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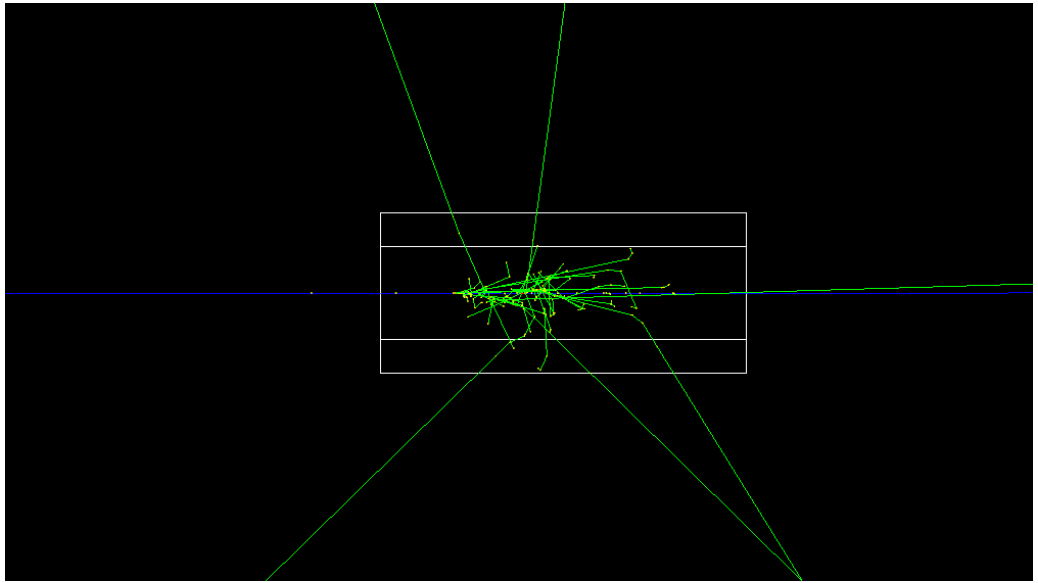
GEANT4 SIMULATION REPORT

FCC Napoli weekly meeting, 16 May 2024

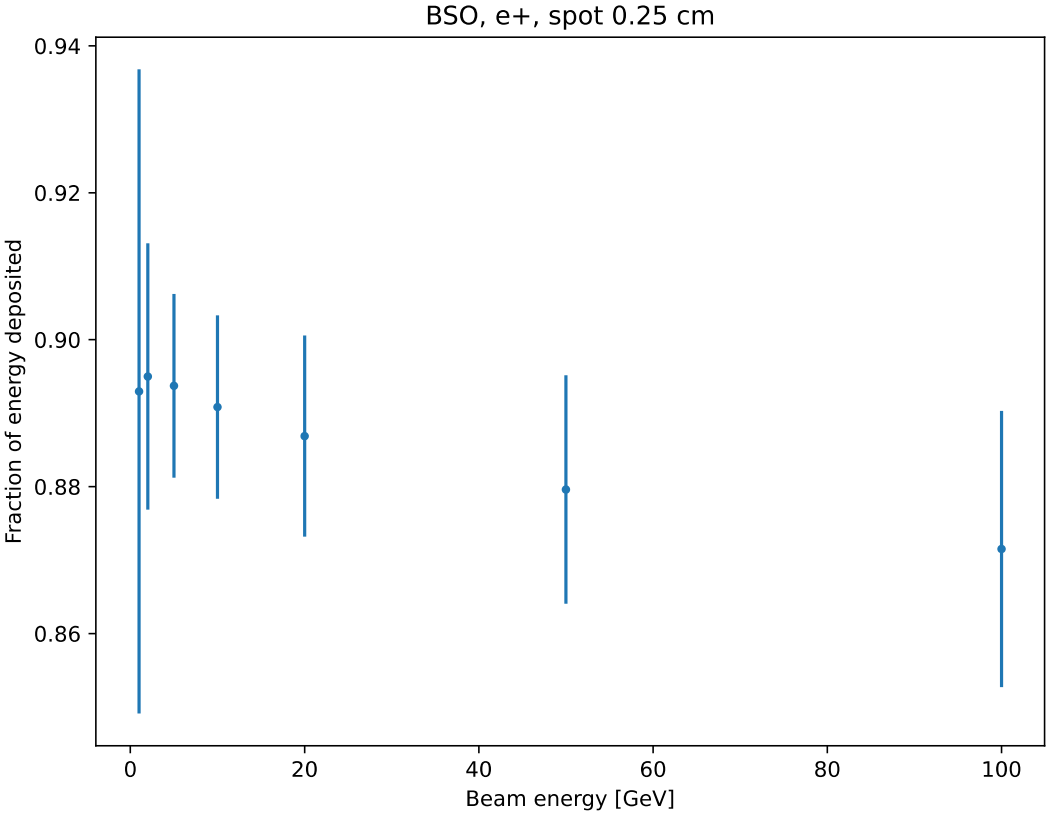
BSO LEAKAGE EFFECTS STUDY

- Potential outcome for future test beam is a lone BSO matrix without PWO encasing
  - Concern for energy leakage

- **Plan**: study energy resolution in a 42 x 42 x 150 mm^3 crystal with e^+ beam at several nominal energies
  - E → [1, 2, 5, 10, 20, 50, 100] GeV

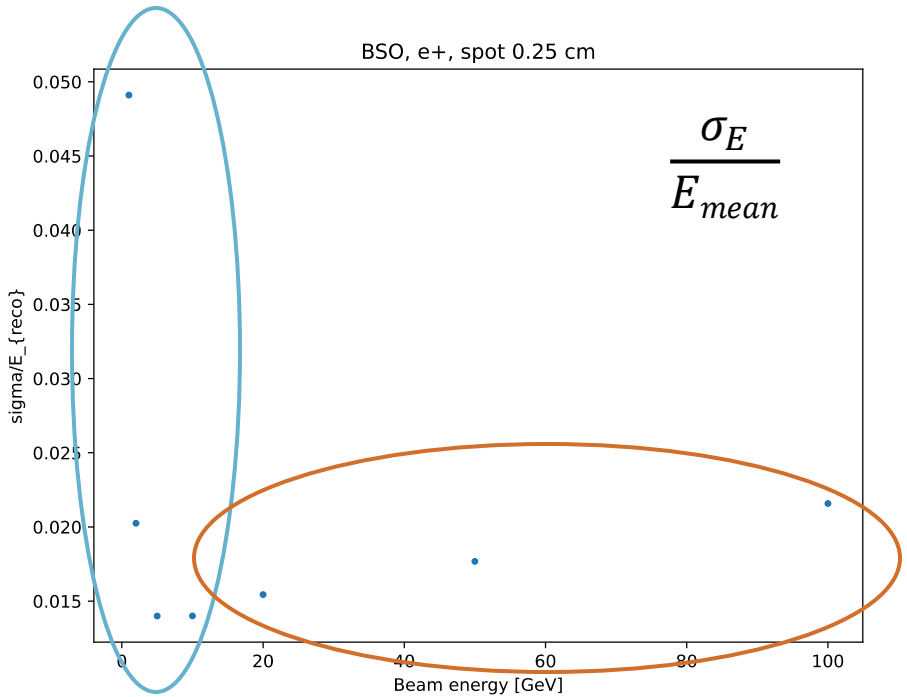


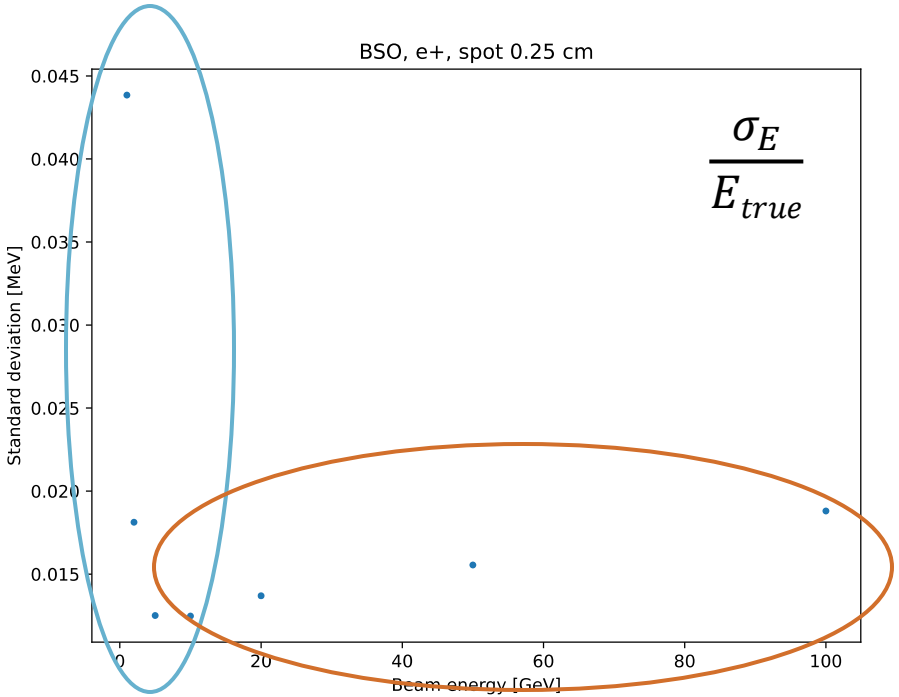
Fraction of deposited energy



Energy resolution

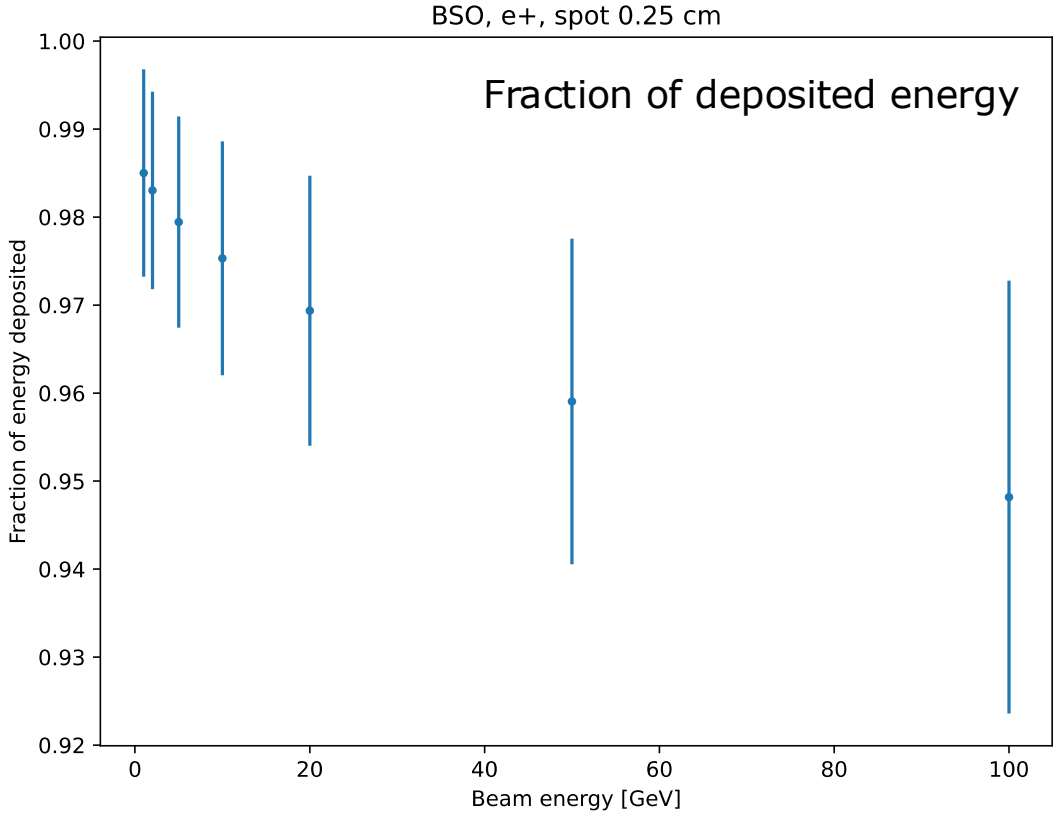
- 2 regions, low energy and high energy





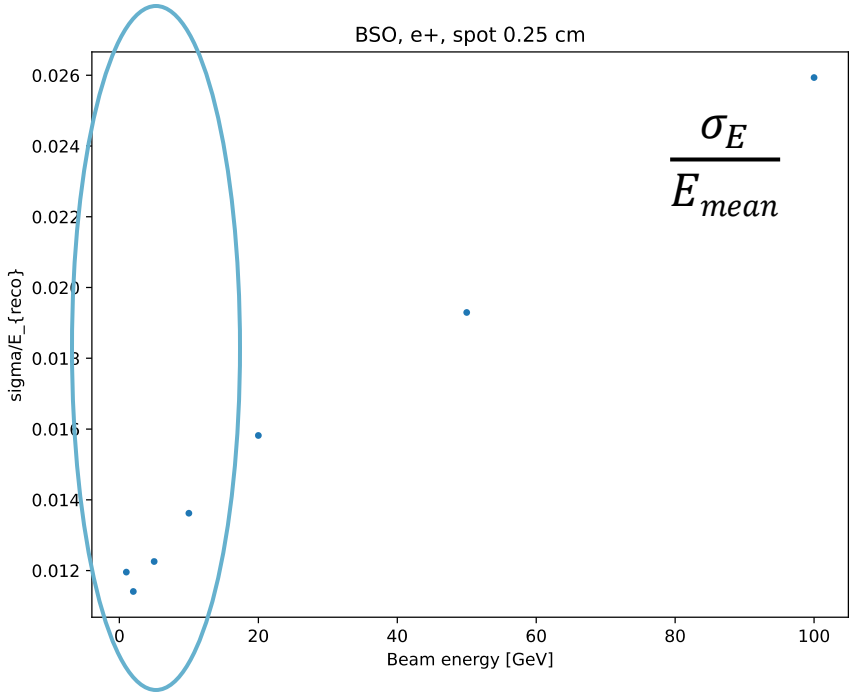
First region: new simulation

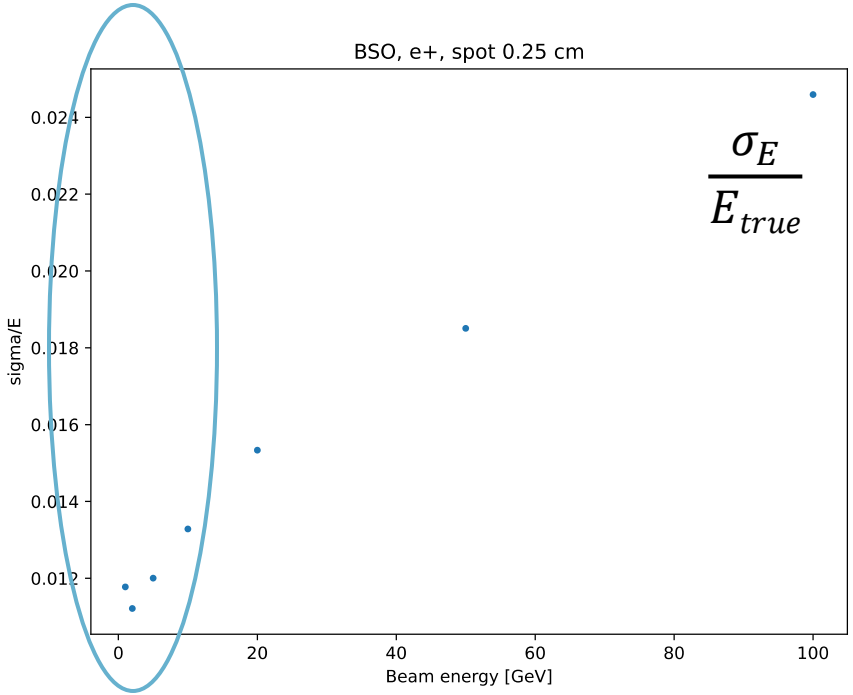
- **New simulation:** Infinite crystal approximation in the trasversal plane, length is still 16 cm



First region: new simulation

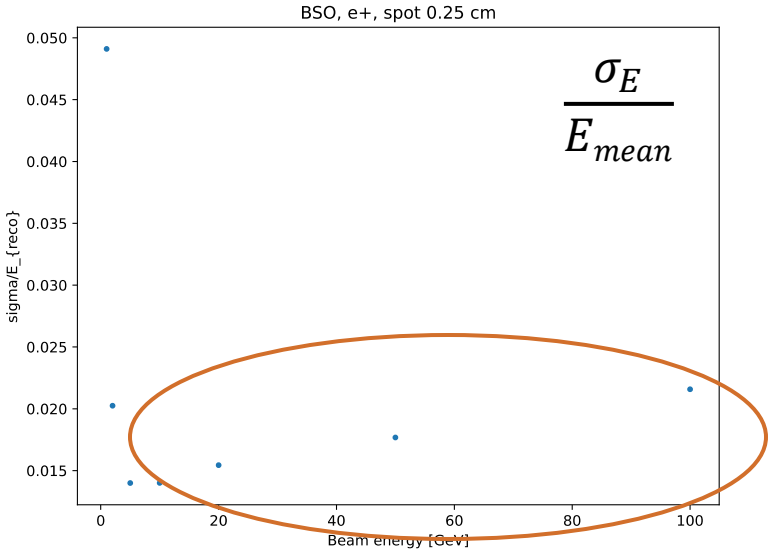
- Lower values at low energies now, it proves the effect is related to **lateral leakage**





Second region: bibliography

- High energy trend could be explained by this source
  - Related to **longitudinal leakage**



Energy Resolution

Shower leakage:

Fluctuations due to finite size of calorimeter; shower not fully contained ...

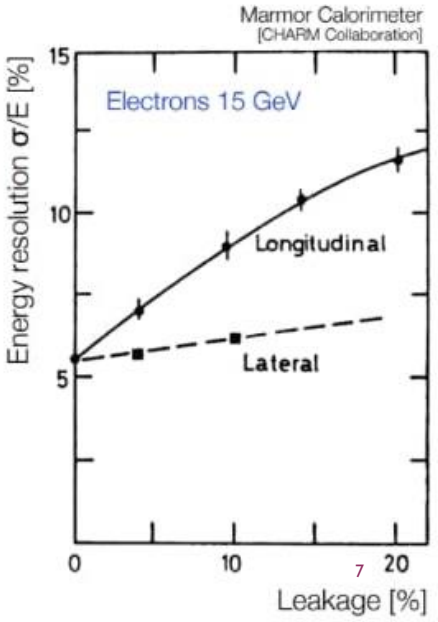
Lateral leakage: limited influence
Longitudinal leakage: strong influence

Typical expression when including leakage effects:

$$\frac{\sigma_E}{E} \propto \left(\frac{\sigma_E}{E}\right)_{f=0} \cdot \left[1 + 2f\sqrt{E}\right]$$

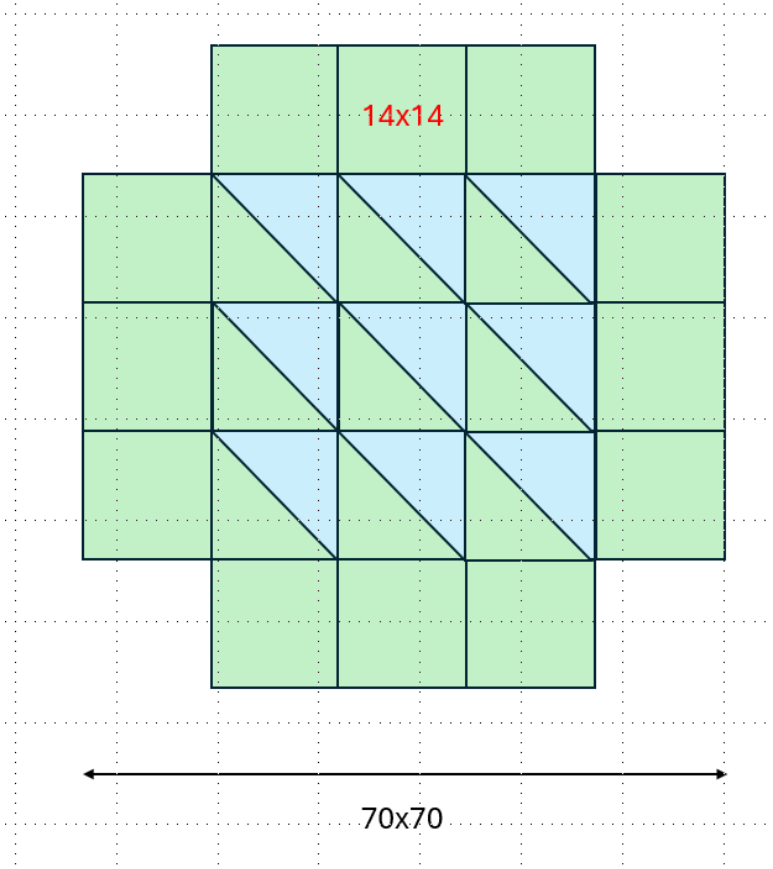
[f: average fraction of shower leakage]

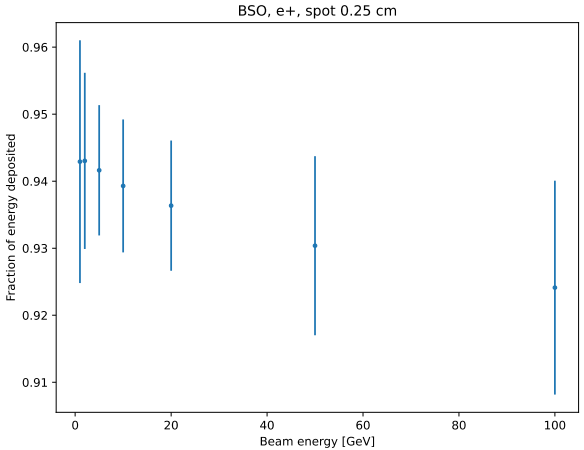
Remark: other parameterizations exist ...

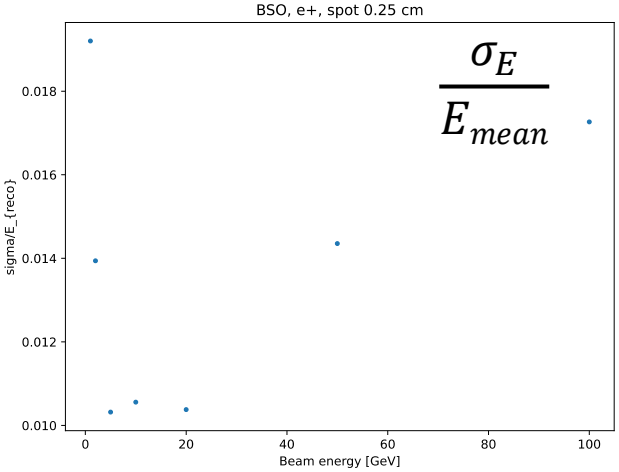


Closer to the idealized setup results (no corners)

- BSO matrix, 5x5 units with 14x14 mm^2 area
  - 16 cm length



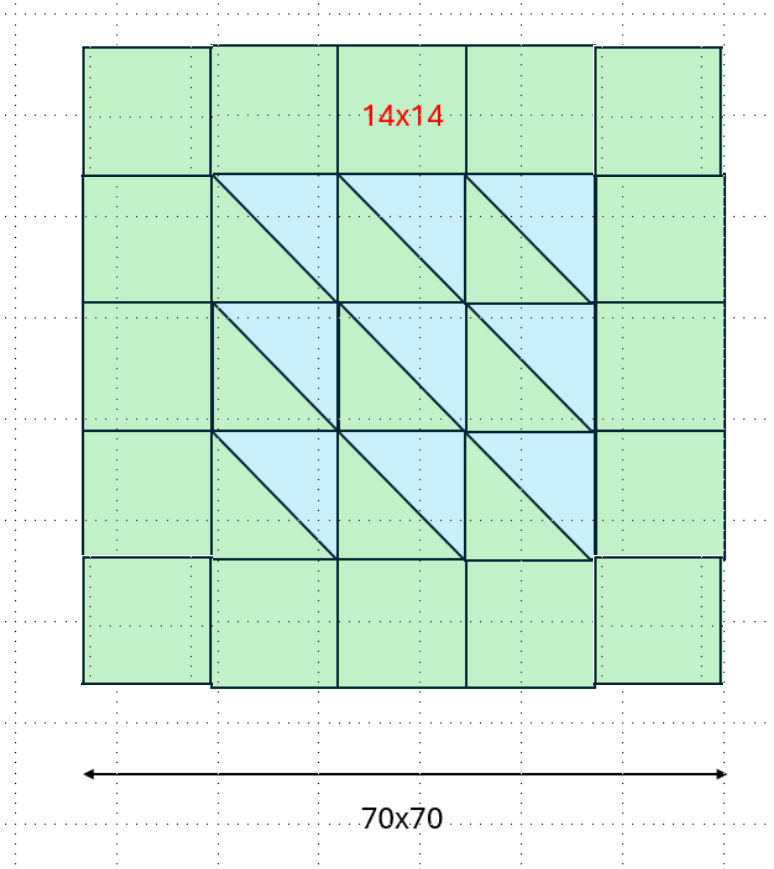


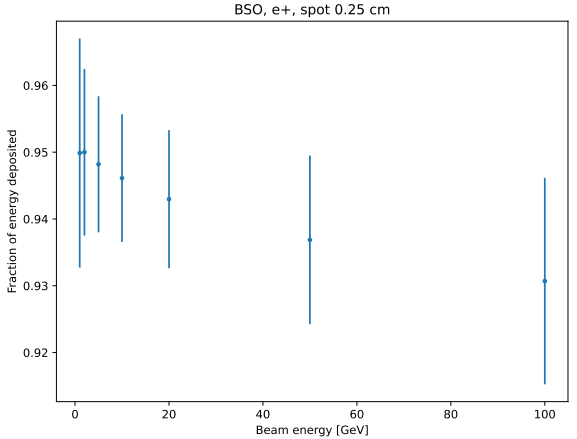


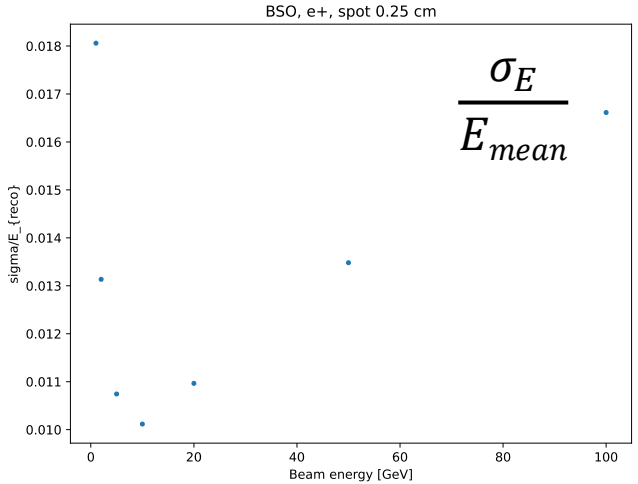
BACKUP

Closer to the idealized setup results (with corners)

- BSO matrix, 5x5 units with 14x14 mm^2 area
  - 16 cm length

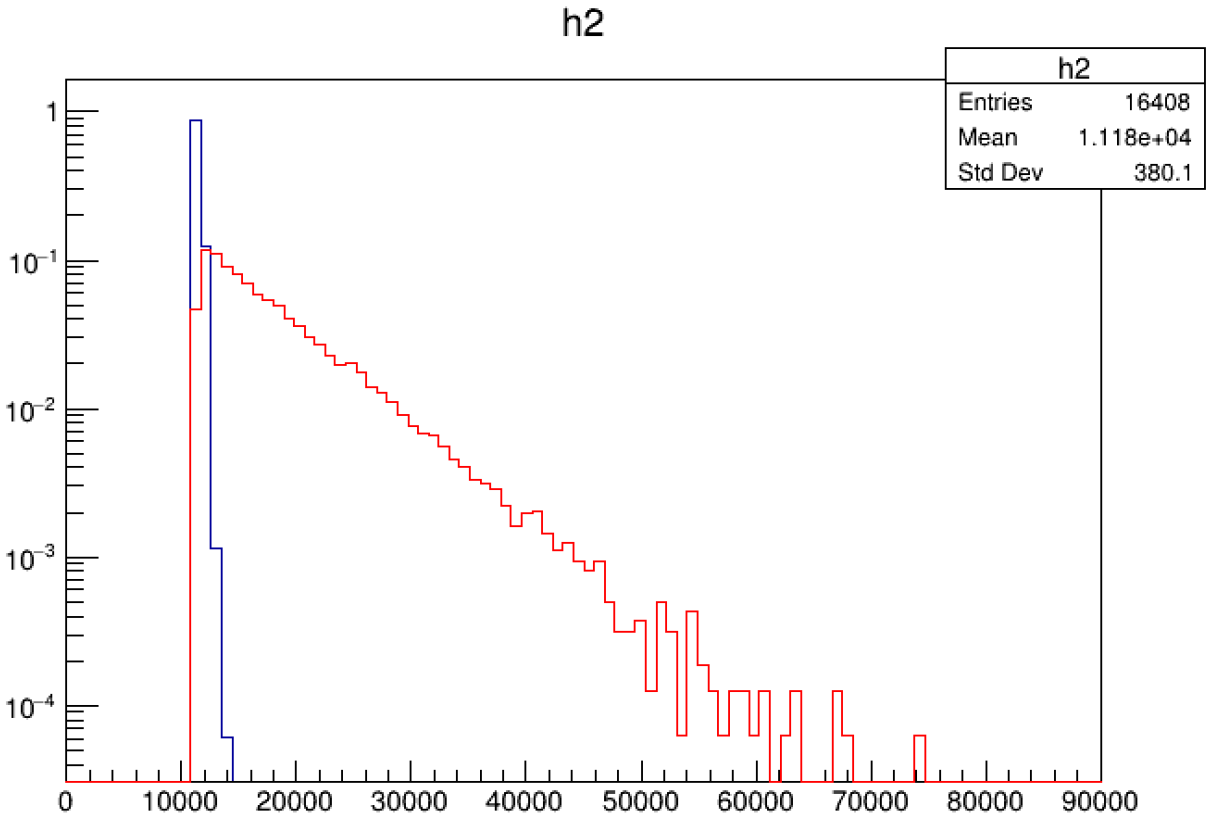






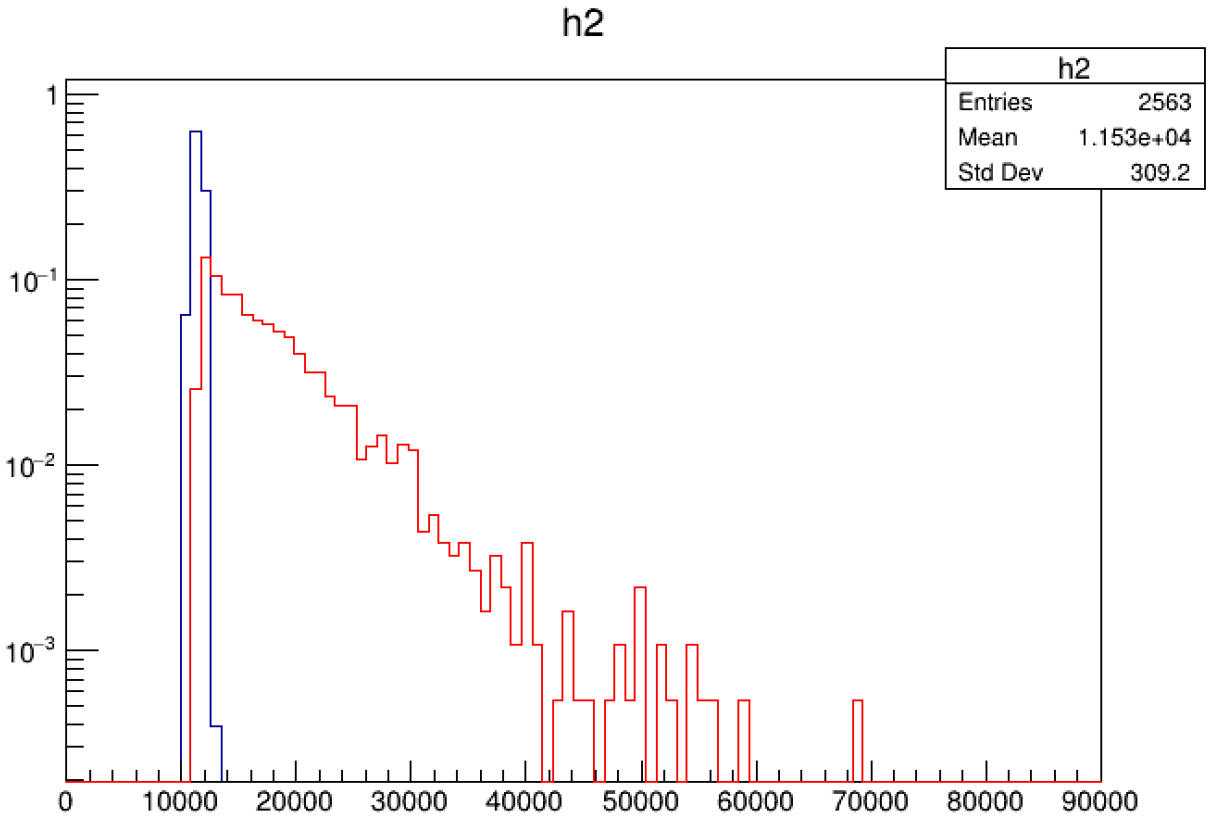
Timing (ps) PWO - Degree 0

Cerenkov
Scintillazione



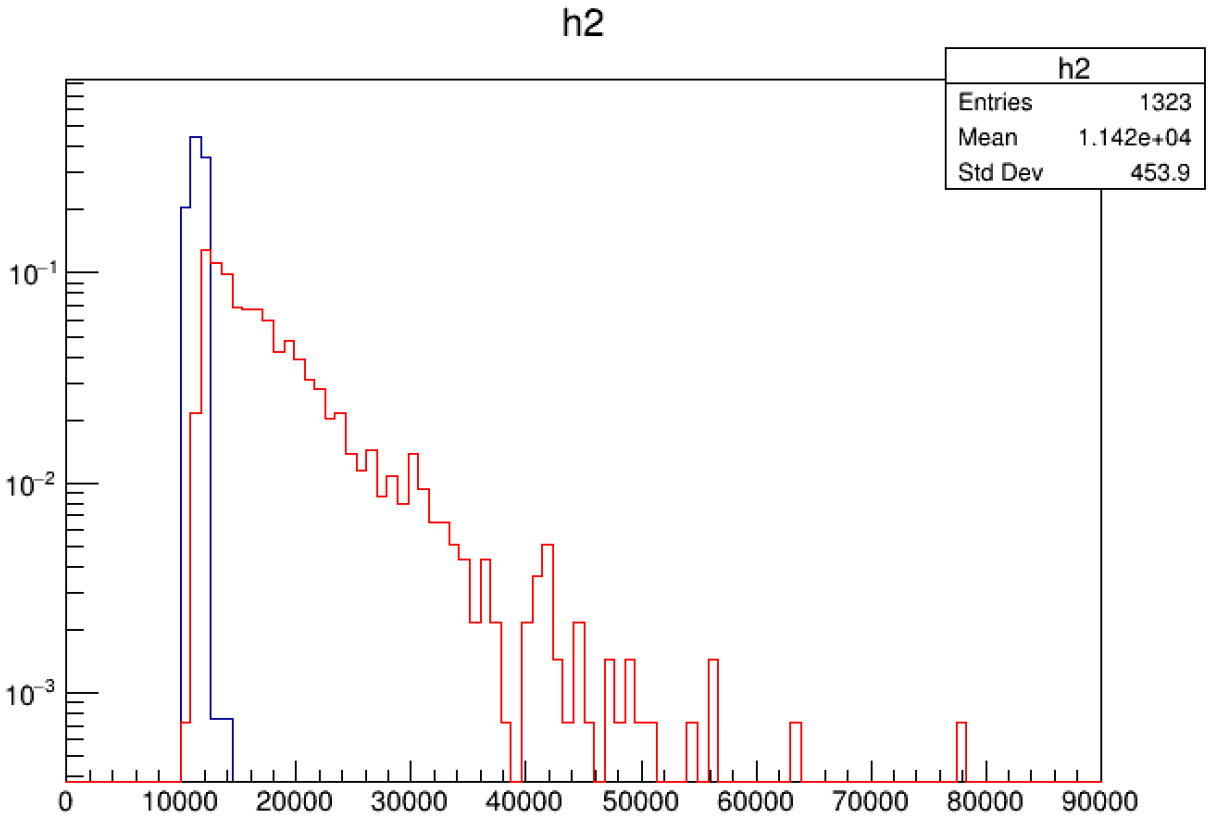
Timing (ps) PWO - Degree 60

Cerenkov
Scintillazione



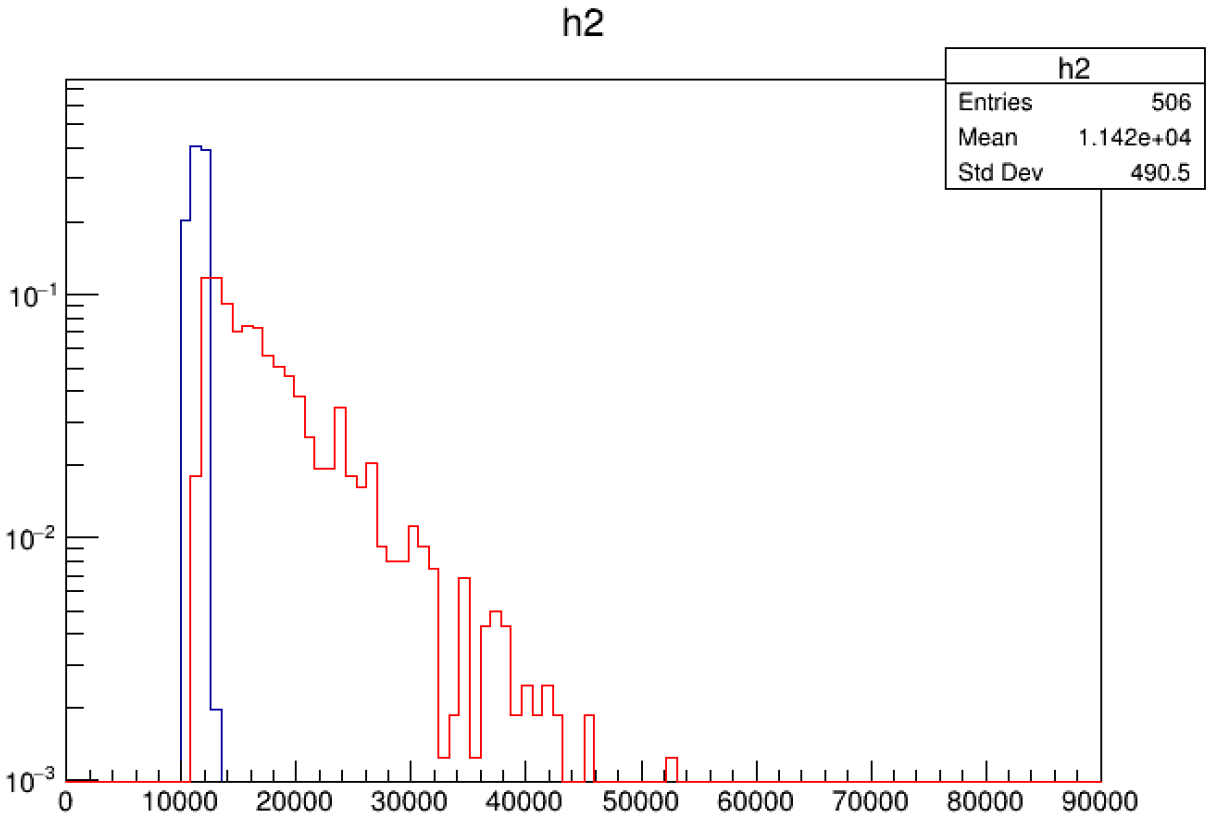
Timing (ps) PWO - Degree 90

Cerenkov
Scintillazione



Timing (ps) PWO - Degree 120

Cerenkov
Scintillazione



Timing (ps) PWO - Degree 180

Cerenkov
Scintillazione