Position reconstruction of low energy photons

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Reminder

Let's have

$$\epsilon_j = \frac{E_j}{E_{cluster}}$$

The reconstructed position is calculated as

$$x_{\text{rec}} = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i}$$

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the weighting factor is

- linear position reconstruction

$$w_i = \epsilon_i$$

- logarithmic position reconstruction

$$w_i = max(0, K + log(\epsilon_i))$$

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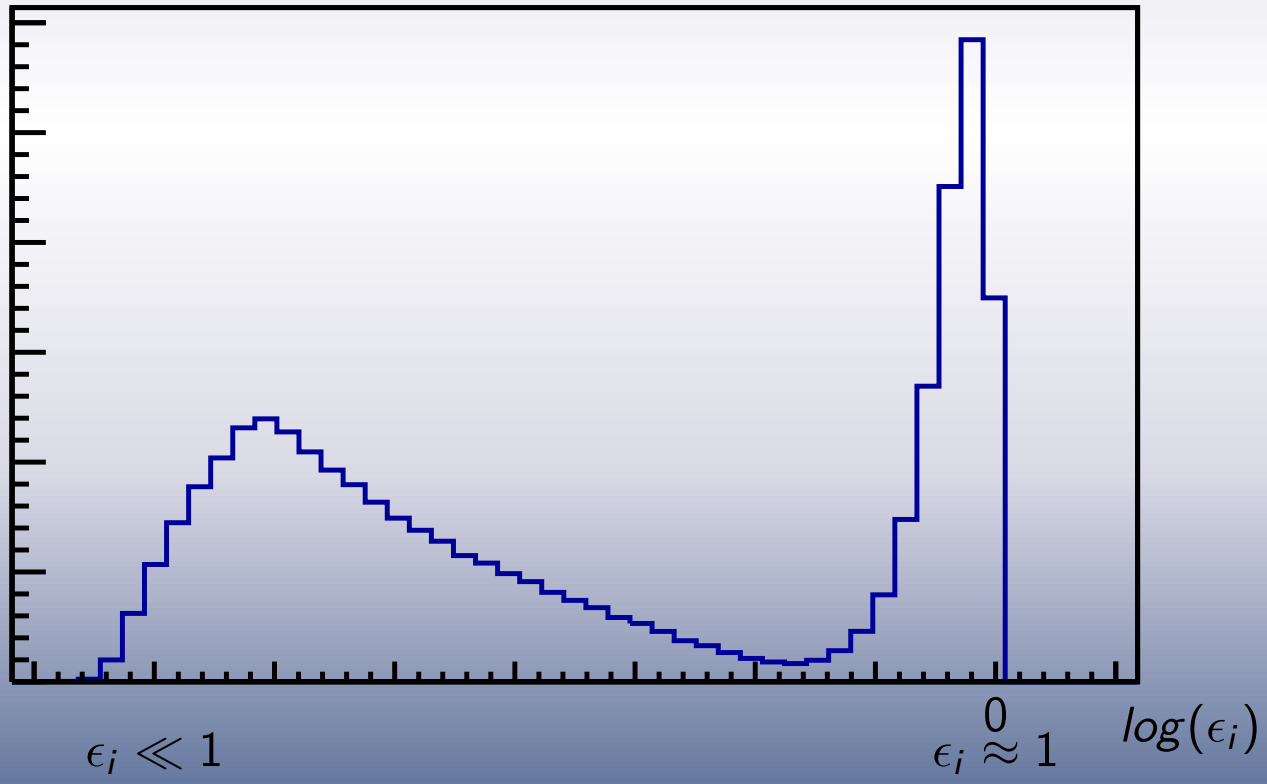
[events with cluster-multiplicity = 1 are removed]



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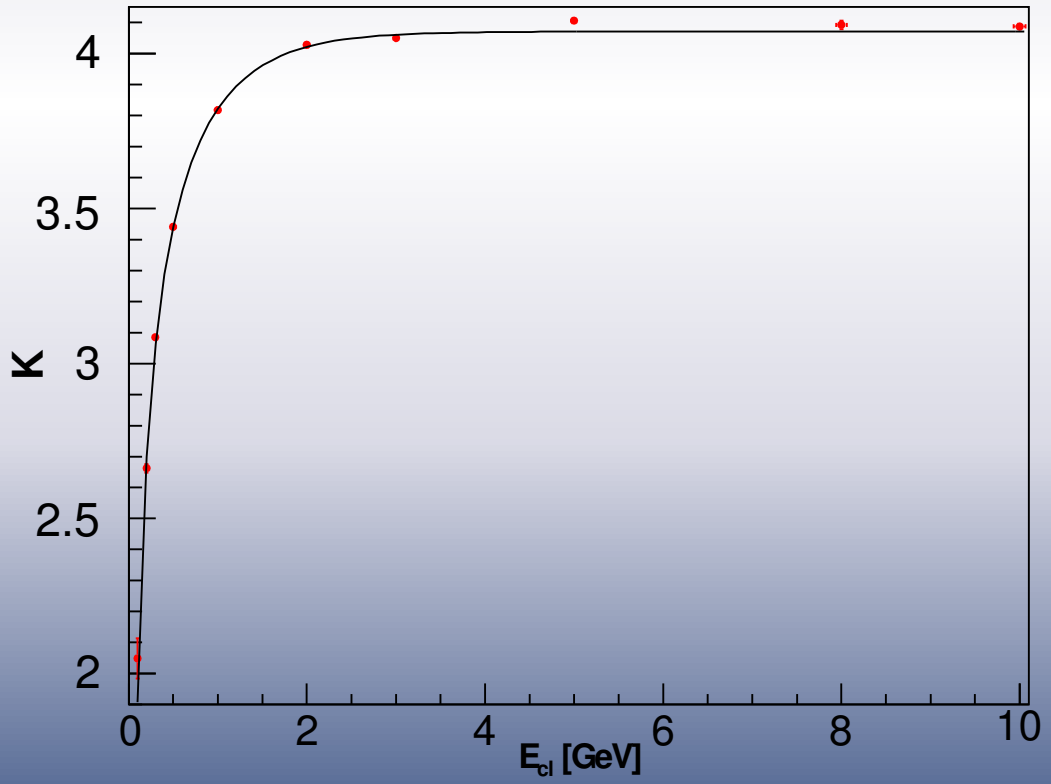
$$w_i = max(0, K(E_{cluster}) + log(\epsilon_i))$$

The energy dependence of K was explored (for the forward endcap) by H. Moeini at al.



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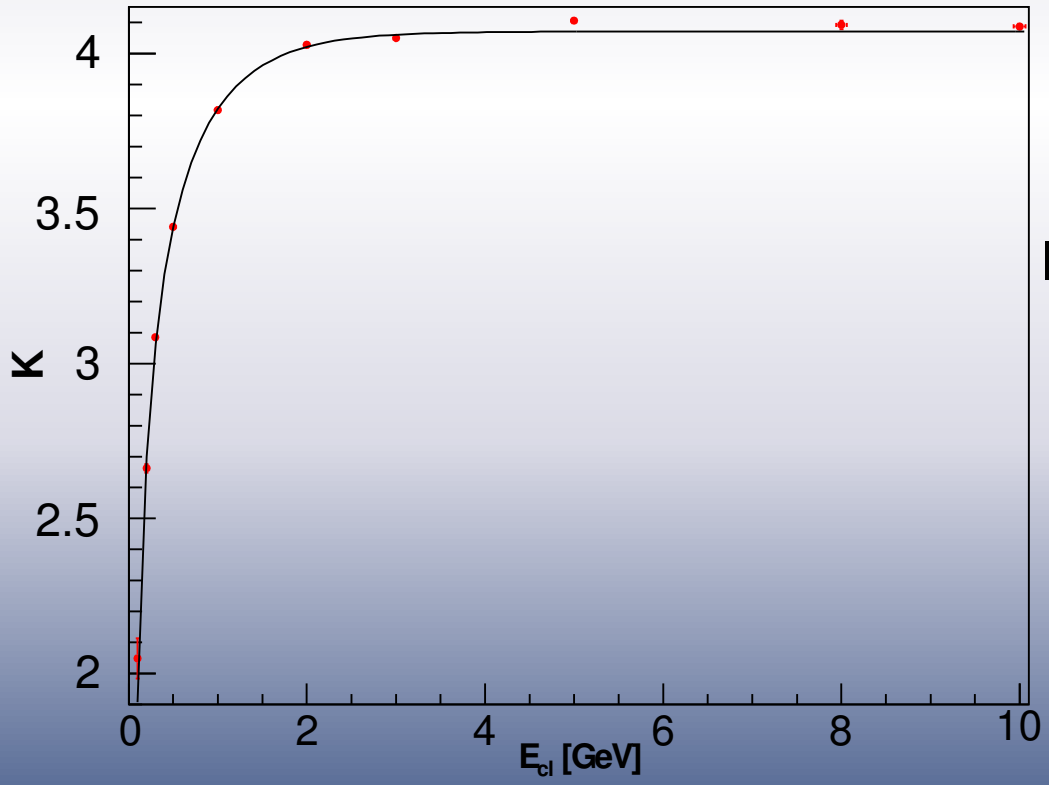

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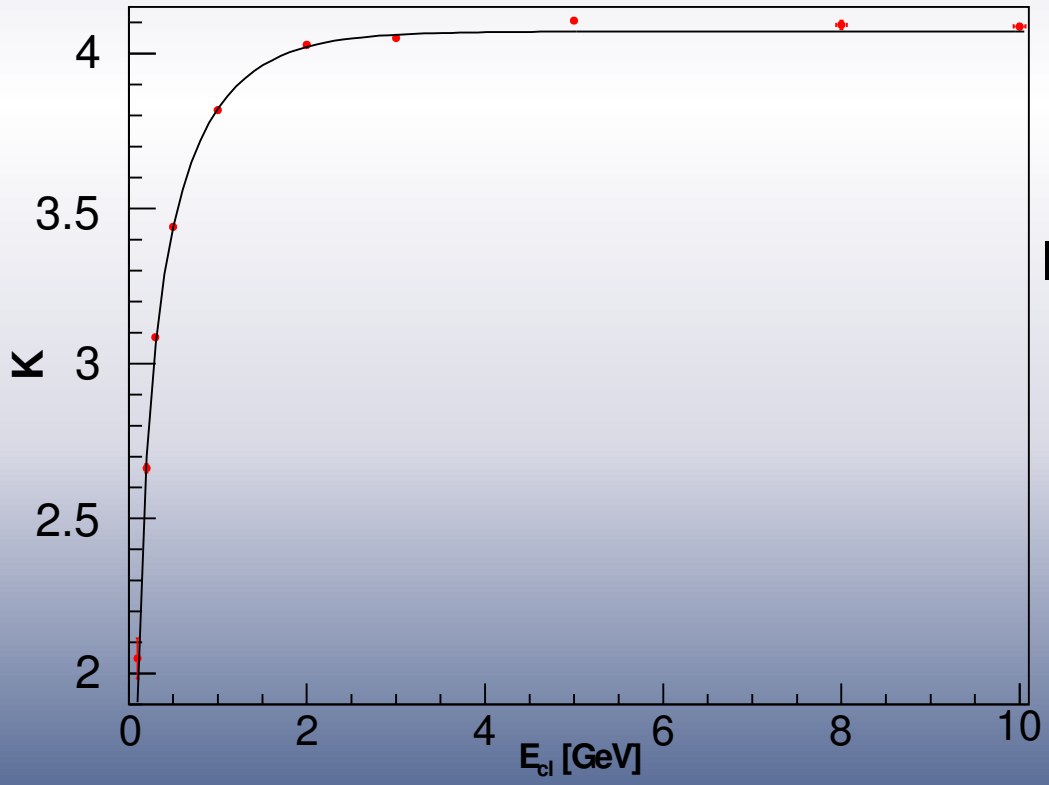

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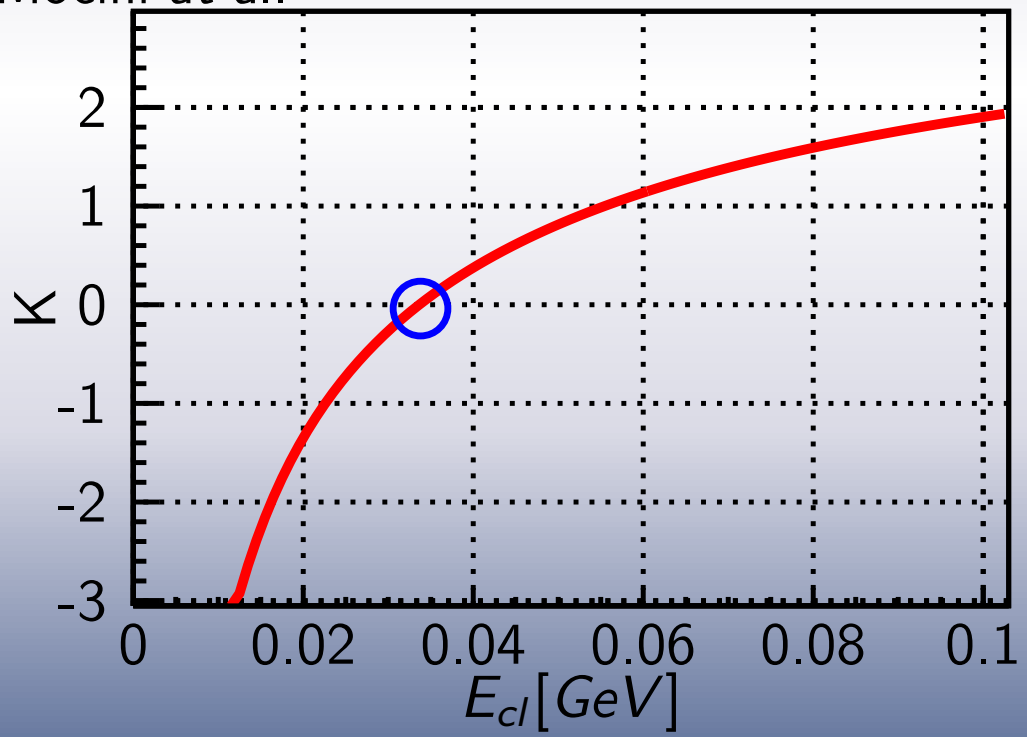

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Motivation Motivation

Measurement is needed!

Experiment @ Lund The experiment

- 4x4 matrix of Forward End-Cap type PWO crystals
- 3x3 are equipped with VPTTs (Hamamatsu R11375 with Al stripes)
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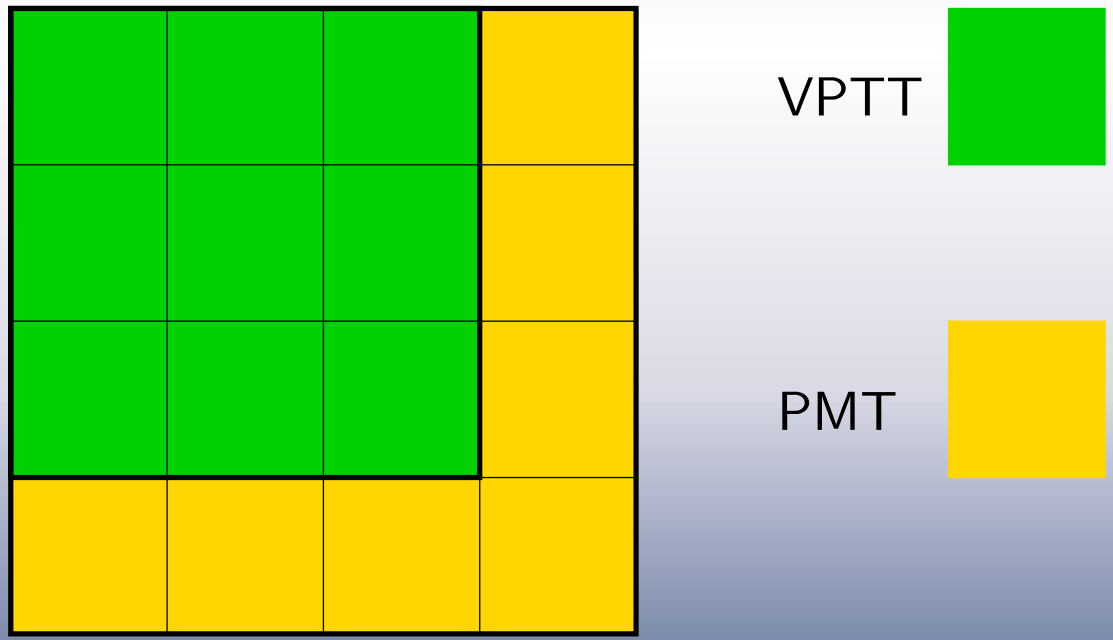

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- The fADC (from Uppsala) is placed close to the setup in the cave (on room-temperature)
- the signal from the fADC is transfered to the counting room via an optical link
- The DAQ is in the control-room.

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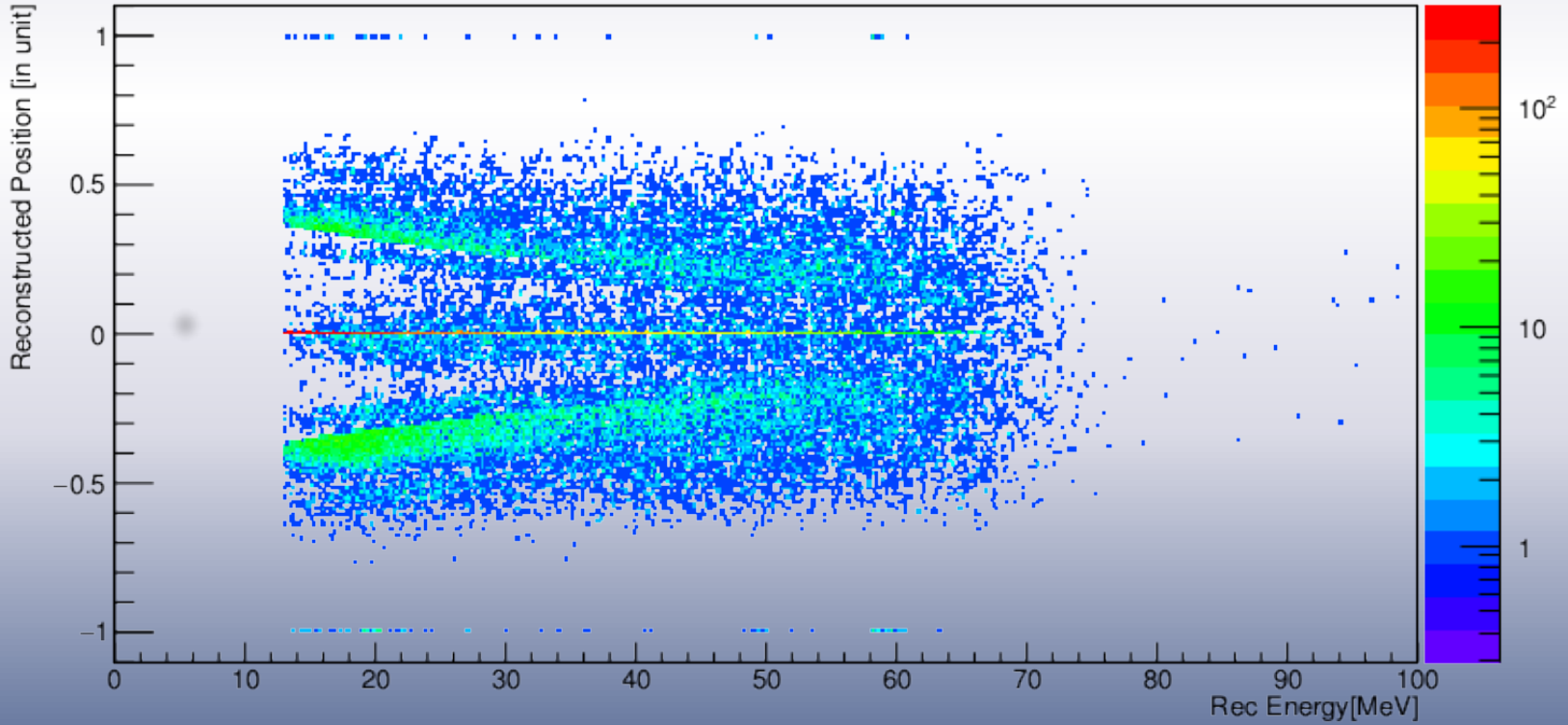
- Trigger on four selected tagger-channels for calibration purpose
- Trigger on 16 tagger-channels (between 13 and 70 MeV) for the measurement

Analysis Analysis

- individual crystal threshold: 2.25, 3 and 5 MeV
- cluster threshold: 13 MeV

Analysis Analysis

Reconstructed position distribution as a function of the deposited energy [K=4]



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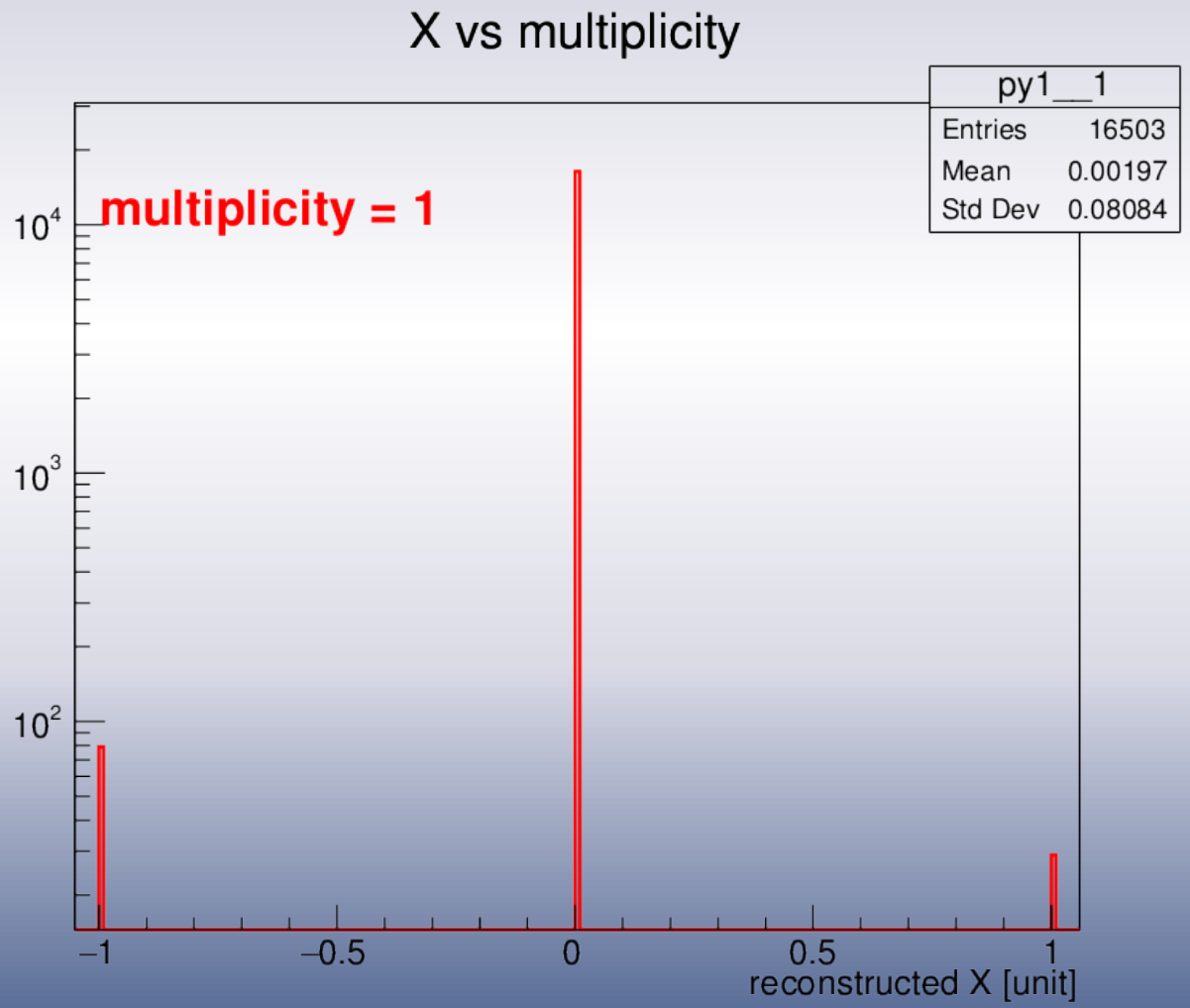

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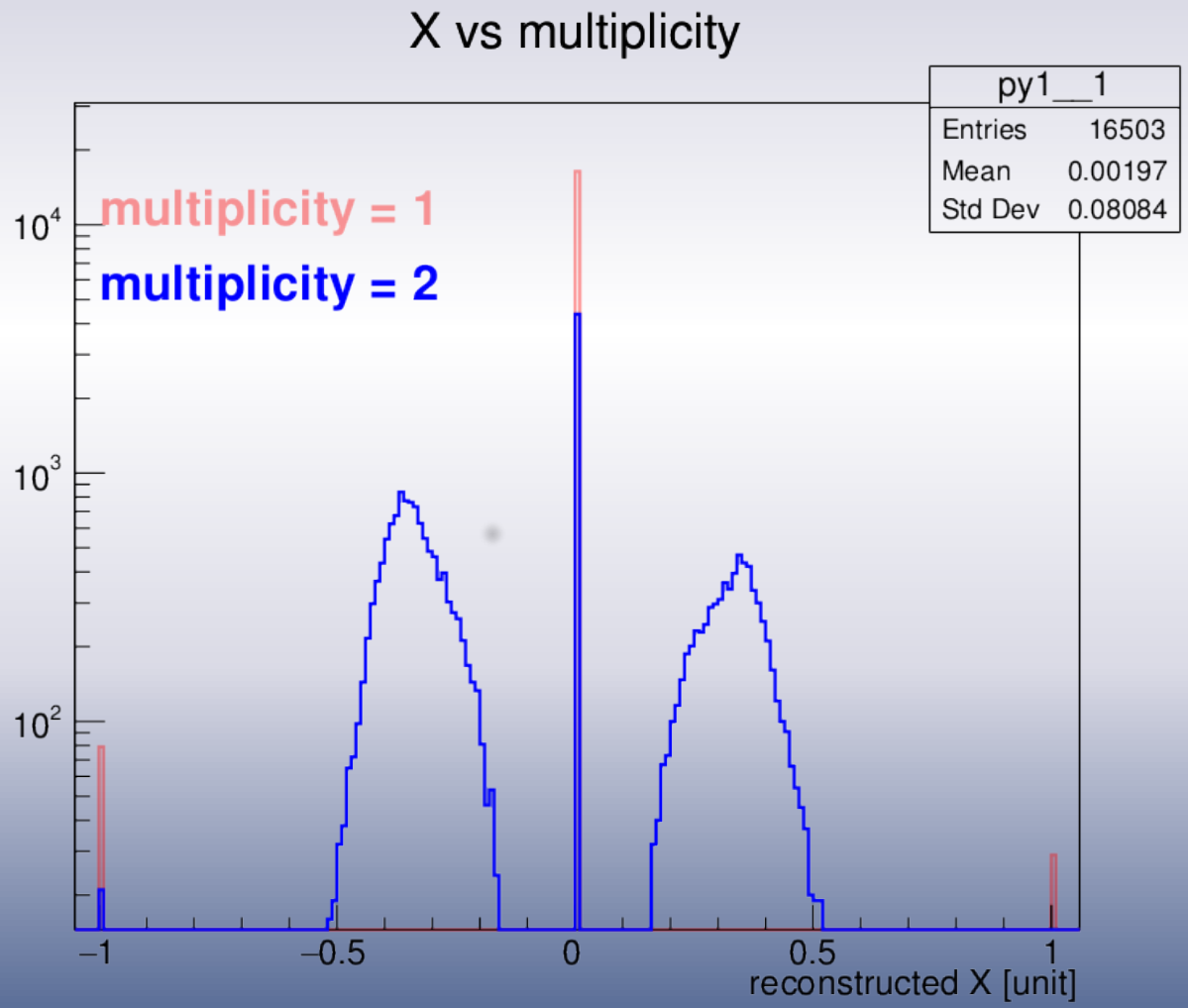

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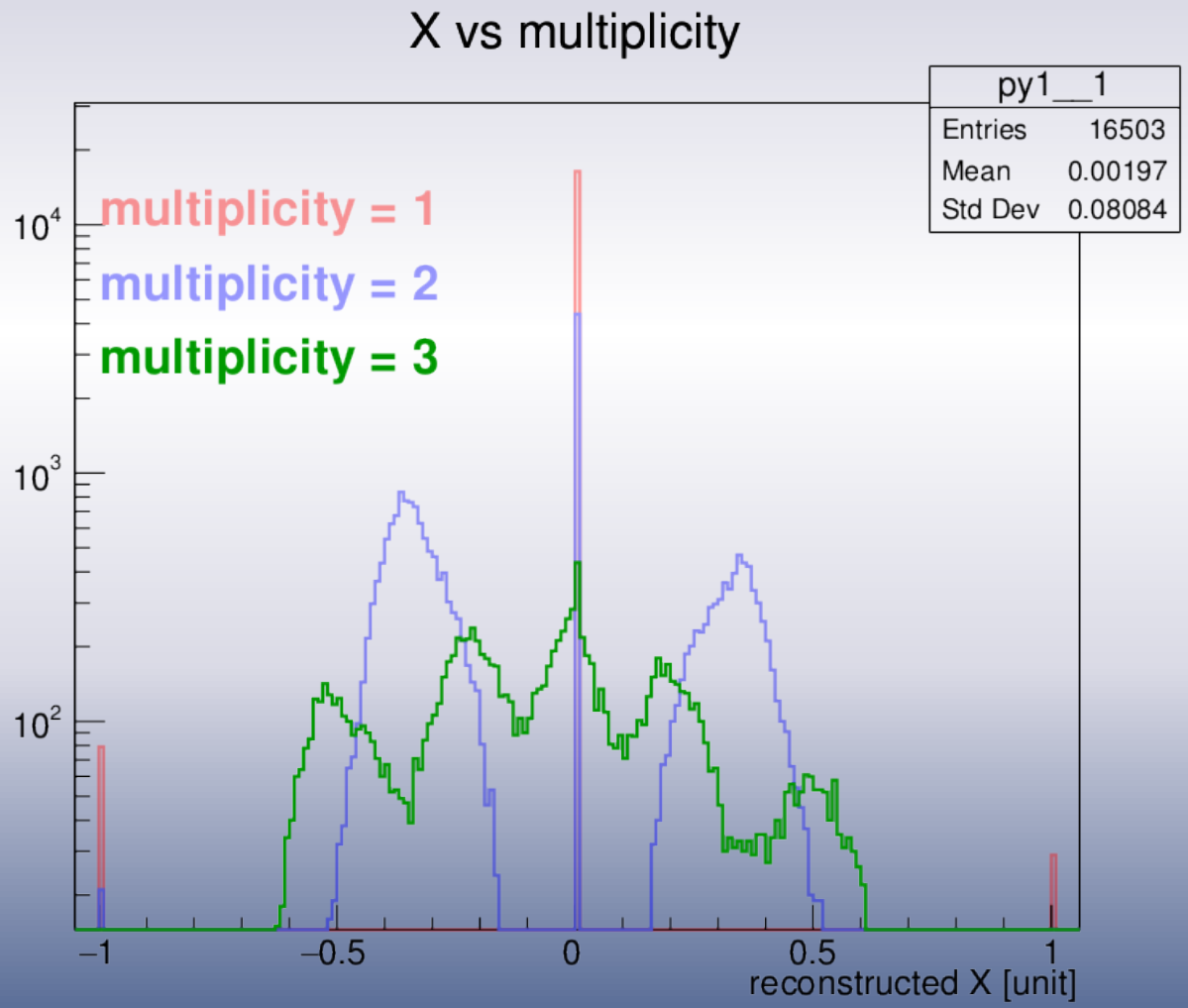

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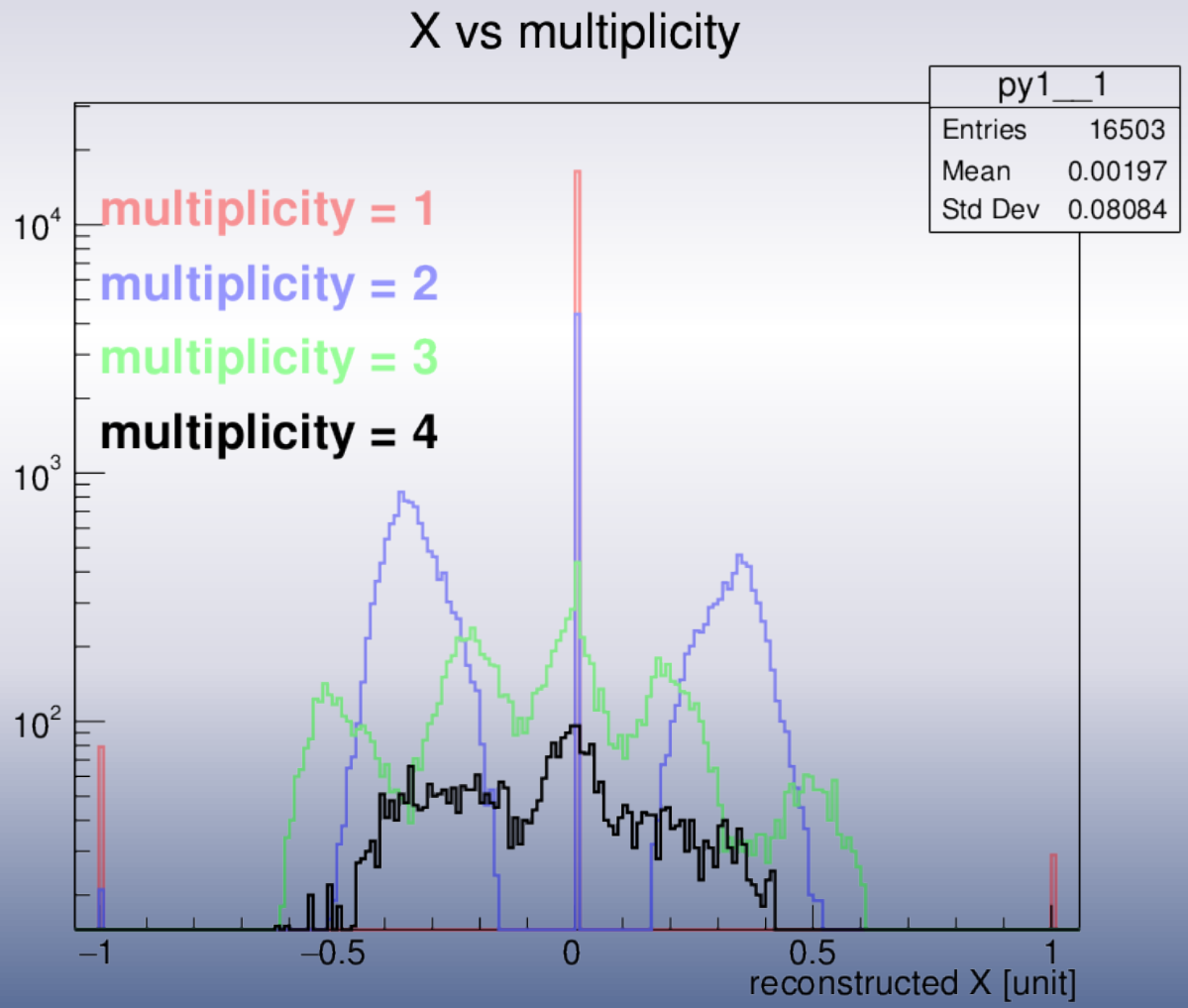

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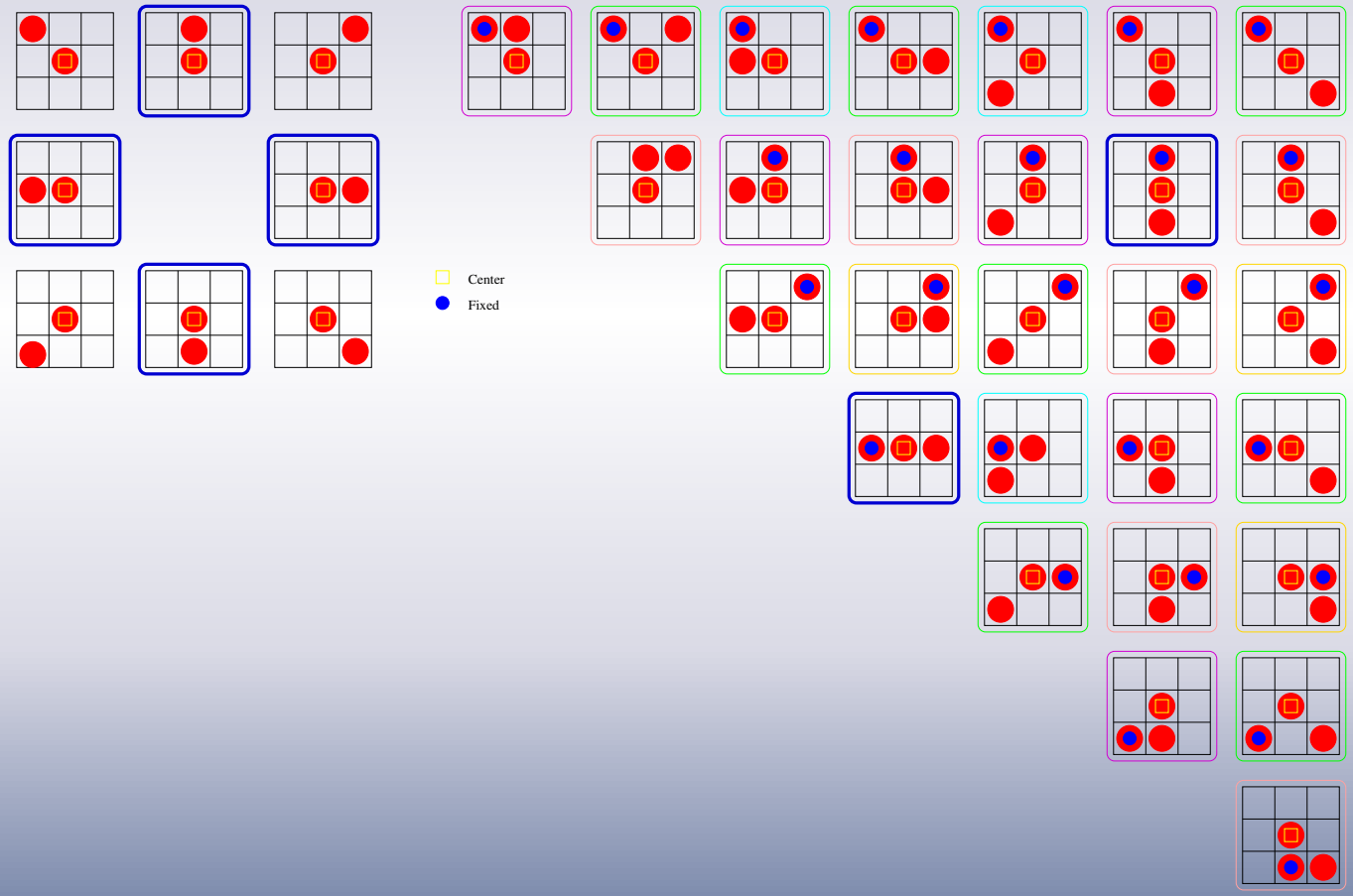

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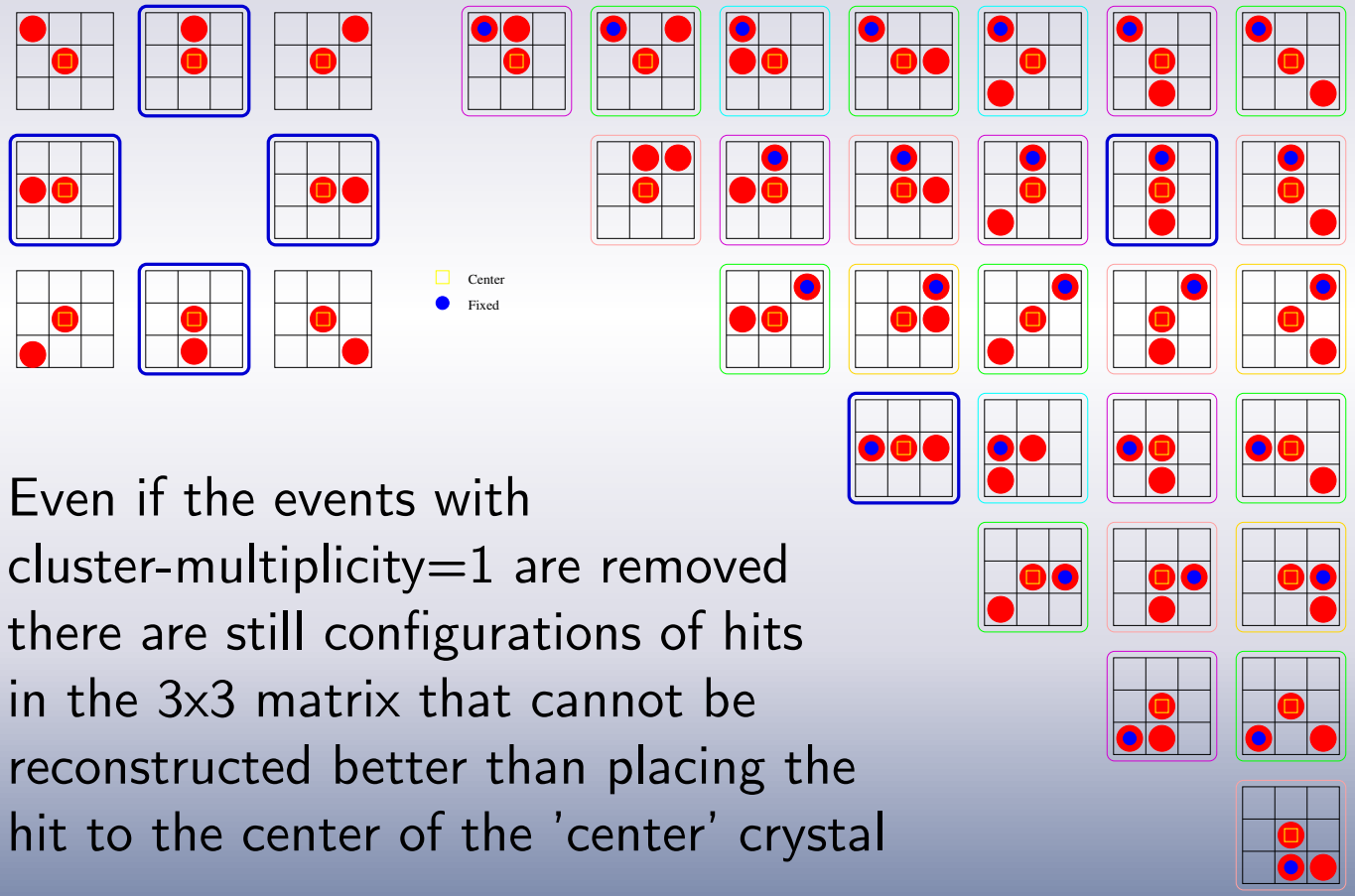
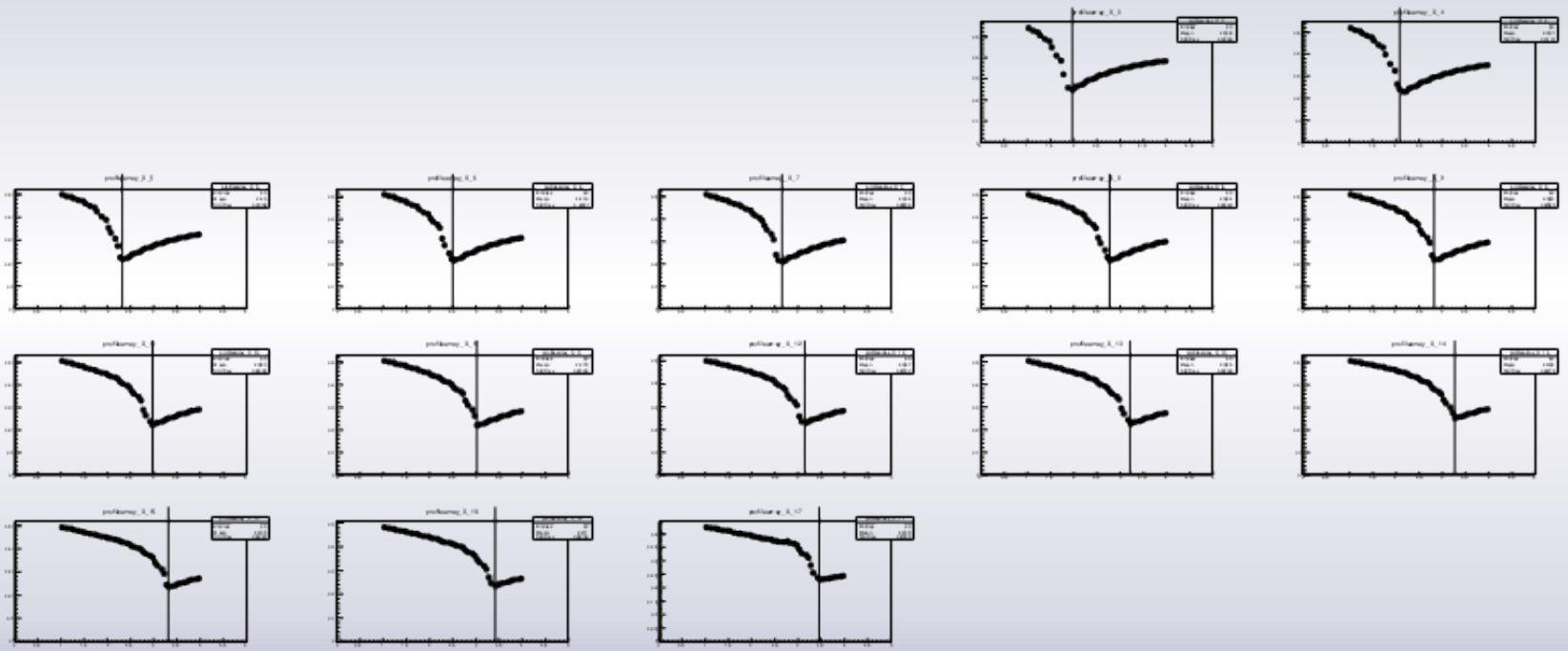


Even if the events with cluster-multiplicity=1 are removed there are still configurations of hits in the 3x3 matrix that cannot be reconstructed better than placing the hit to the center of the 'center' crystal

Analysis Analysis

- no additional information can be used about the position of the hit,
  - instead of compering the reconstructed hit position with some secondary information, we try to minimize the width (RMS) of the distribution of the photons
- In order to be able to do the reconstruction properly the X_{rec}=0 are removed
- several different 'K' were used between 1 and 4 in steps of 0.05

Results Results



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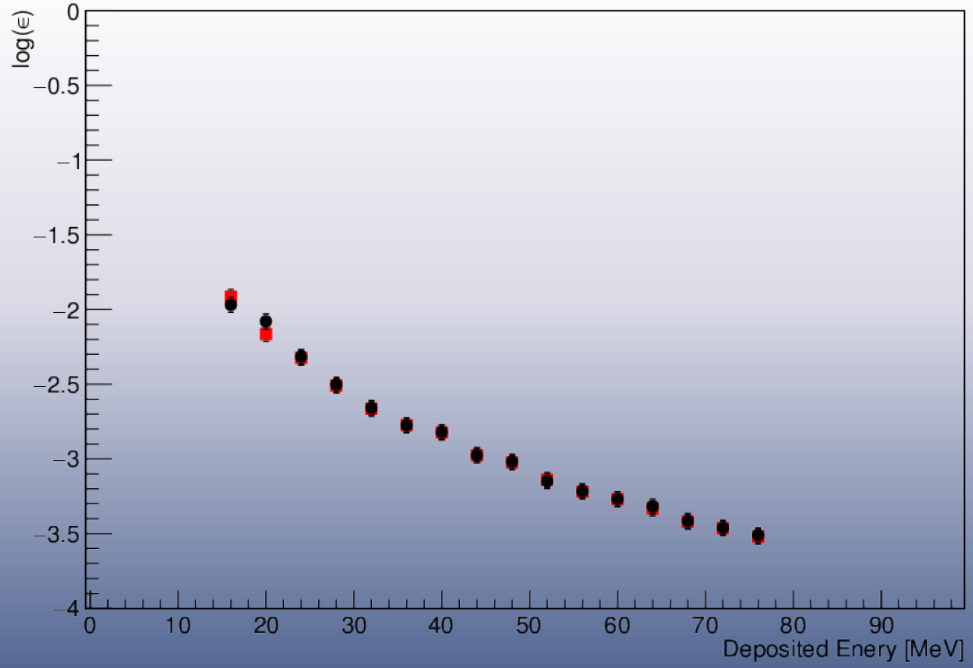

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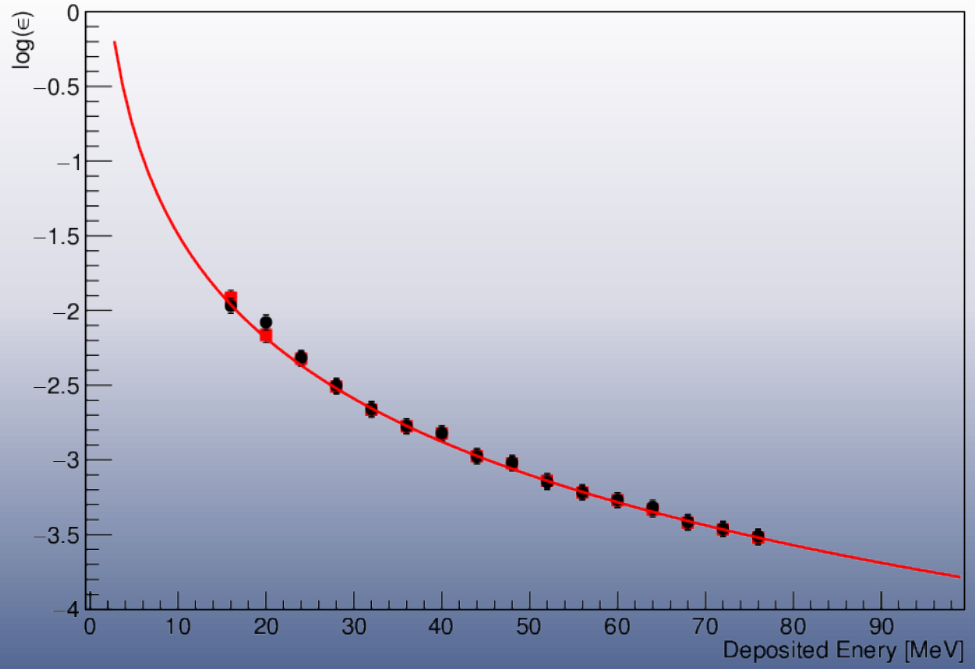

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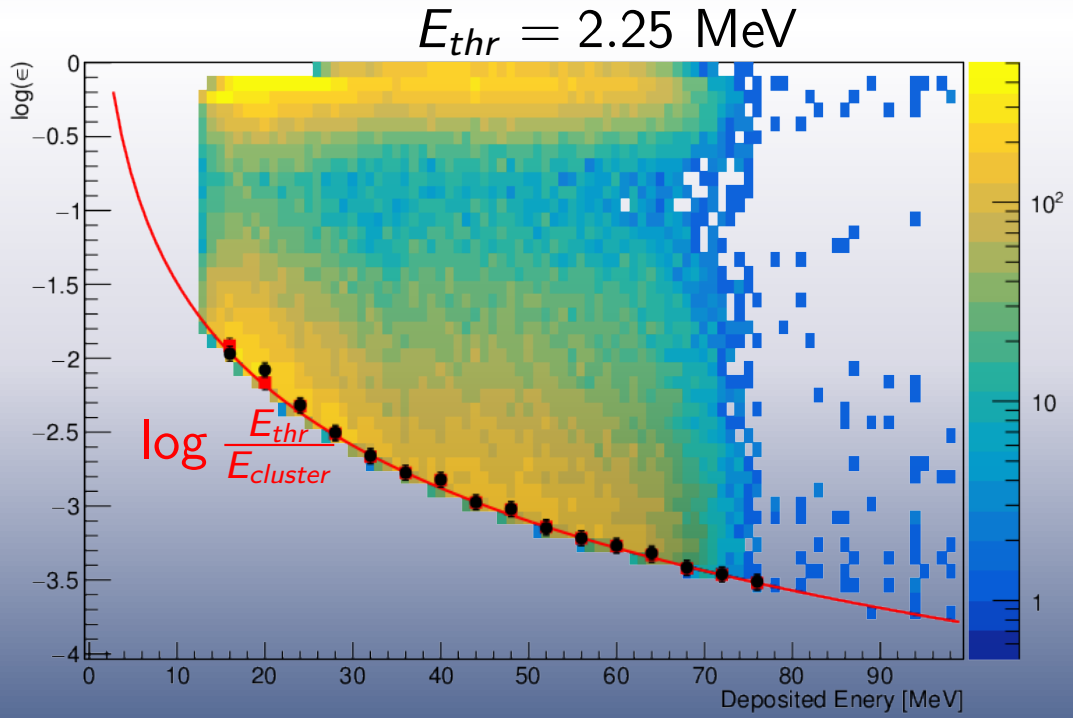

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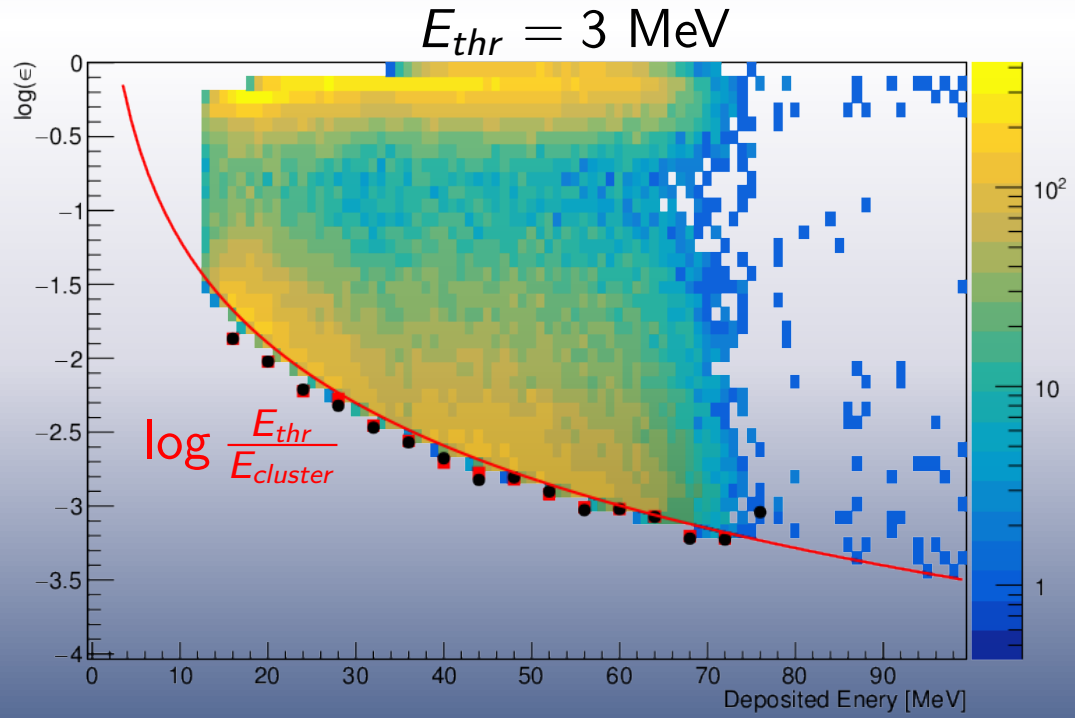

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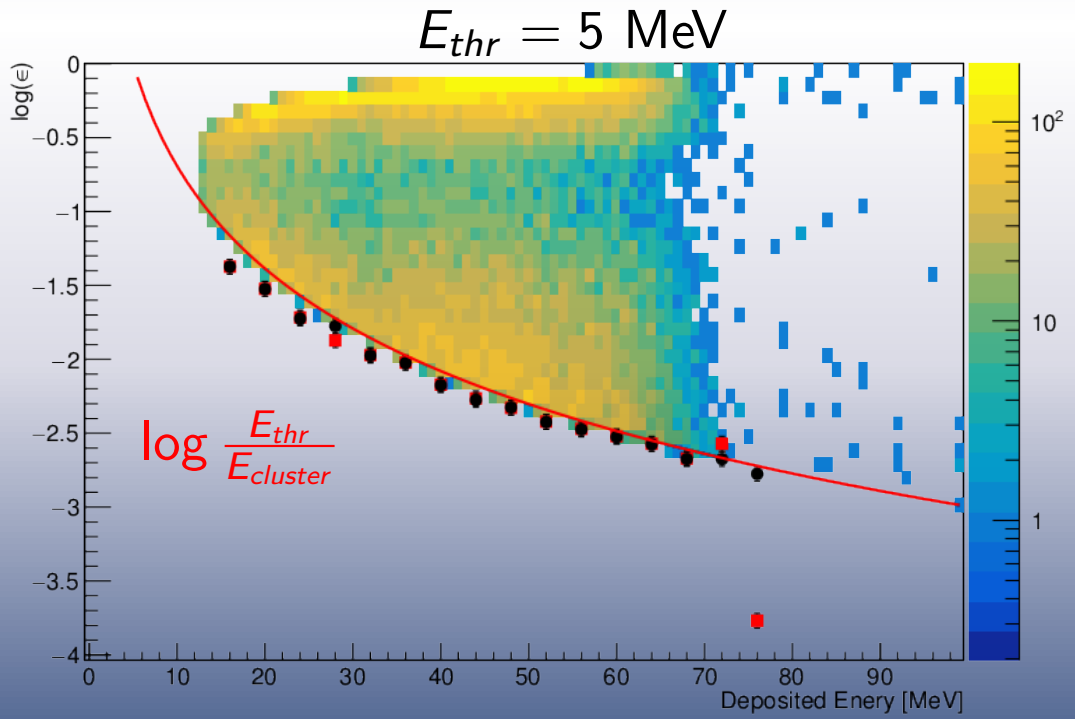

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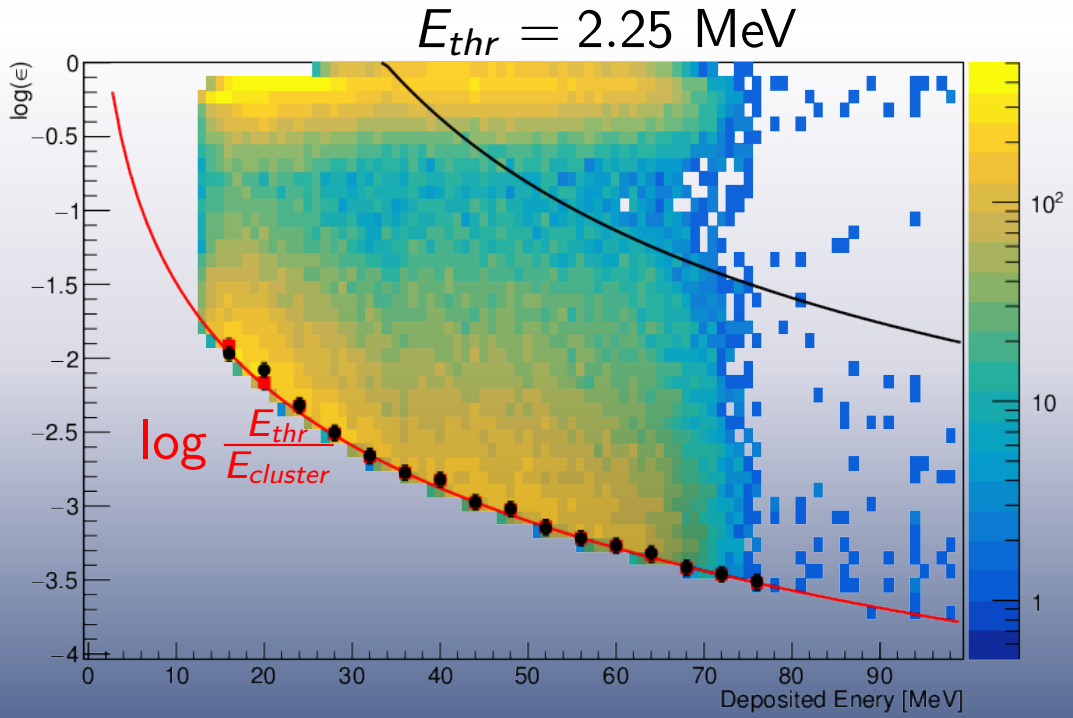

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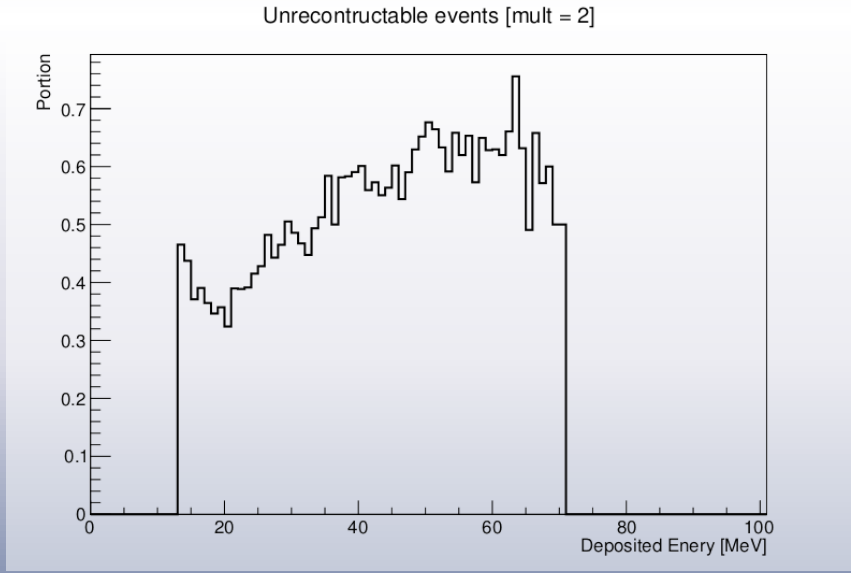

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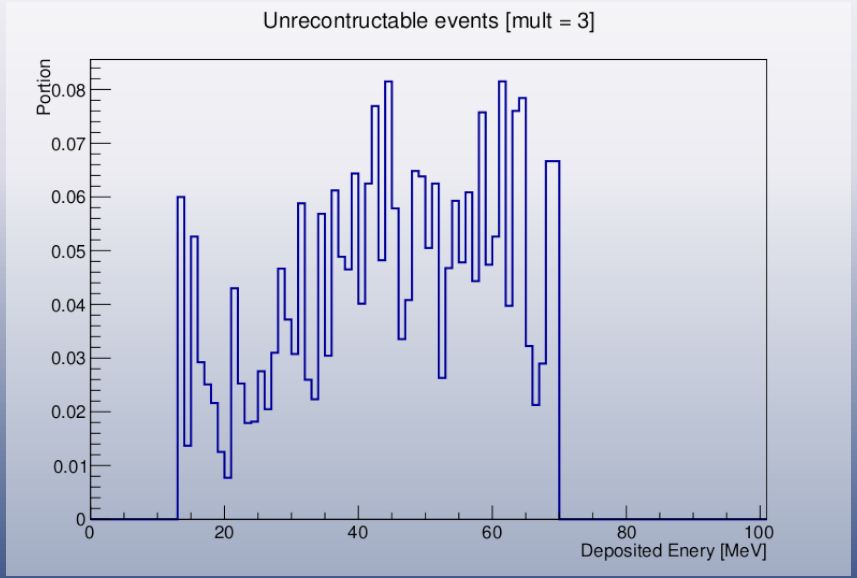

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- The number of events that can be reconstructed at low energies ($\leq$ 70 MeV) is not negligible
- My analysis shows that the optimal K value follows the $-log(\frac{E_{thr}}{E_{cluster}})$ (all event is used!)

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- support the results via MC (modelling the used setup and the whole PANDA)
- performing the reconstruction of hits with non-central beam positions

Thank You