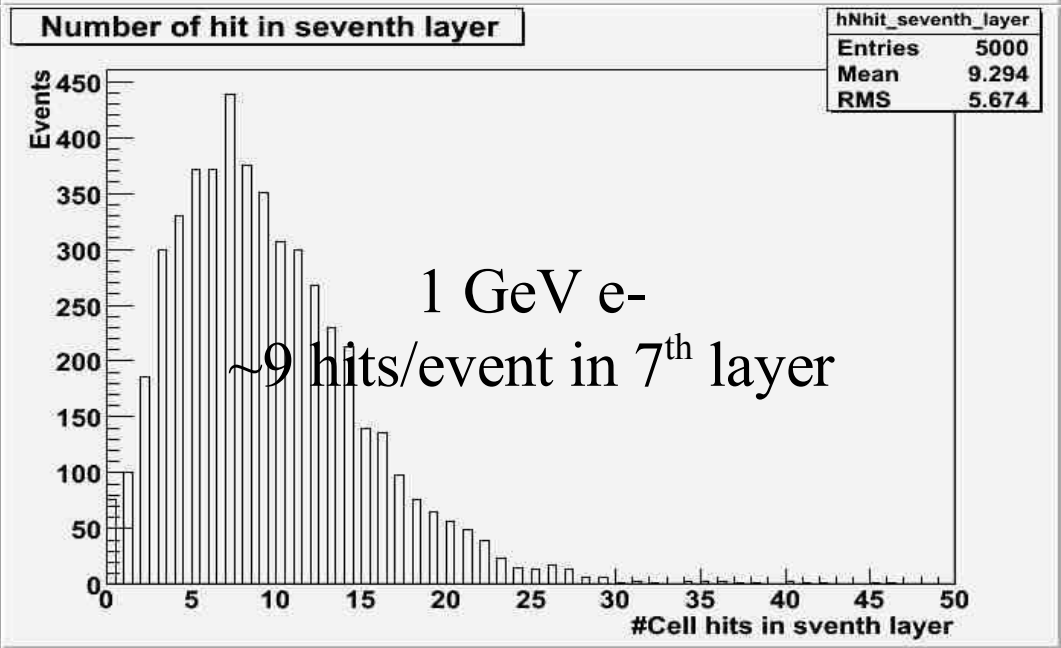
Feasibility study (#Cell hits distribution in particular layers)

#Cell hits distribution in each 2nd/3rd/5th/7th layer individually, for 1 GeV e-
(B fields is off -> Radiated photon has hits in the same place)



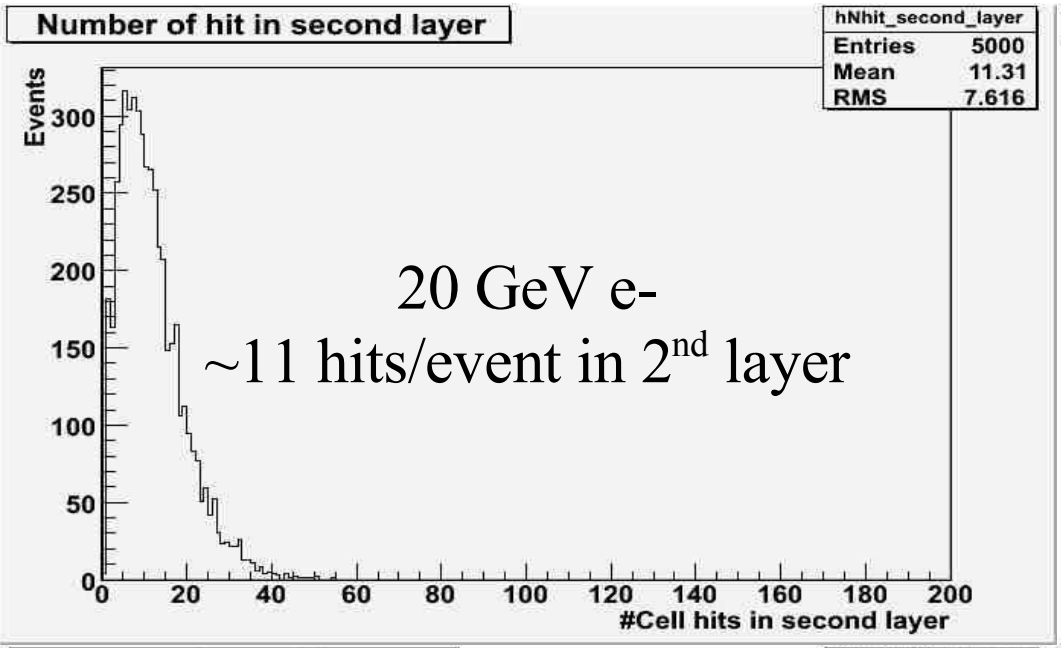


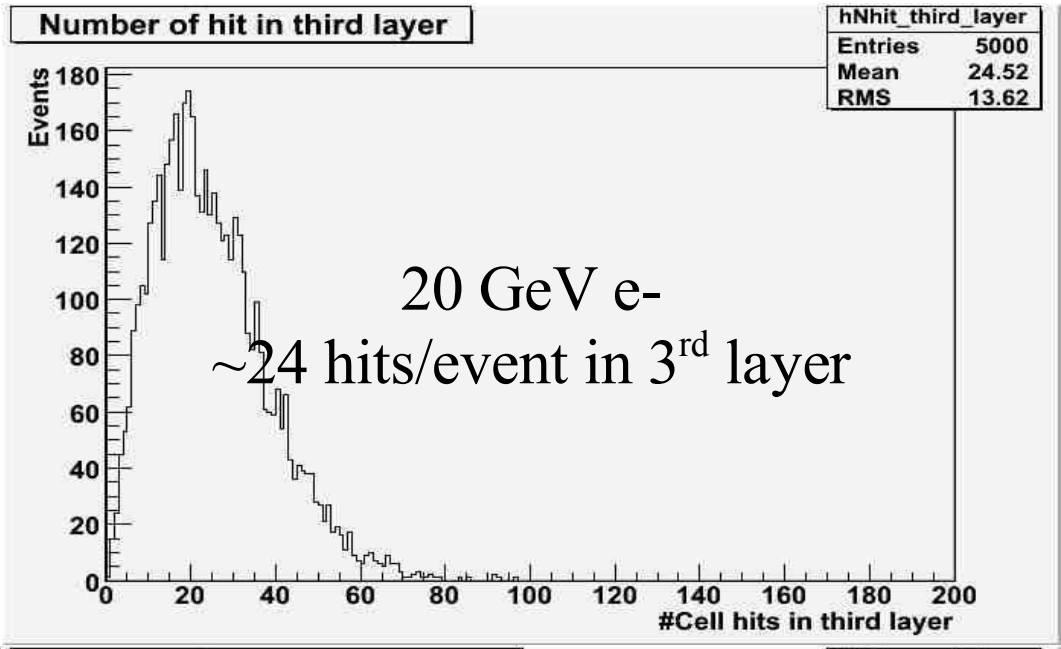


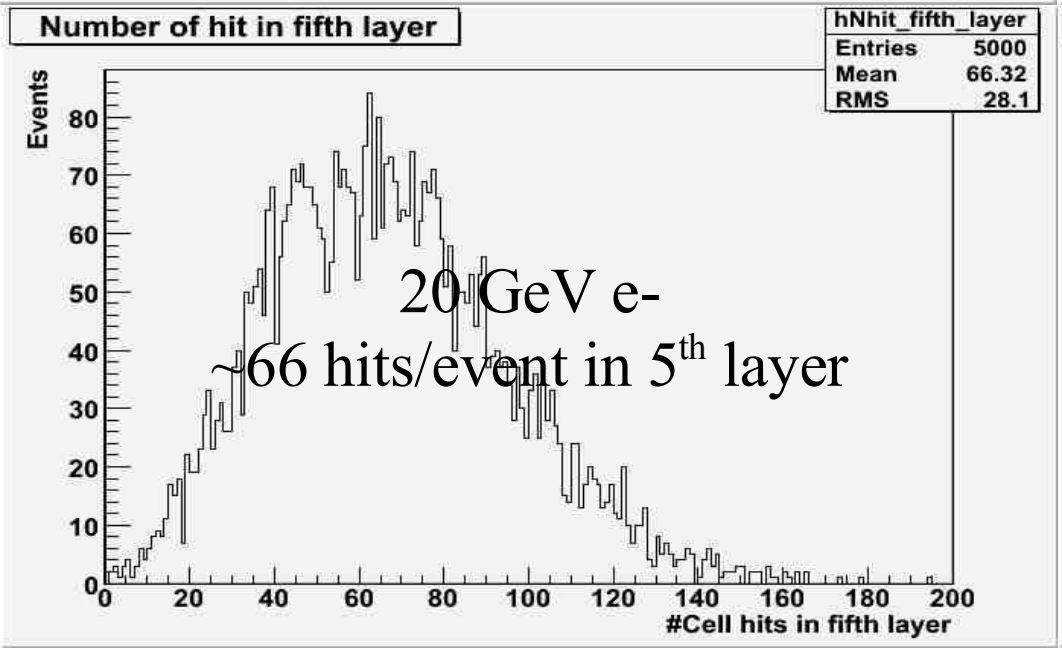


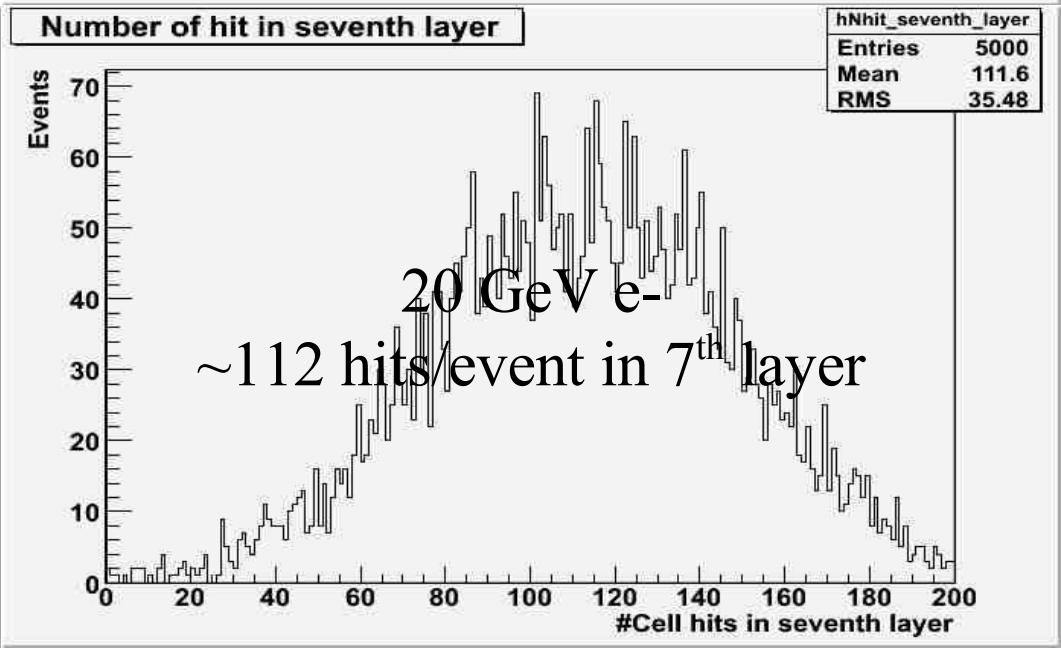
Feasibility study (#Cell hits distribution in particular layers)

#Cell hits distribution in each 2nd/3rd/5th/7th layer individually, for 20 GeV e-









Efficiency of initial grouping finding with radius dependence and #hits dependence

Efficiency = #Event which have hits grouping within one of **inner three layers** / #Events of all generated single e-

(Grouping was done within the same layer. No threshold, no noise are applied.)

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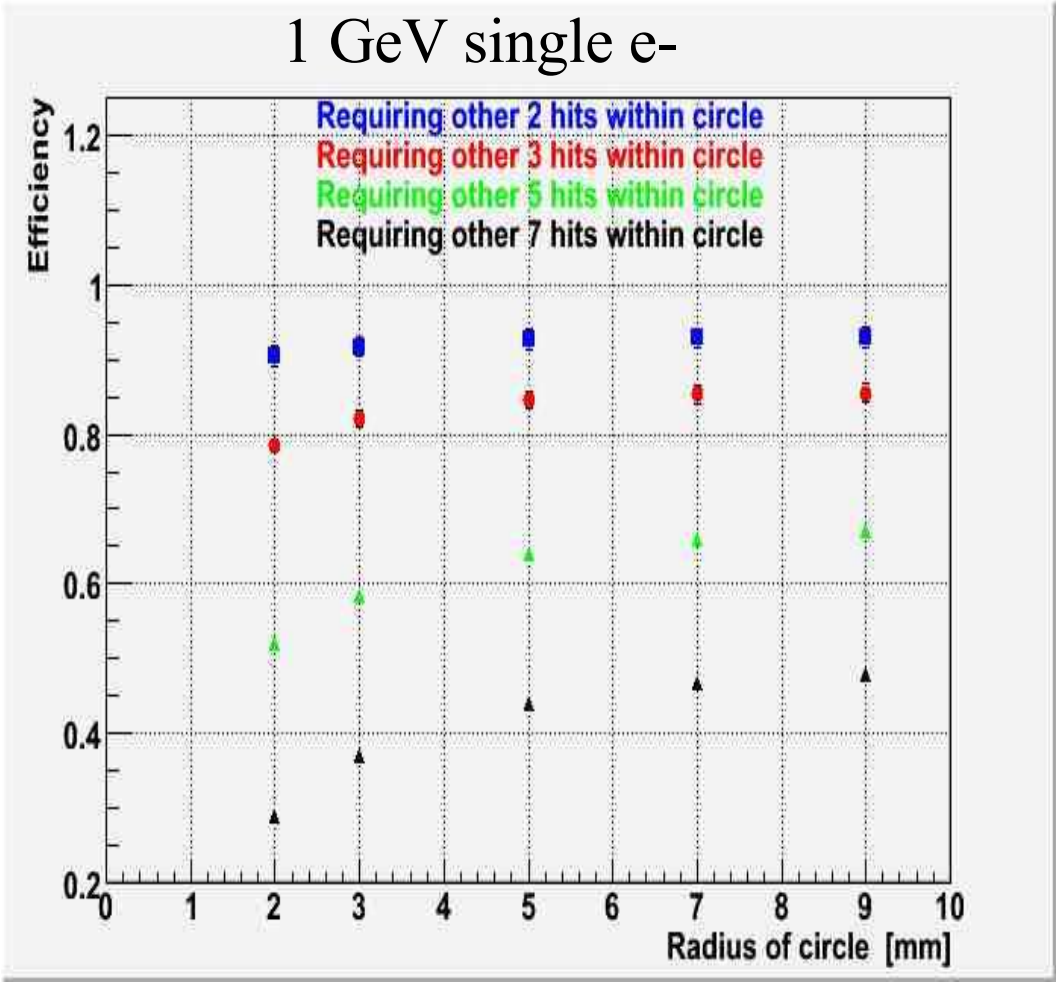
1 GeV single e-



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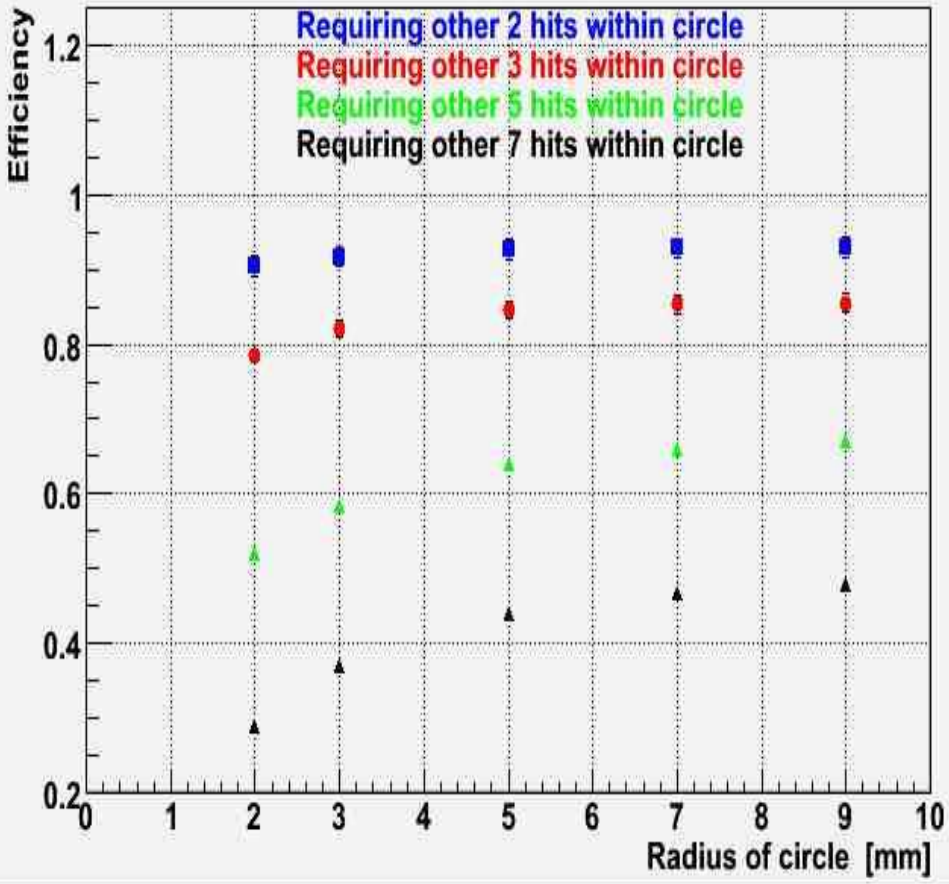
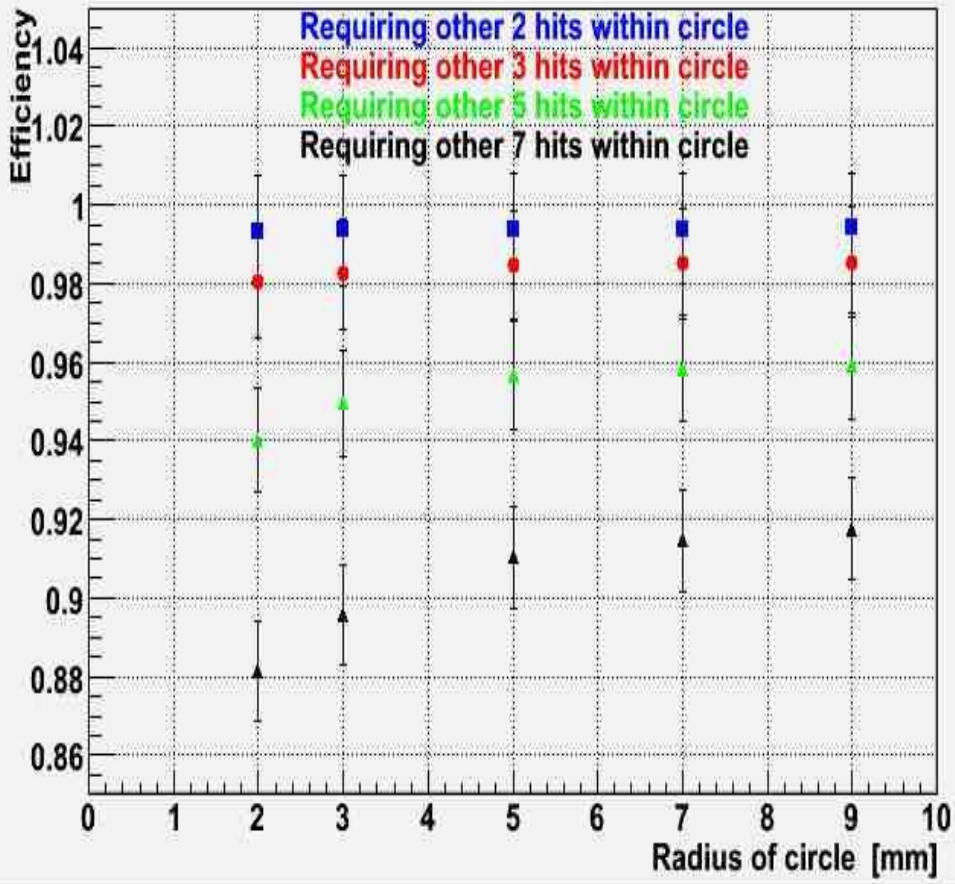


20 GeV single e-

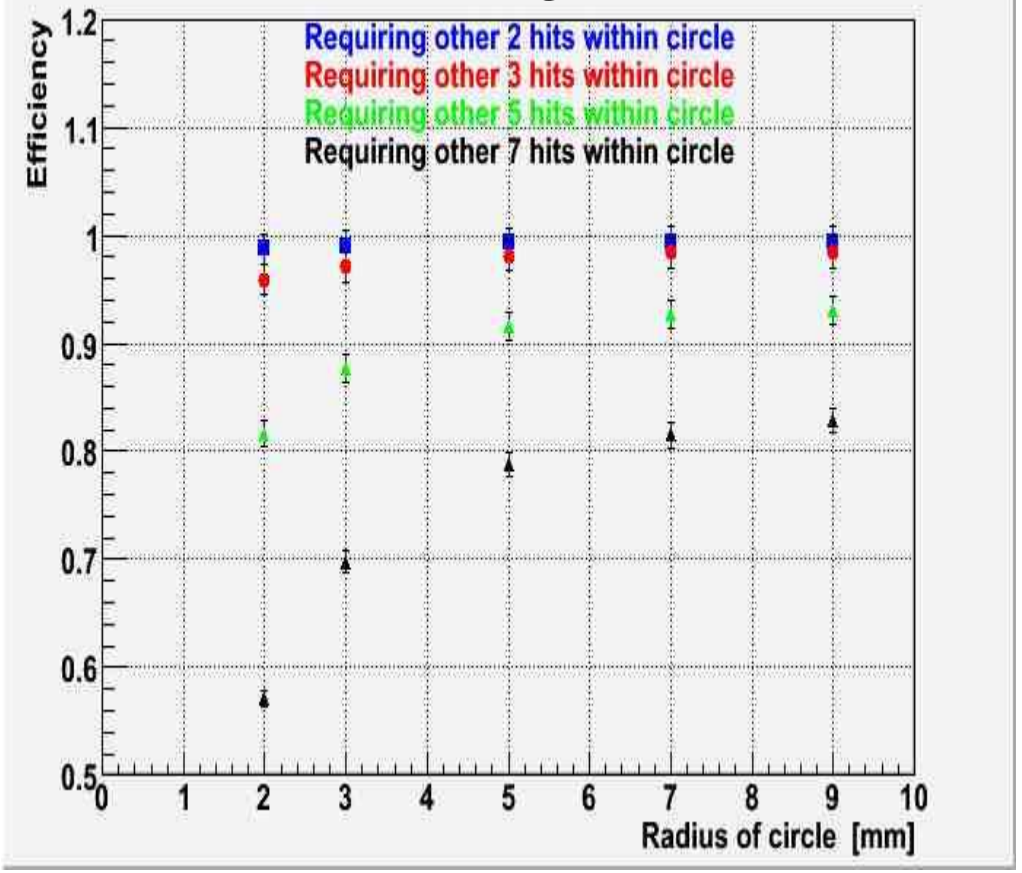


Efficiency of initial grouping finding with radius dependence and #hits dependence

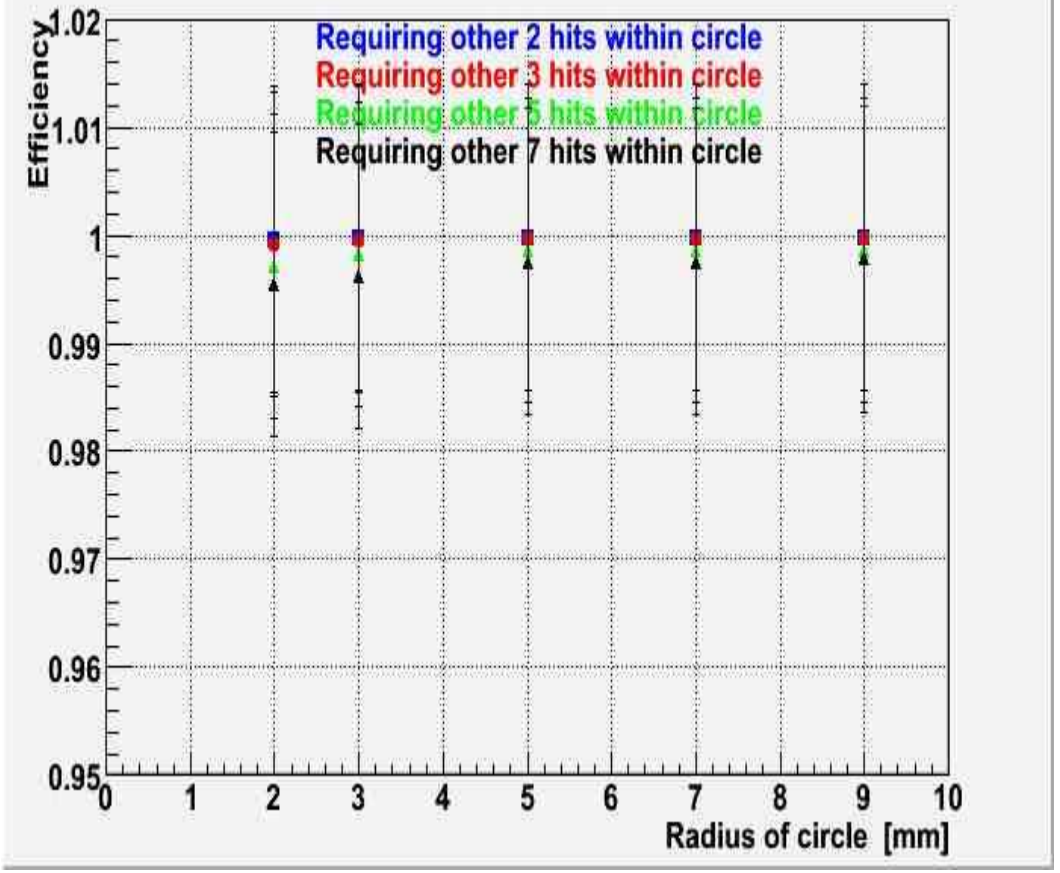
Efficiency = #Event which have hits grouping within one of **inner five layers** / #Events of all generated single e-

(Grouping was done within the same layer. No threshold, no noise are applied.)

1 GeV single e-



20 GeV single e-

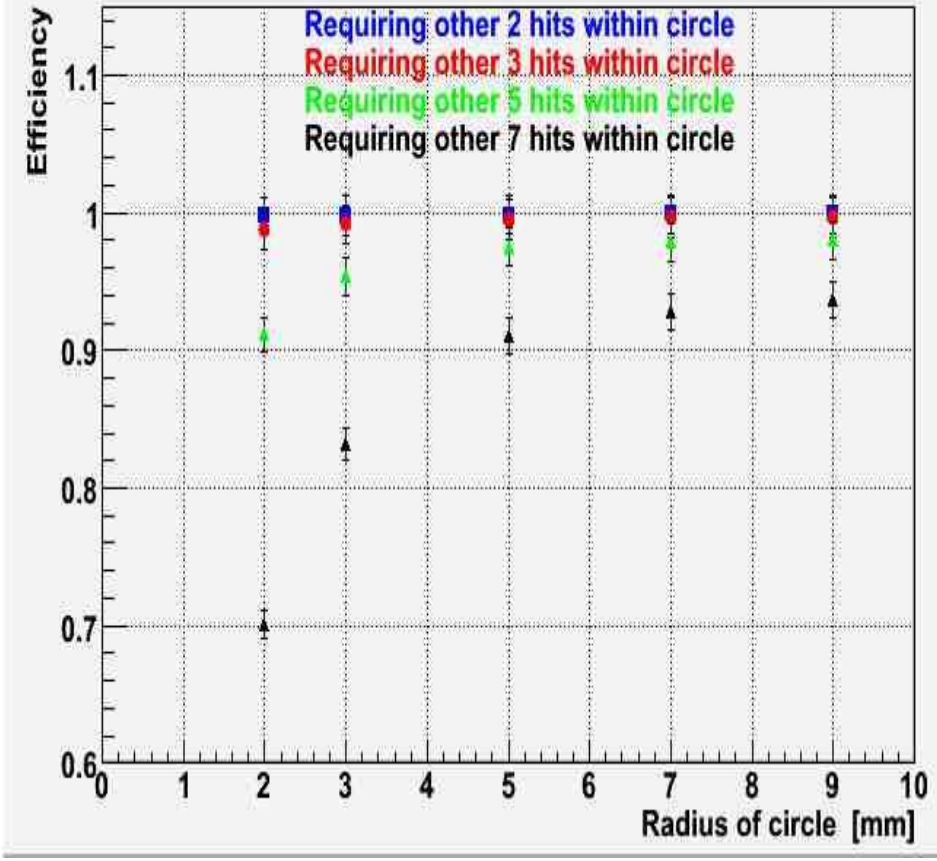


Efficiency of initial grouping finding with radius dependence and #hits dependence

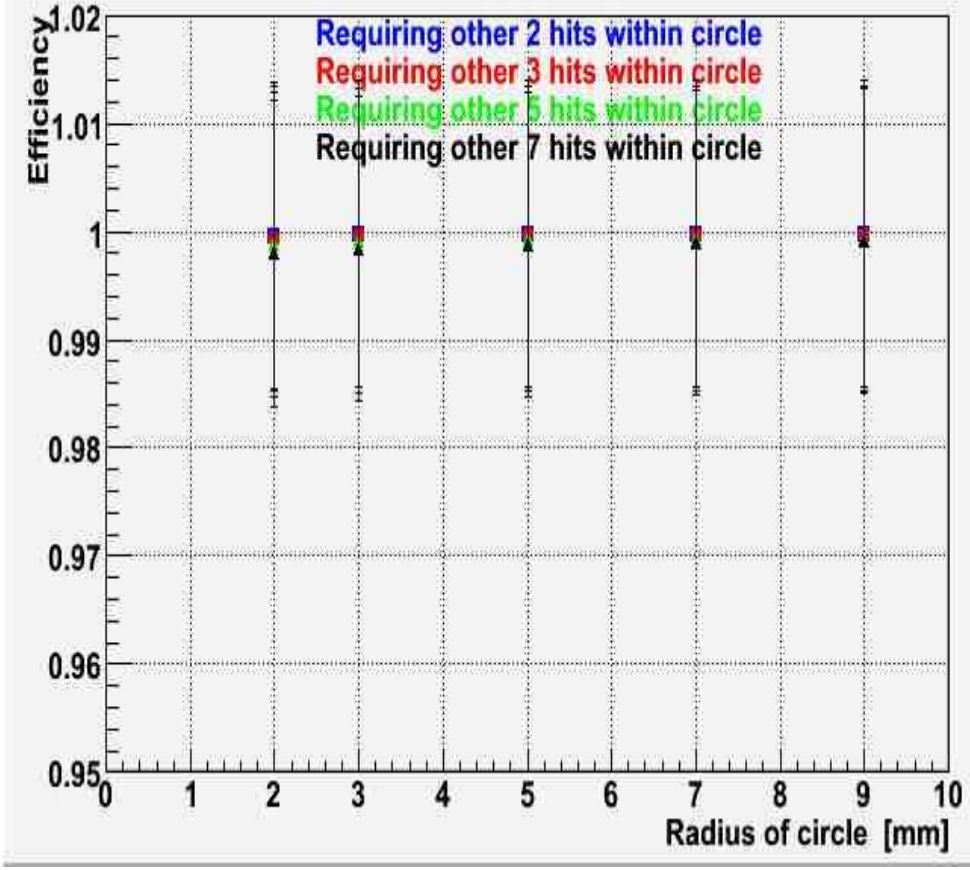
Efficiency = #Event which have hits grouping within one of **inner seven layers** / #Events of all generated single e-

(Grouping was done within the same layer. No threshold and no noise are applied.)

1 GeV single e-

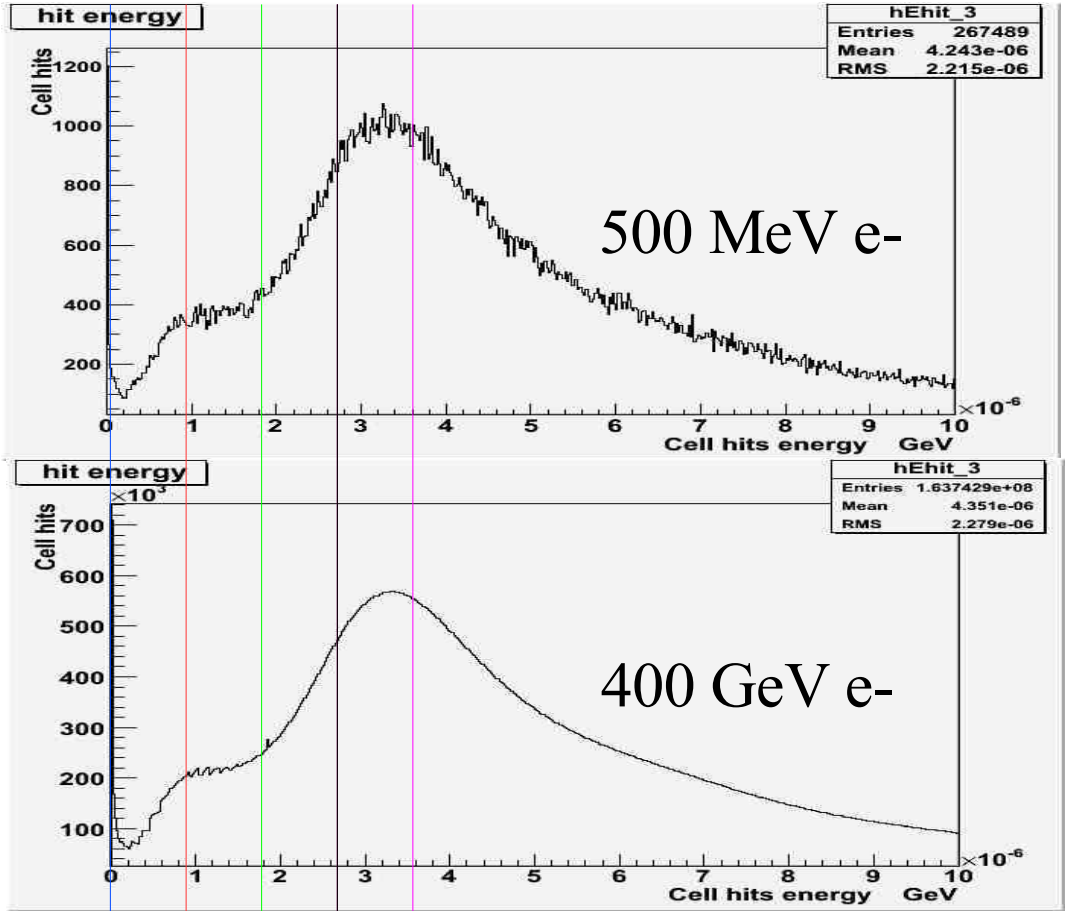


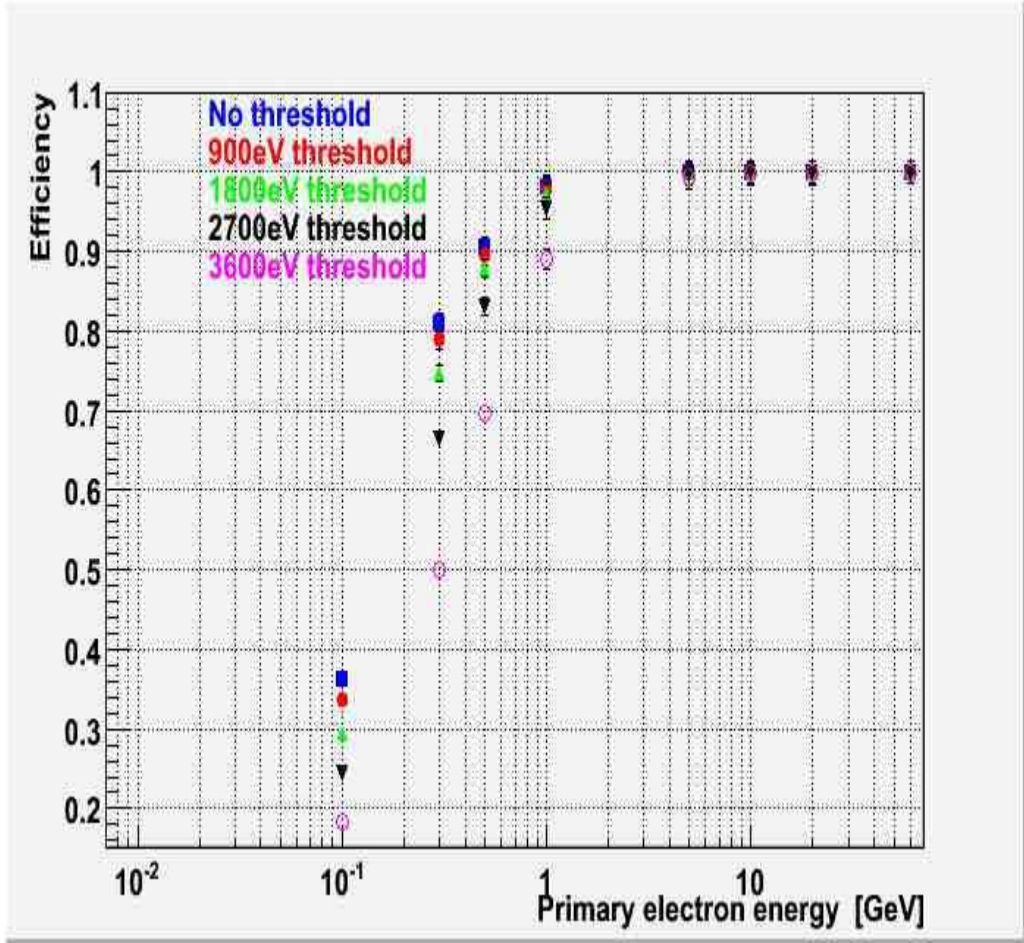
20 GeV single e-



Efficiency of initial grouping finding with primary electron's energy dependence & with cell hits energy threshold dependence

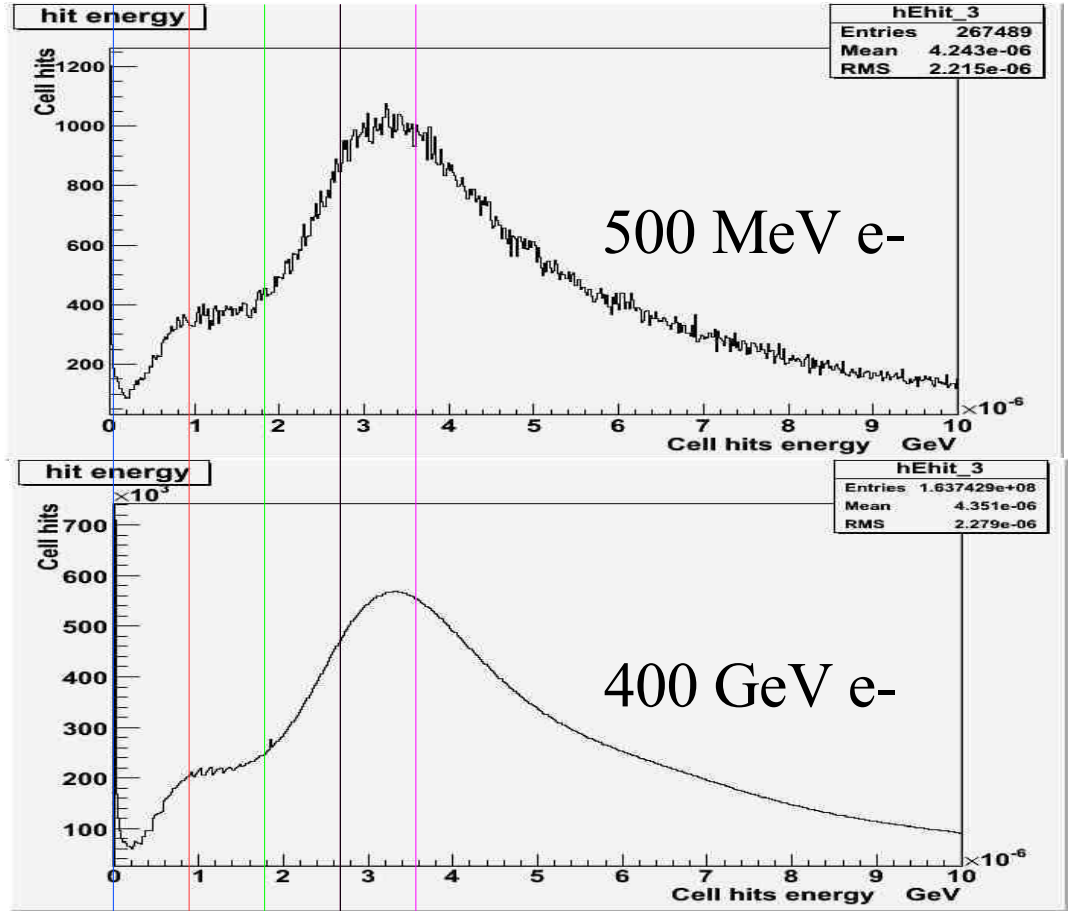
1. Finding initial grouping of hits within one of inner 5 layers.
   - ➔ Requiring that more than other 3 hits are within circle of 5.0 mm radius.
   - ➔ Applying threshold for all 4 hits

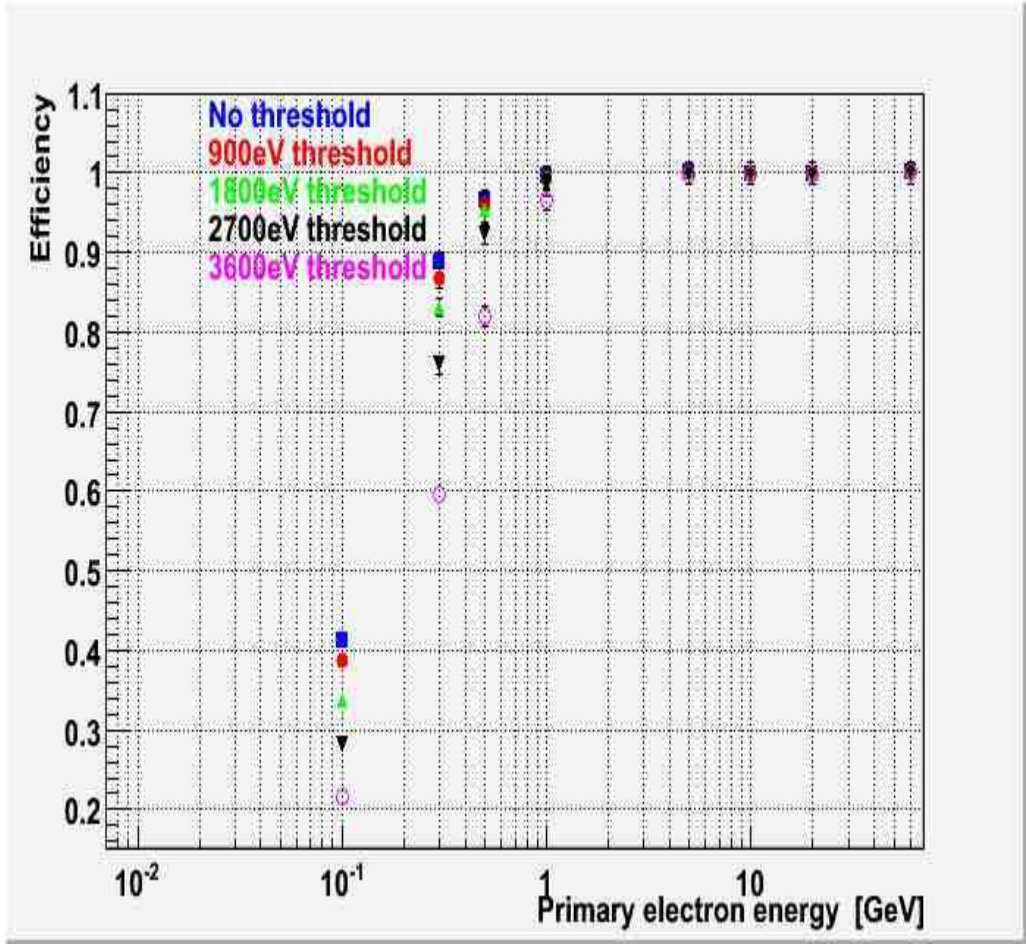




Efficiency of initial grouping finding with primary electron's energy dependence & with cell hits energy threshold dependence

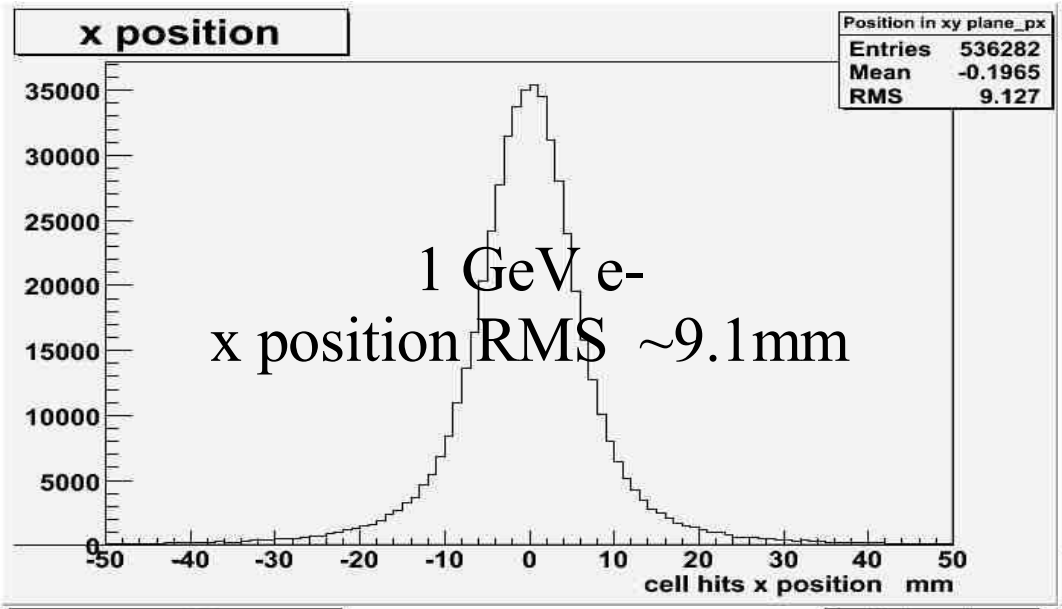
1. Finding initial grouping of hits within one of inner 7 layers.
   - ➔ Requiring that more than other 3 hits are within circle of 5.0 mm radius.
   - ➔ Applying threshold for all 4 hits

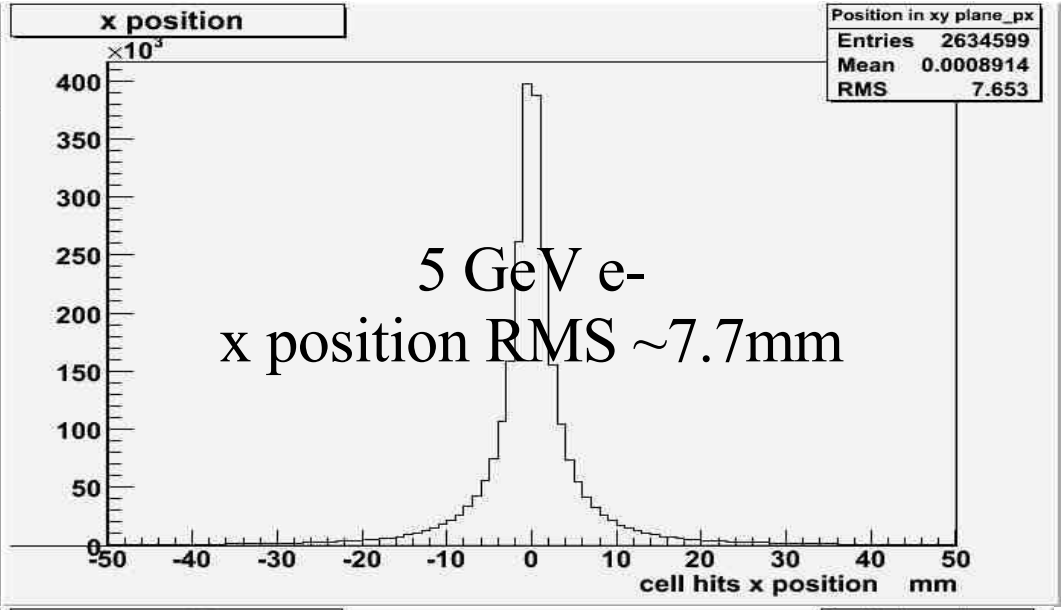


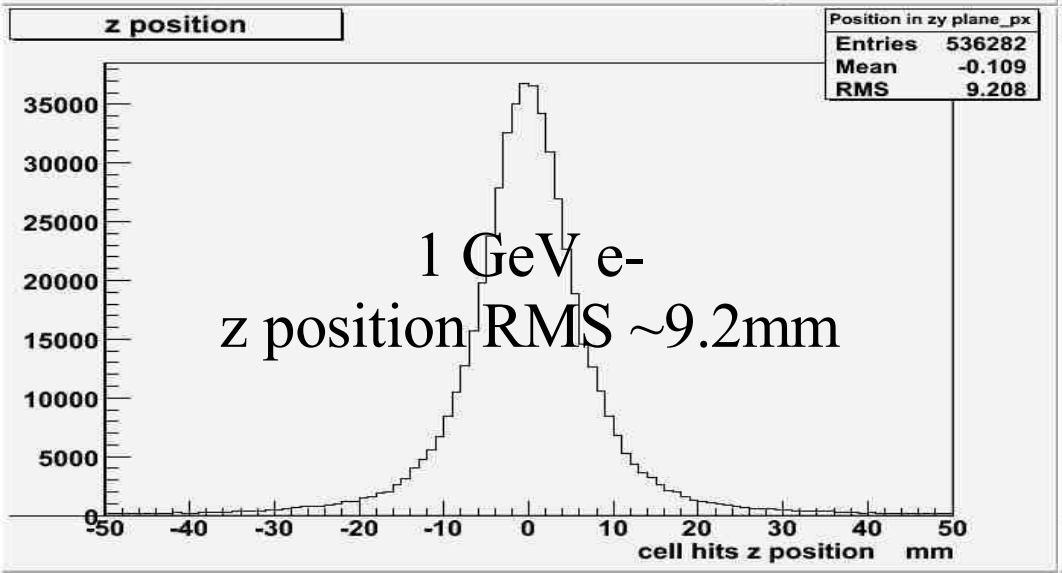


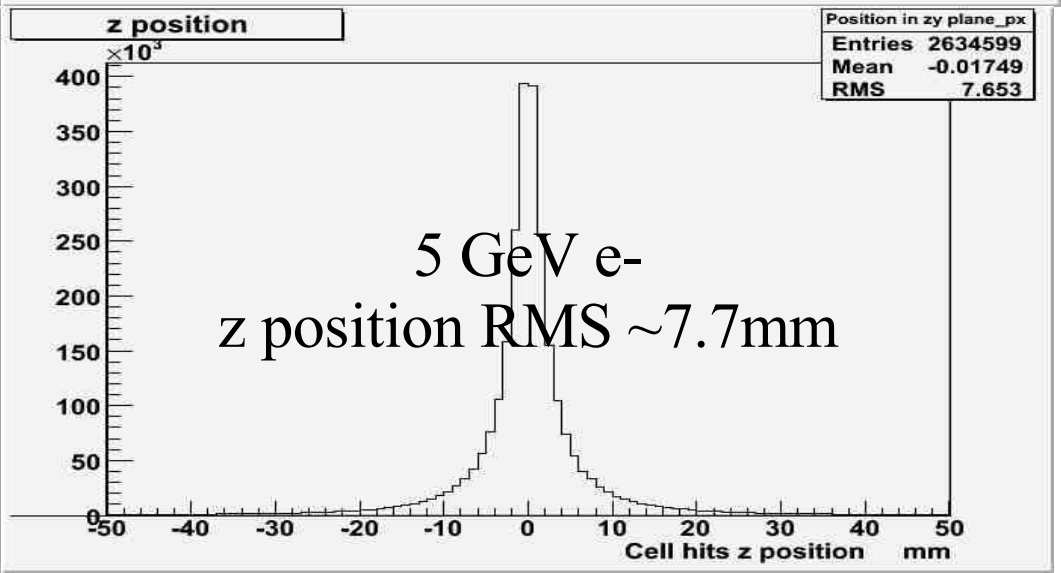
Position resolution

- B fields is off
- Without clustering
- All cell hits without any criteria
- 5000 events sum









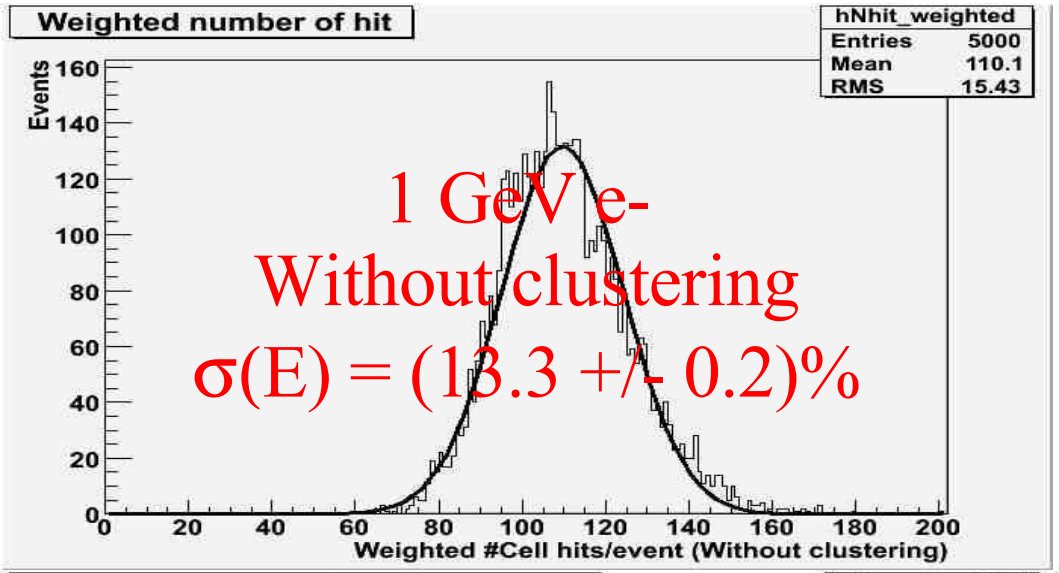
Temporary clustering algorithm Criteria
[method (1)]

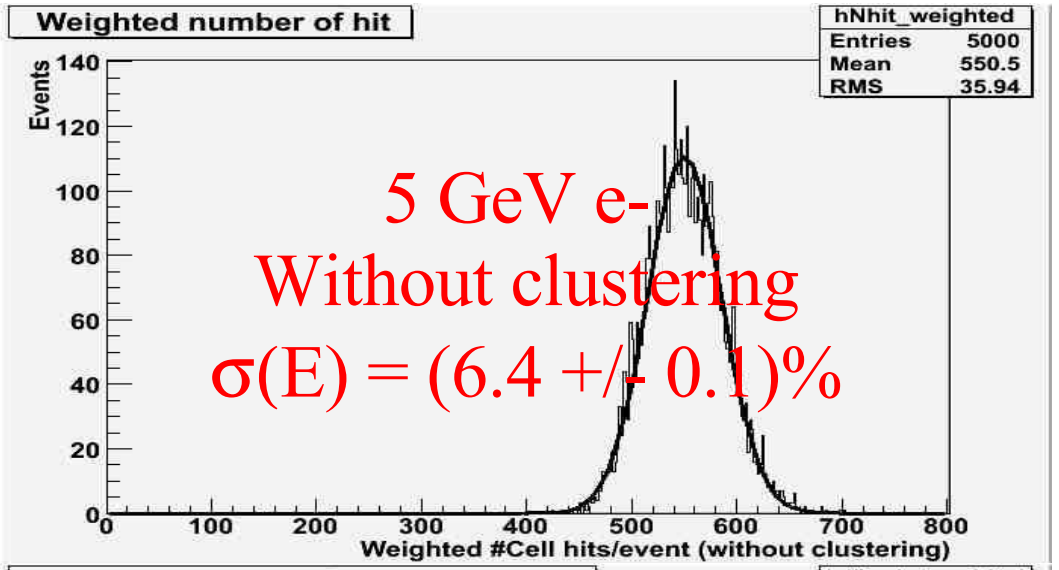
Red variables need be optimized.

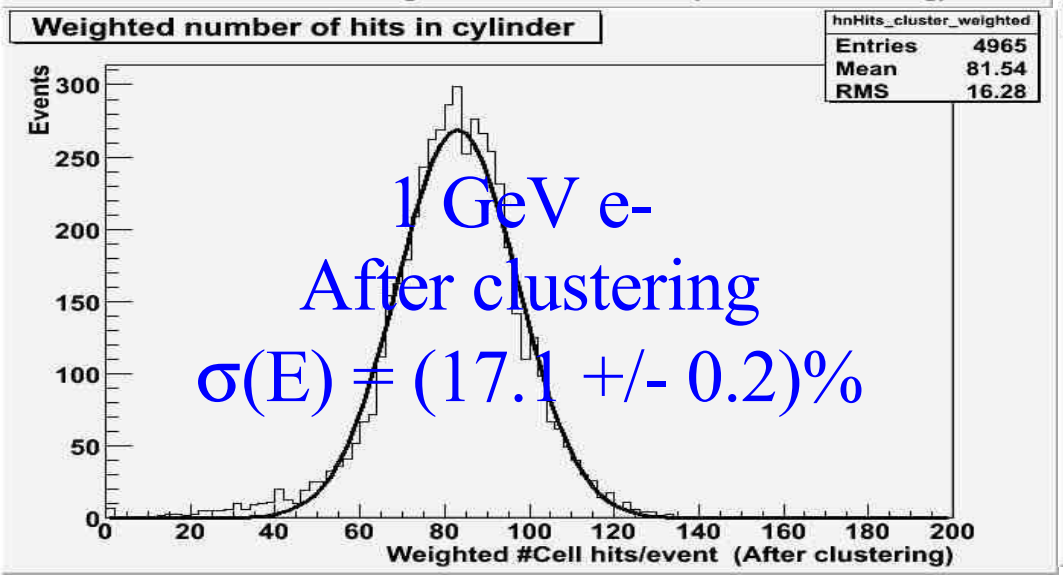
1. Finding initial group of hits within particular one of inner 7 layers.
   - Requiring more than other 3 hits (in total 4 hits) are within circle of 5.0 mm radius.
   - Applying 1800 eV threshold for cell hits energy (This is applied for Geant4 output, then it corresponds to cell energy threshold after charge diffusion plus digitization.)
2. Searching hits in outer layers which has located within 3.0 cm hemisphere from initial hit.
   - Deciding direction of cluster: From the center of gravity in the initial grouping within inner layer to the center of gravity in the hemisphere.
3. Adding all hits in 30 layers within cylinder of 1.0 cm.

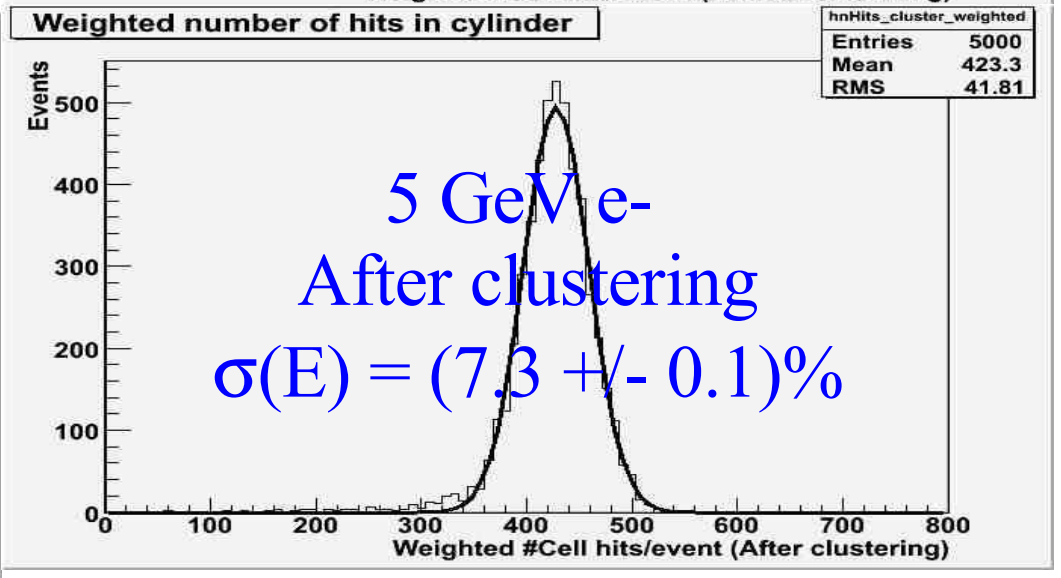
Energy resolution after clustering with temporary clustering criteria (not yet optimized)

- B fields is off
- Using Gauss fitting
- Geant4 output (which would be correspond to after charge diffusion plus digitization)
- Double counts removing algorithm is not yet. (Temporarily, one cluster per event is required.)









Summary & Next steps

- Summary
  - Initial conservative clustering works with ~98% efficiency level up to lower energy 1 GeV electron
  - Base line of clustering algorithm looks working well.
- Next steps
  - Double count removing for general case
  - Cross-checking the effects of charge diffusion and charge sharing compensation without clustering
  - Adding charge diffusion and charge sharing compensation into clustering
  - Optimizing of each criteria for single electron case at first
  - Angle dependence study
  - Event shape variable (E_sum in 5mm radius/E_sum in 1cm radius)
  - Physics events study
  - Optimizing each criteria again for physics event case

BACK UP :

#Cell hits distribution in each 2nd/3rd/5th/7th layer individually, for 400 GeV e-