Report on KOTO EMCal Study

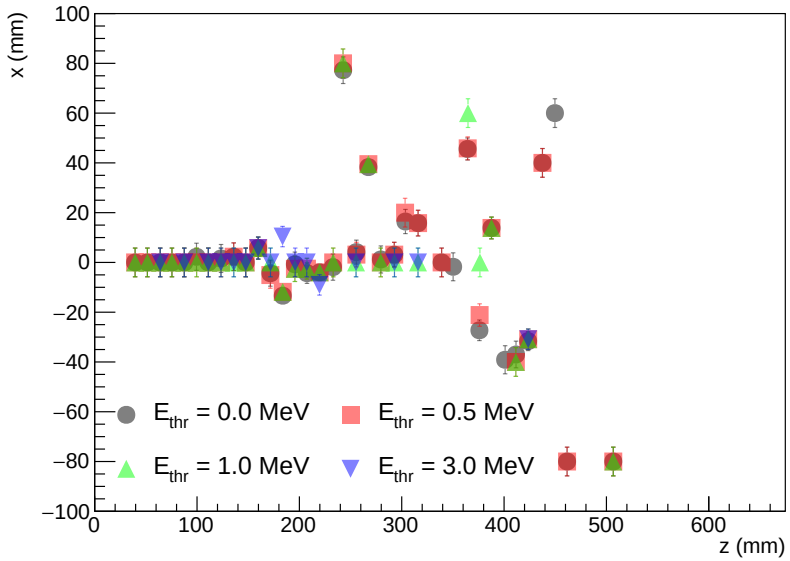
Junlee Kim

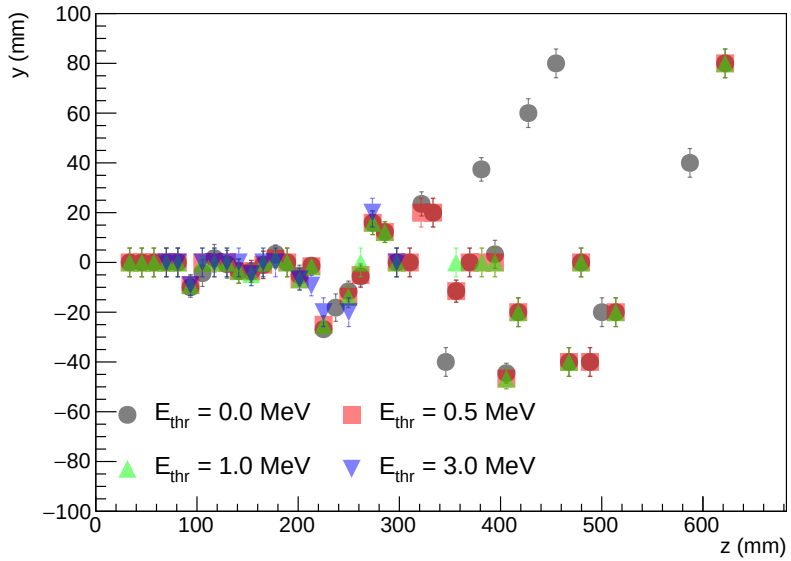
August 25, 2020

Current status

- YJ has implemented step-level data collection.
  - Technical problem in my side
  - Not available yet to me
- Topological studies have been done for
  - Energy cut study
  - Fit range study
- Smoothing procedure between layers has been tested.

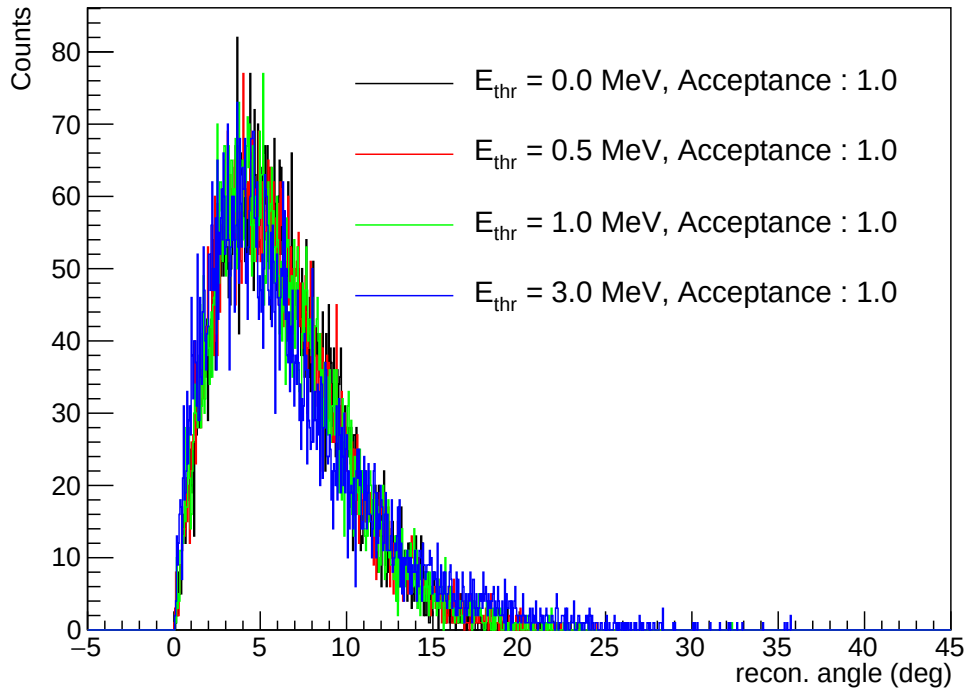
Energy cut study (single event)





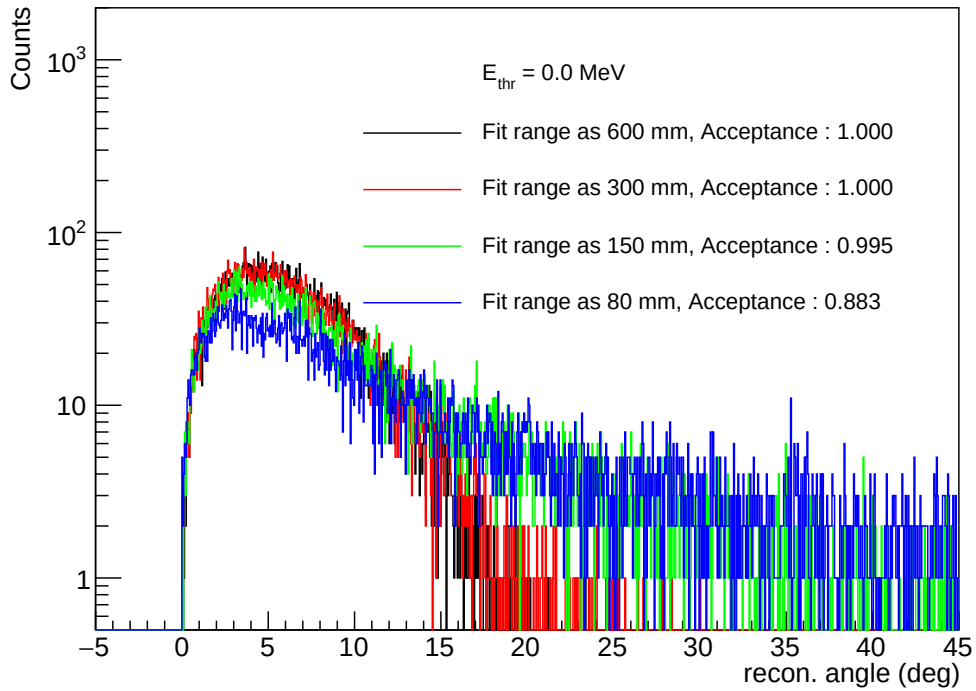
- γ direction as $(0, 0, 1)$ with 1 GeV energy.
- The energy cut was applied to each segment.
- Energy threshold as `0, 0.5, 1.0, 3.0` MeV
- Rear part of the shower can be rejected.

Reconstructed angle with the energy cut(10k event)



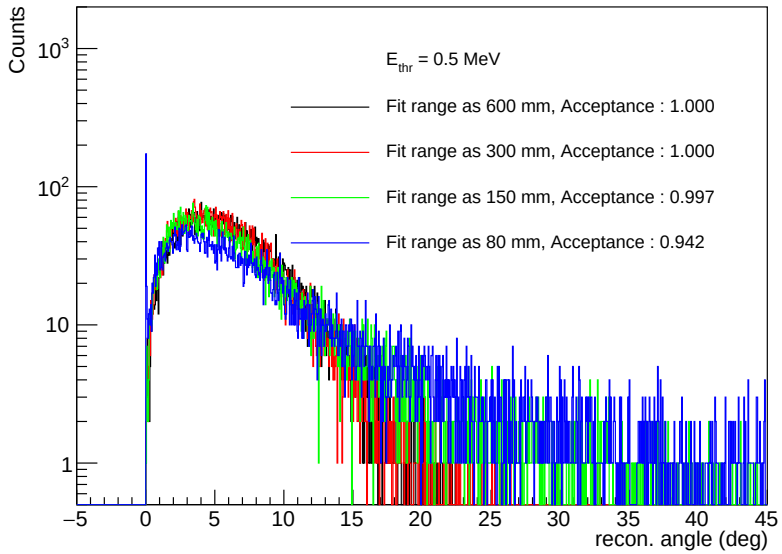
- The angle has been defined as $\theta = \text{atan}(\Delta z/\sqrt{\Delta x^2 + \Delta y^2})$
- Events having the small number of points(< 6) either in x or y segment were rejected from the distribution.
- No significant improvement has been observed..

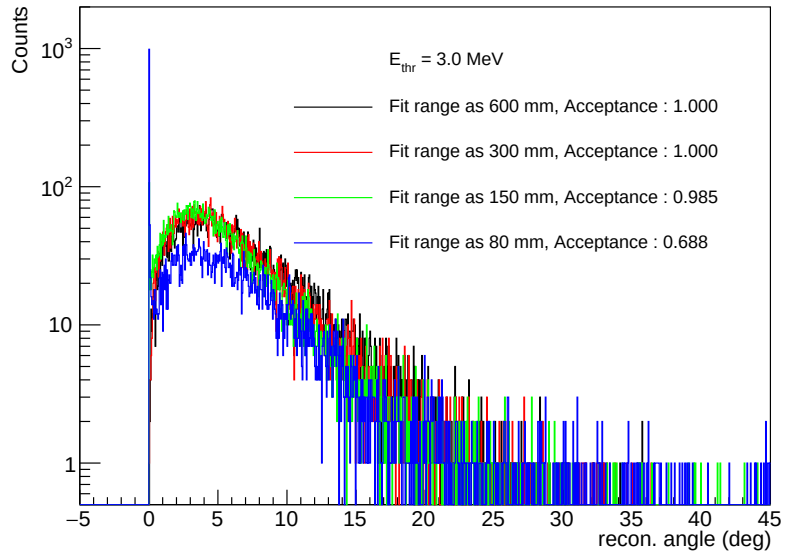
Fit range study



- The fit range is defined as a distance from the first hit along z-axis.
- Distances as `600, 300, 150, 80` mm
- Acceptance drop can be seen with a short distance.

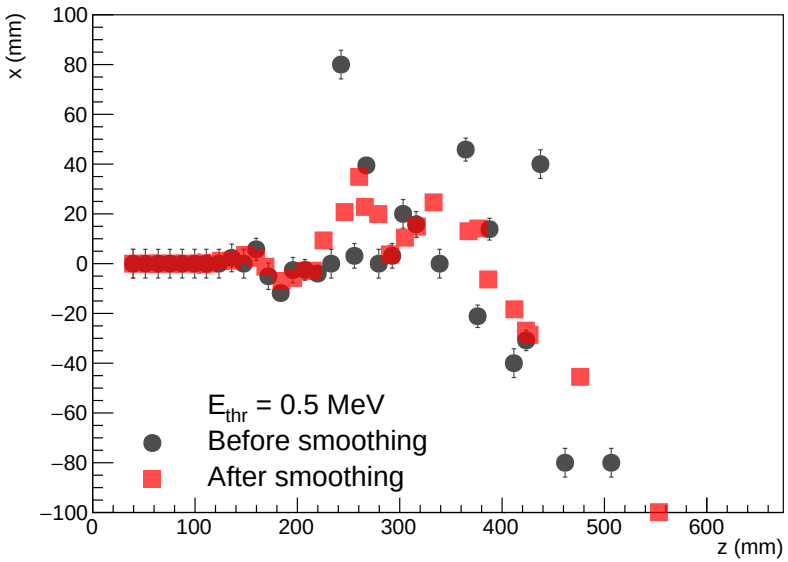
Fit range + energy cut

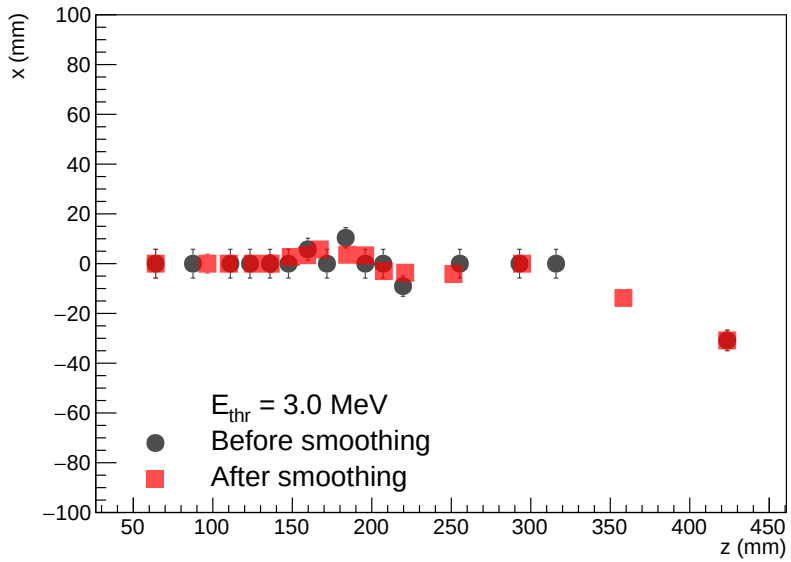




- Very narrow peaks in angle ~ 0 with fit range as 80 mm.
- Note these events are also required to have enough points in the defined fit range.
- Acceptance increased with 0.5 MeV cut from no energy cut.
  - Due to the first hit position dependence?

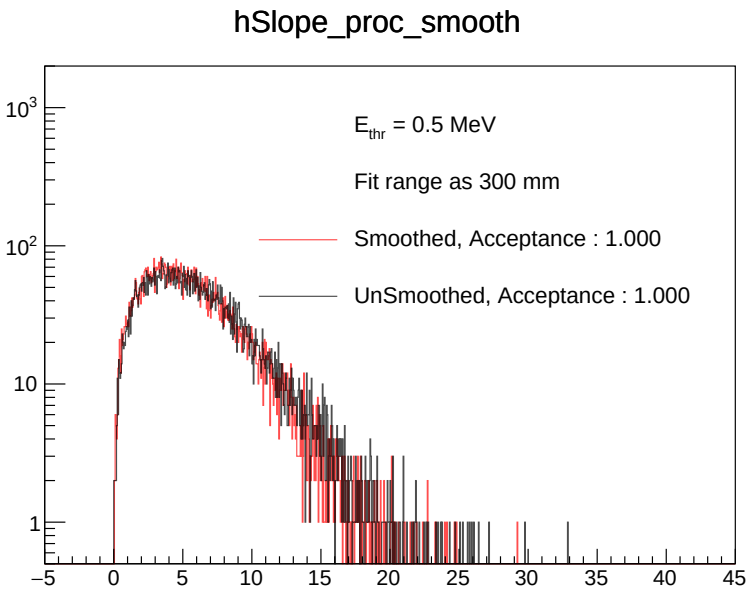
Smoothing procedure

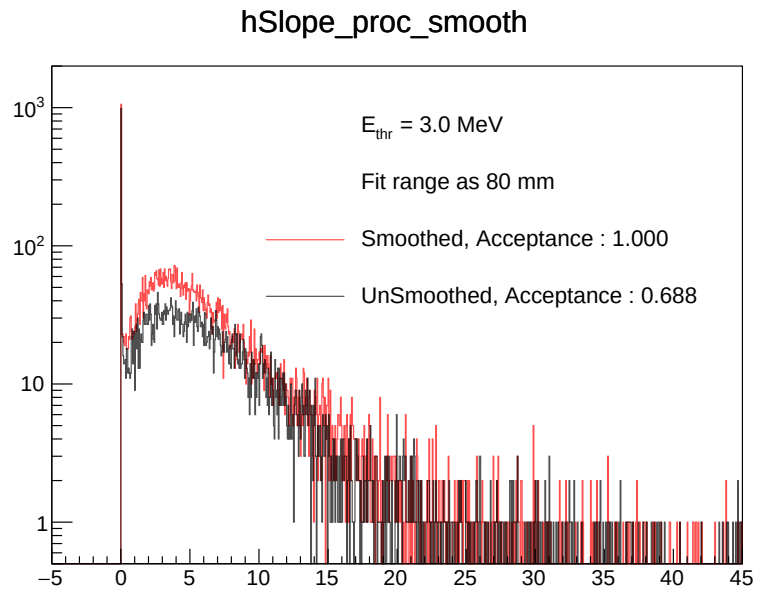




- Smoothing procedure with energy weighting
  - $x_i^{\mathrm{smoo}} = \dfrac{x_{i-1}e_{i-1} + x_i e_i + x_{i+1}e_{i+1}}{e_{i-1} + e_i + e_{i+1}}$
  - The procedure allows one to give significance to a layer having larger energy.
  - The procedure would be neither useful nor proper for the rear part of the shower.
  - How about the front part?
- The effect of smoothing procedure has been studied(with the limited fit range(essential) and the energy cut).

Recon. angle with smoothing procedure





- No significant improvement was observed..

Outlook

- Topological studies have been done
  - Fit range
  - energy cut
  - The impact of the energy cut can not be seen
- Smoothing procedure has been applied to the single track
  - The impact of the smoothing procedure can not be seen.
- Need to confirm the result with the limited fit range(delta peak on zero).
  - analysis code in github : `anacode/jikim/ana.C`