Report on KOTO EMCal Study

Junlee Kim

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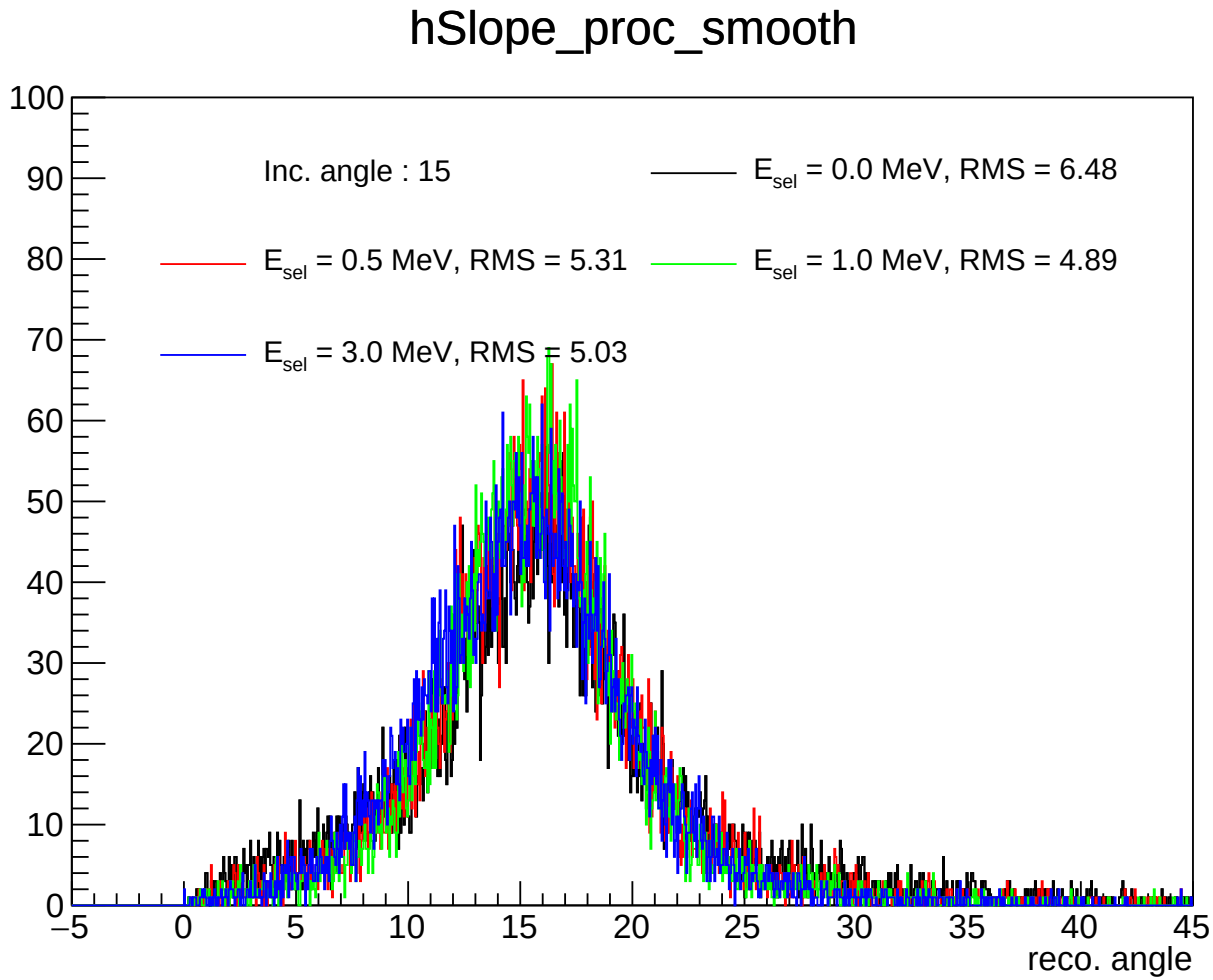
- Minimum energy selection
- Origin finding test
- Energy weighting study

Intrinsic resolution for multiple Coulomb scatterings?

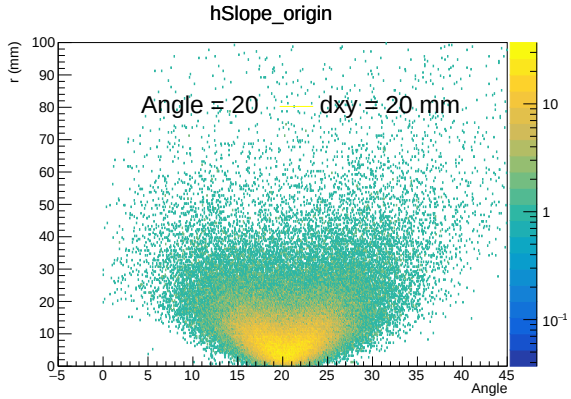
- In PDG,
- $\theta_0 = \frac{13.6\,\mathrm{MeV}}{\beta cp} z\sqrt{\frac{x}{X_0}}\left\{1 + 0.038\ln(\frac{xz^2}{X_0\beta^2})\right\}$
  - For a charged particle
  - $\beta \sim 1$,$p \sim 500$ MeV/c, x=5X_0, z=$\pm$1
  - $\theta_{\mathrm{space}} = \sqrt{2}\theta_0 = 4.93$ (deg)
- Smaller x to reduce θ_{space}
  - Thickness of Pb plates?

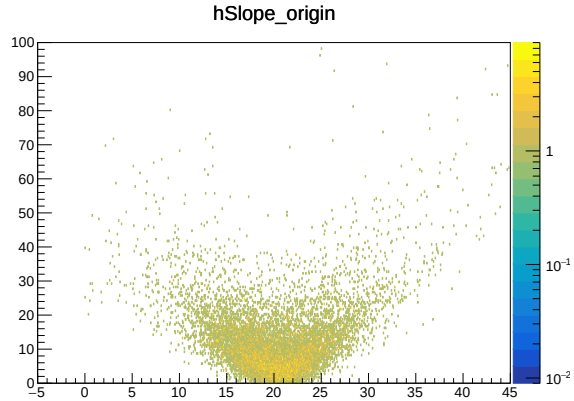
Minimum energy selection



- $\Delta x(y) = 20$ mm
- Not effective?

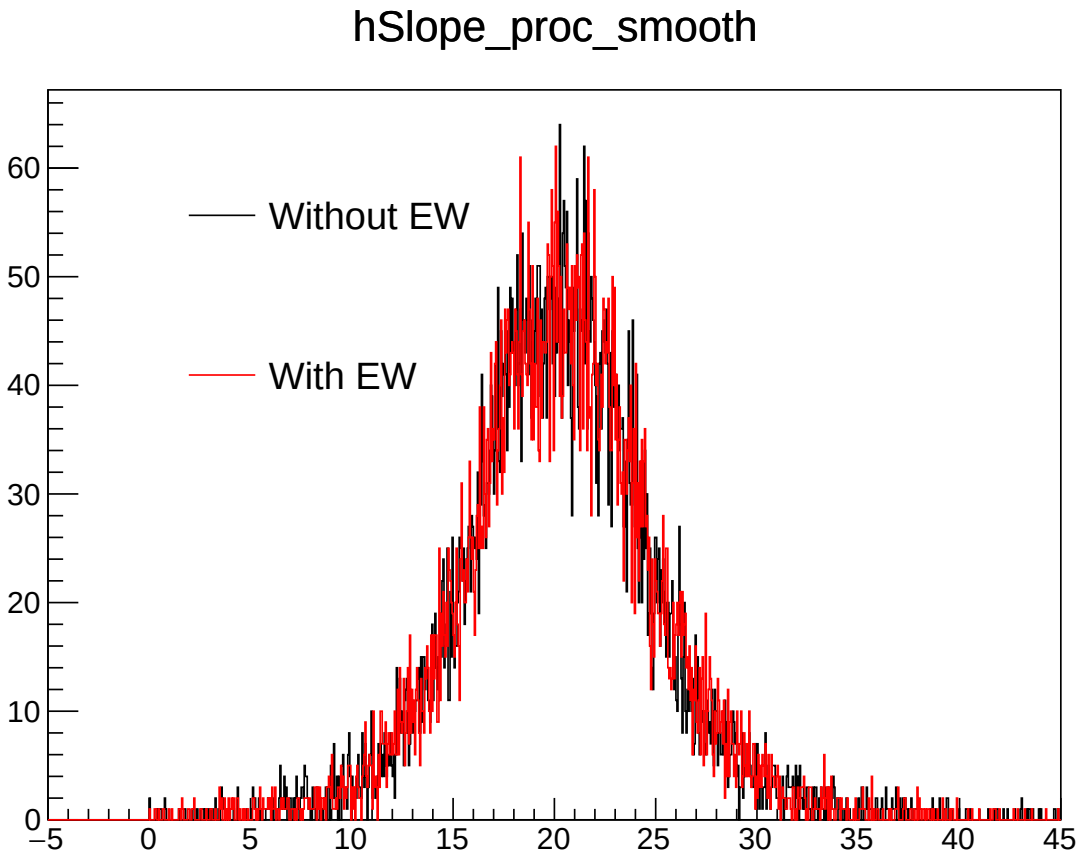
Origin finding test





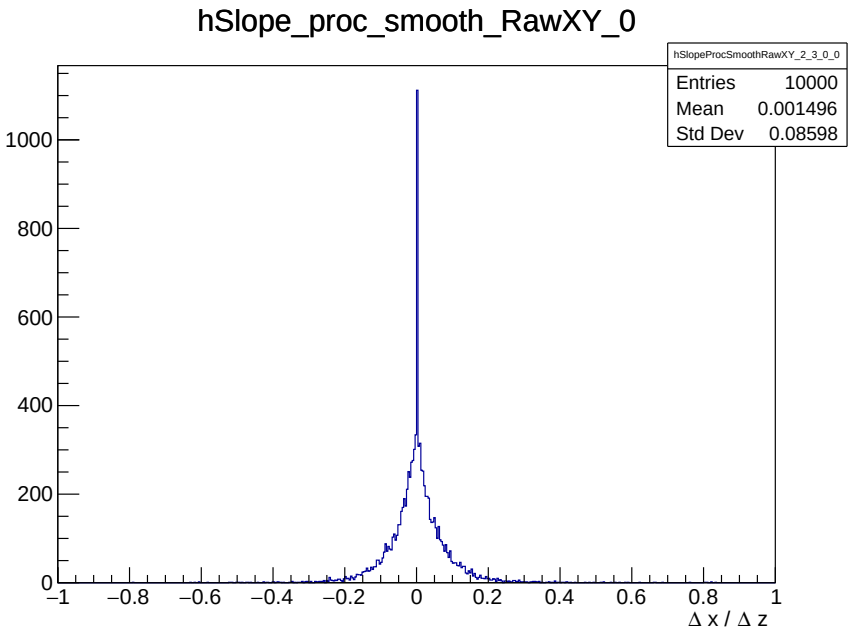
- Lines from two points are constructed.
  - $ax + by + c{=}0$
- Define distance with assumed position(x_0, y_0)
  - $d_{i,j}^2 = \dfrac{(ax_0 + by_0 + c)^2}{a^2 + b^2}$
- Minimize $\sum_{i<j} d_{i,j}^2$ using TMinuit.
- Extrapolate the position with already reconstructed incident angle.
- Left(old, 100k events), Right(new, 10k events)

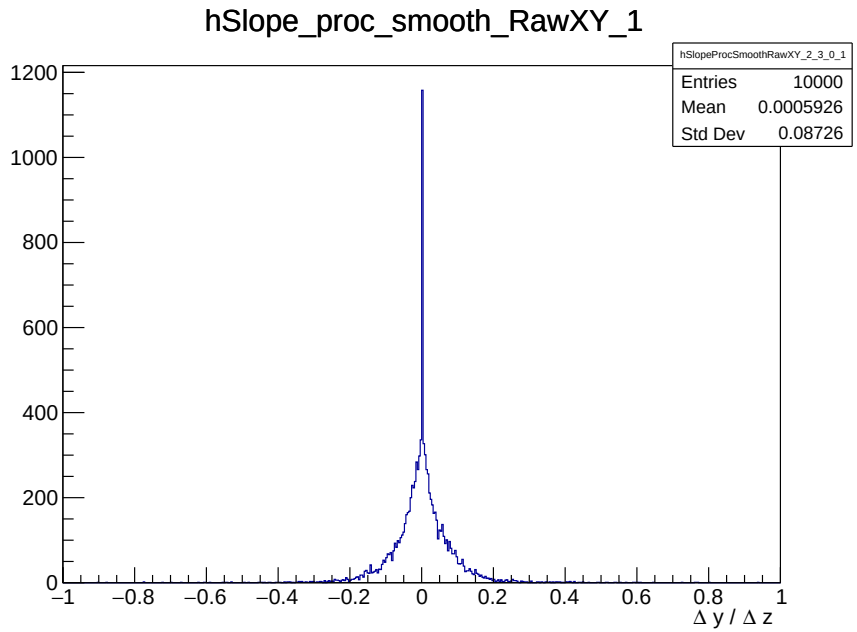
Energy weighting study



- Energy-weighting procedure has been done with
  - $S = \dfrac{\sum_{i<j} S_{i,j} \times (e_i + e_j)}{\sum_{i<j} (e_i + e_j)}$
- Not effective ($\Delta x(y) = 20$ mm)

At Inc. angle=0





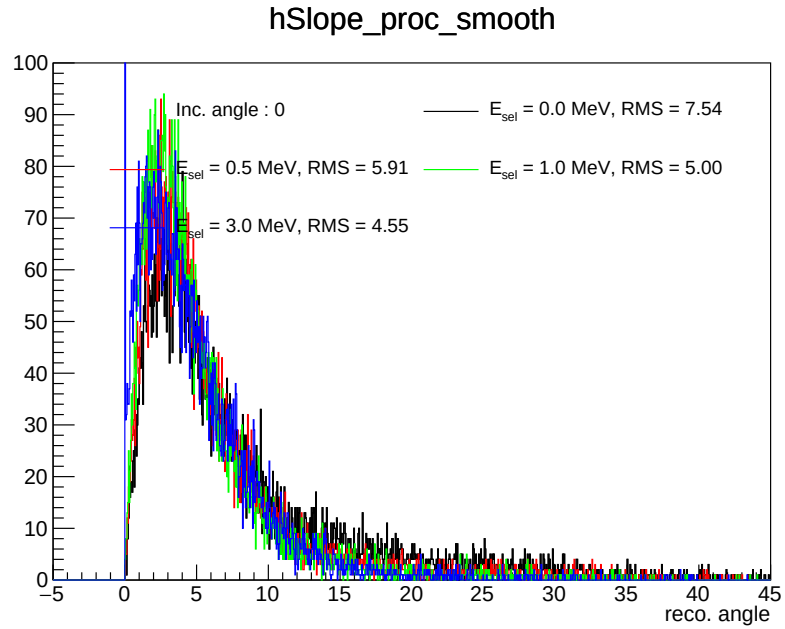
- $\theta = \mathrm{atan}(\sqrt{\Delta x^2 + \Delta y^2}/\Delta z)$
- $\dfrac{\Delta x}{\Delta z}$ and $\dfrac{\Delta y}{\Delta z}$ have been checked.
- Peaks at 0

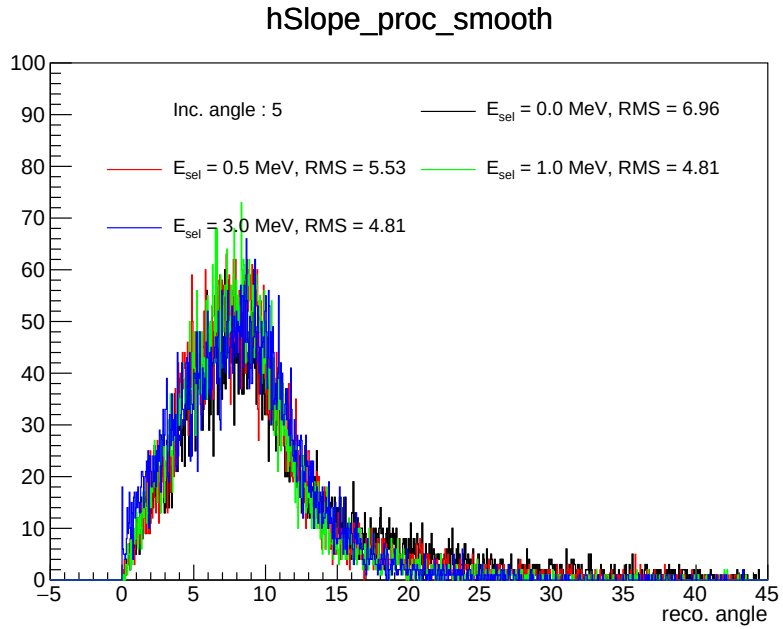
Outlook

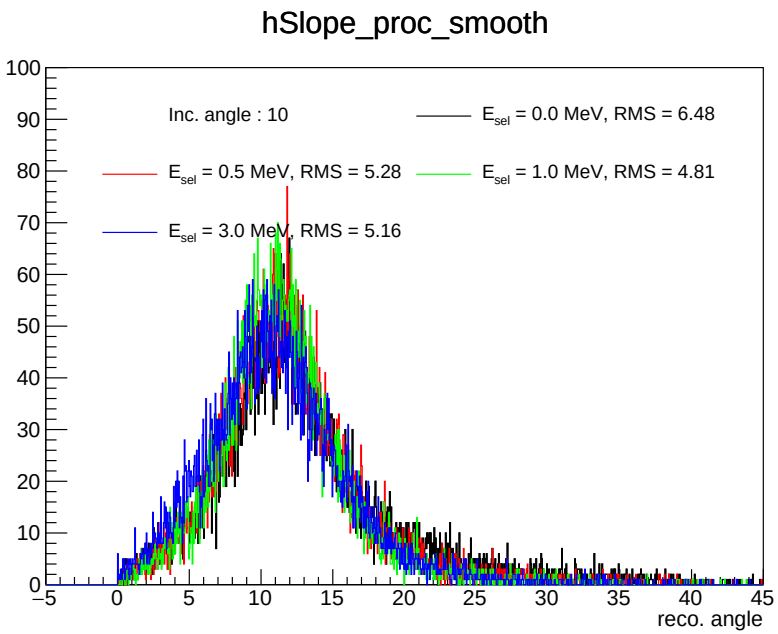
- Minimum energy selection has been checked
  - No significant improvement on tracking.
- Origin finding test has been done
  - No significant improvement on tracking.
- Energy weighting study has been done
  - No significant improvement on tracking.
- Current shower reconstruction has been done with only front part of shower, which is defined as 150 mm from the first hit.
  - Topological study on the definition?
  - Reduce the thickness of Pb plate only for front part?

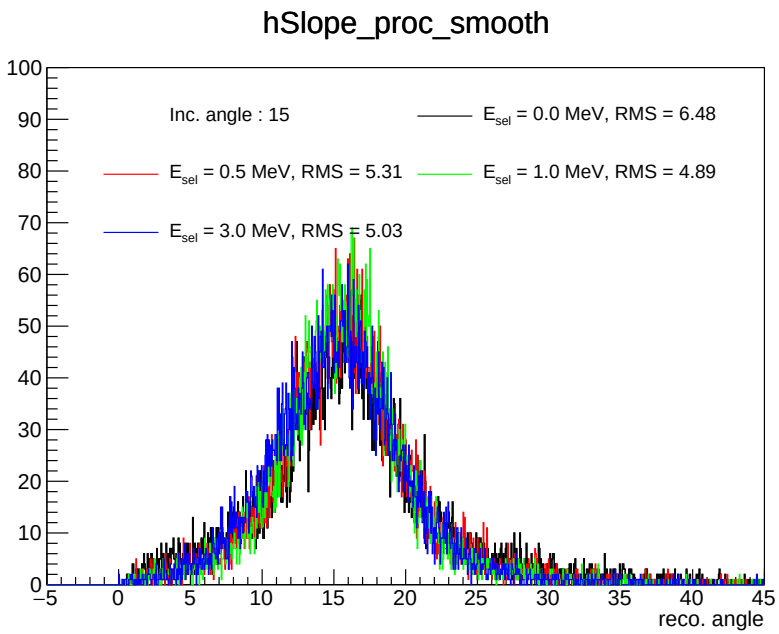
BACKUP

Minimum energy selection









Minimum energy selection