

Working Group PNS



Laboratoire de Physique
des 2 Infinis

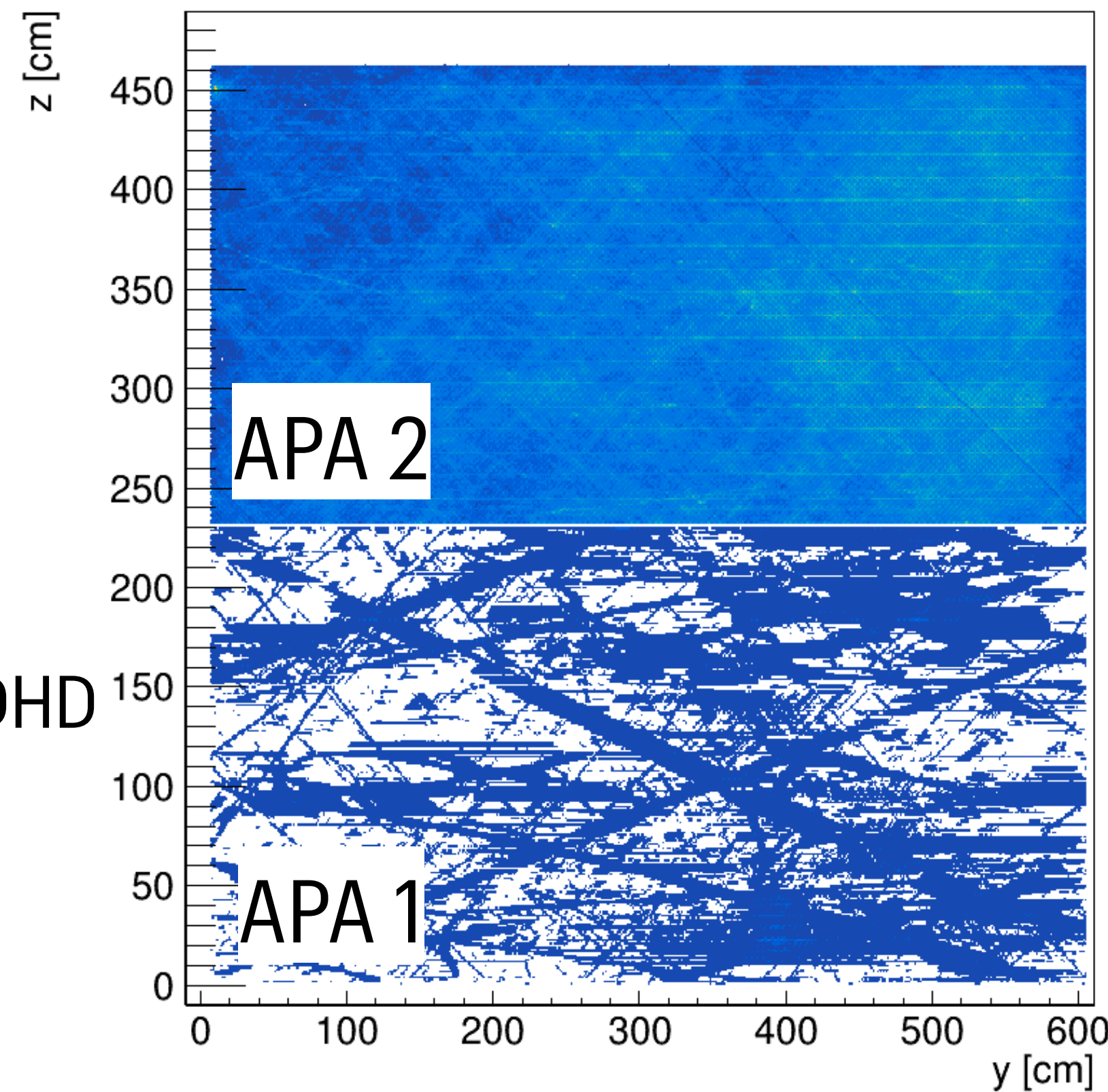


Summary

- SingleHit module philosophy
- Bismuth 207 in PDHD
- PNS ColdBox

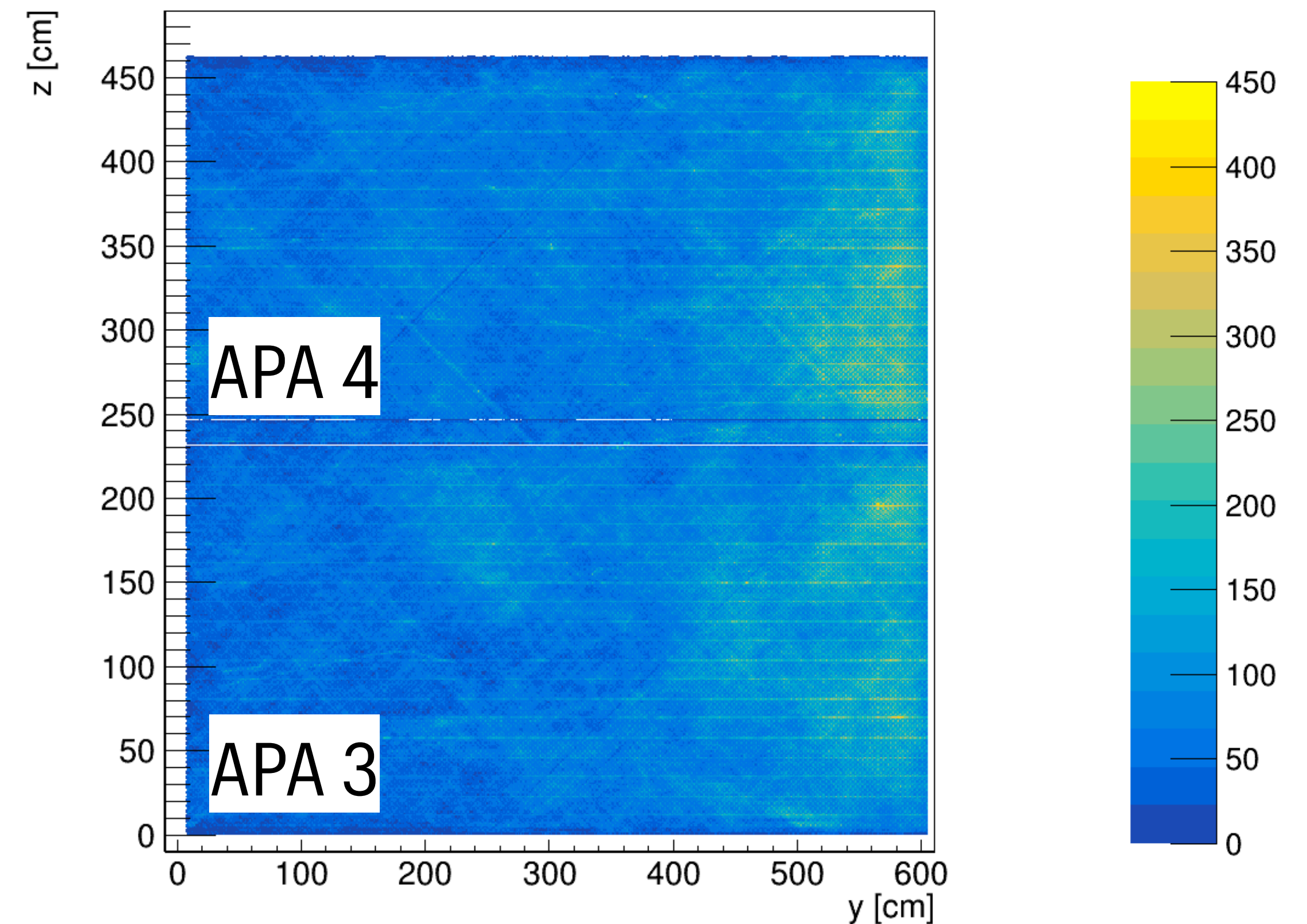
- LArSoft analysis/reconstruction module developed for 2 years ([github here](#))
- **First: reconstruction of the position** of hit with low charge $\lesssim 500$ [ADCxticks] ≈ 10 [MeV]
 - `pandora` and `reco3d` optimised for GeV track like events
 - **crossing point** of a collection wire with 1 or 2 induction wire in **time coincidence** (2 or 3 view coincidence)

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100 events

Run 28850 PDHD

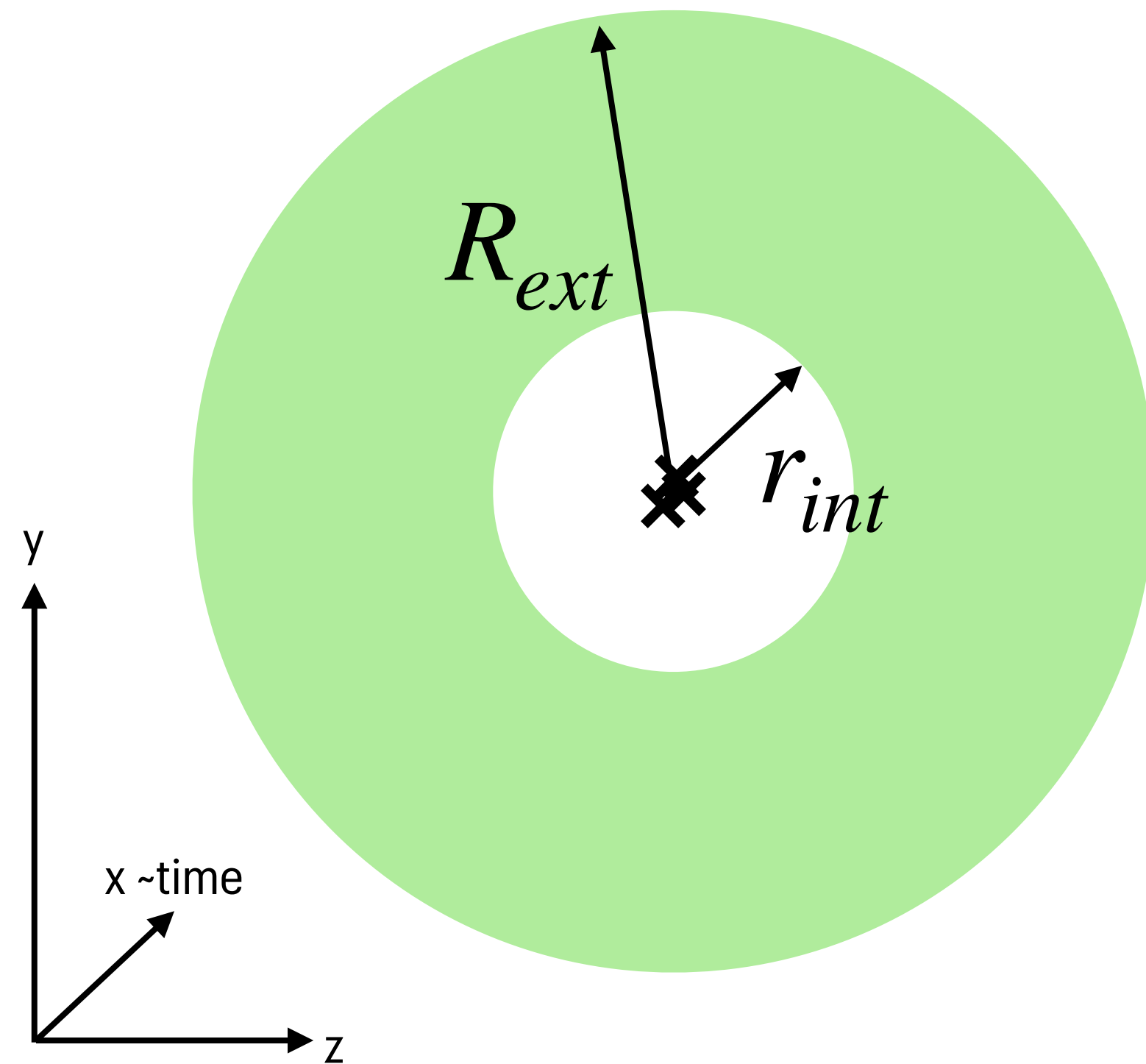


achieved precision on spatial reconstruction (test on MC) ≈ 0.5 cm \approx wire pitch

- First: reconstruction of the position of hit with low charge $\lesssim 500$ [ADCxticks] ≈ 10 [MeV]
- Second: the reconstructed space-points must be **isolated** and **localised**
 - **isolated** → important for **surface detectors** (cosmic contamination) : protoDUNE's
 - **localised** → Ar39 spread on up to 2 wires/channels
 - blip-like (PNS, higher energy radiologicals ...) spreads on few wires/channels

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« Donut analysis »



$$R_{ext} > 10 \text{ cm}$$

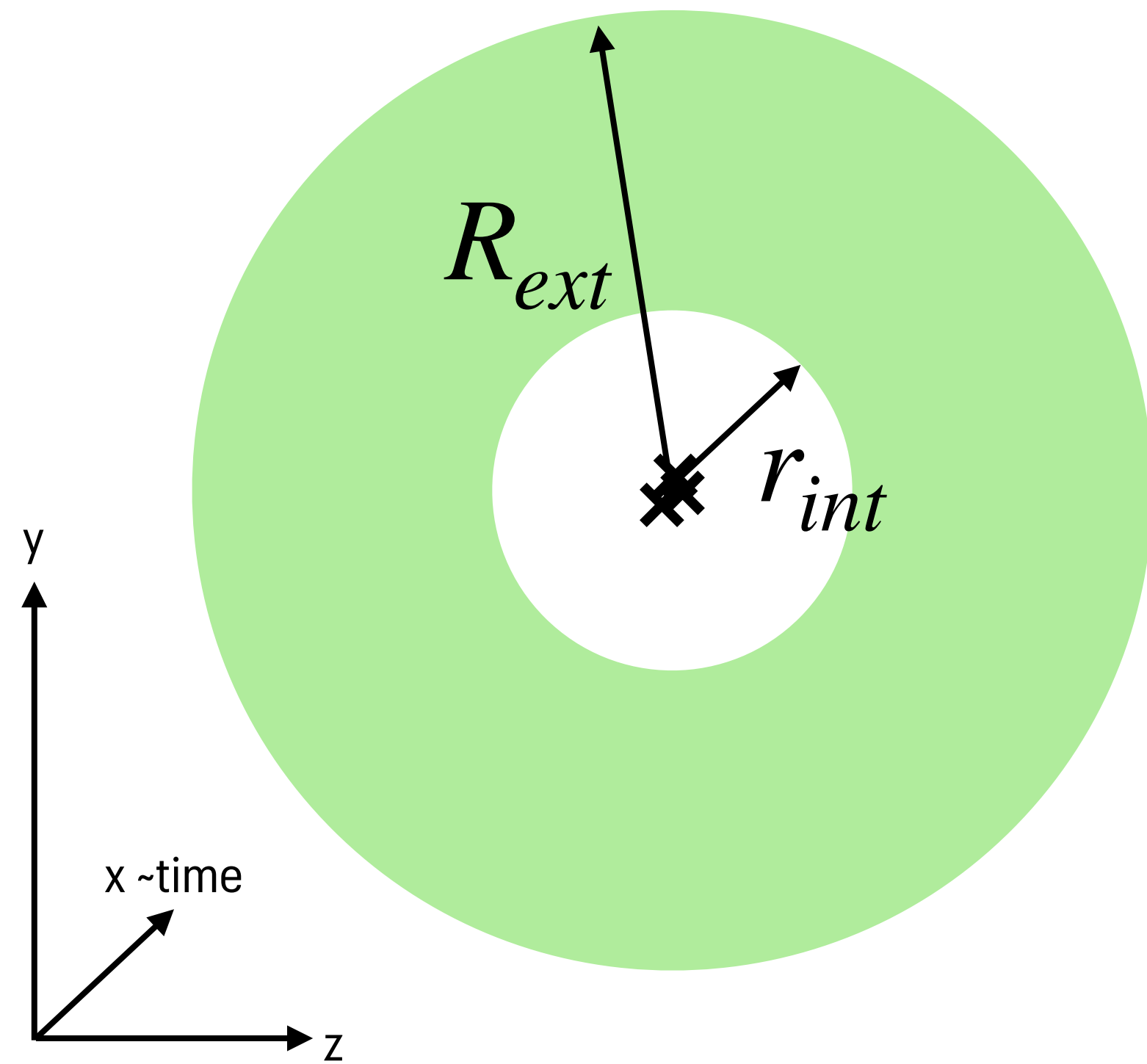
$$r_{int}^{39\text{Ar}} = 0.5 \text{ cm}$$

$$r_{int}^{\text{PNS}} = 4 \text{ cm}$$

z [cm]

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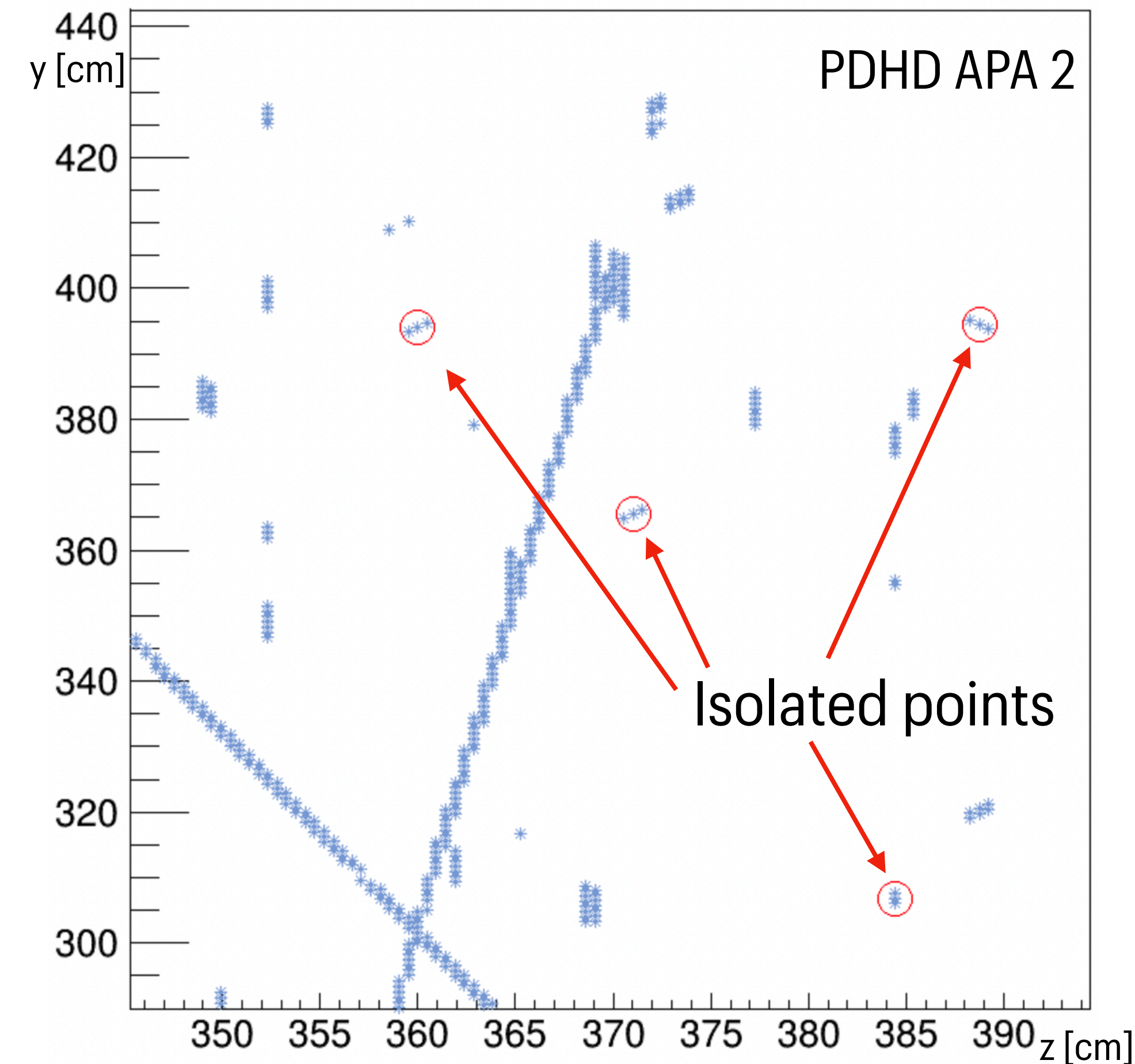
« Donut analysis »



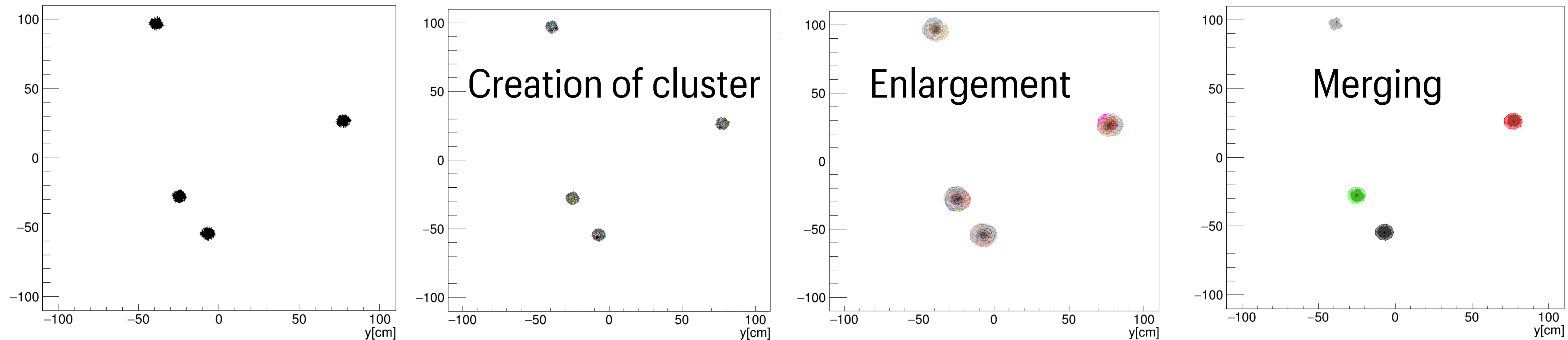
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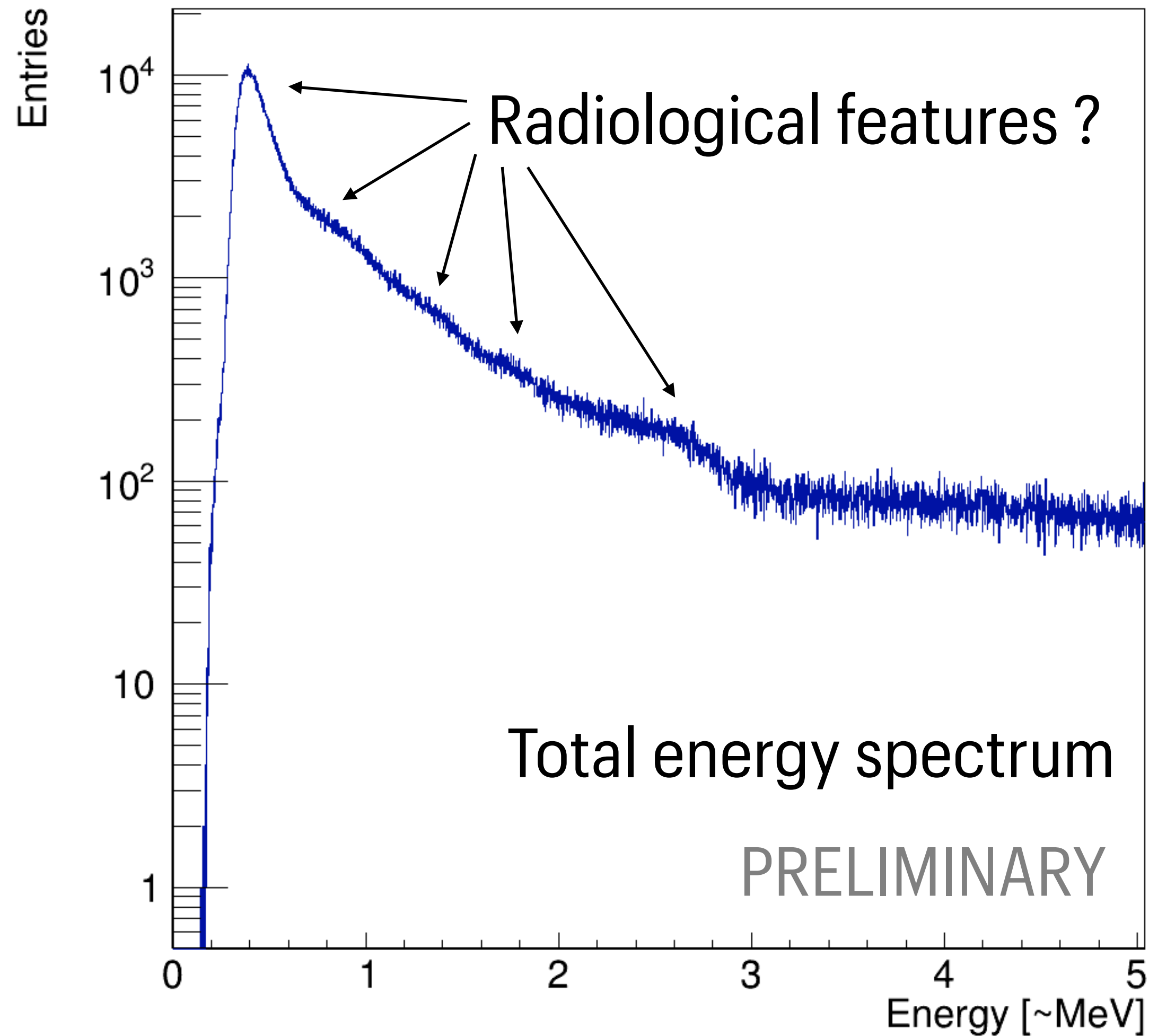


- **First:** reconstruction of the position of hit with low charge $\lesssim 500$ [ADCxticks] ≈ 10 [MeV]
- **Second:** the reconstructed space-points must be **isolated** and **localised**
- **Third:** Clustering of this space-points (lloyd-kpp algorithm) (not going to develop here if interested go [see](#))

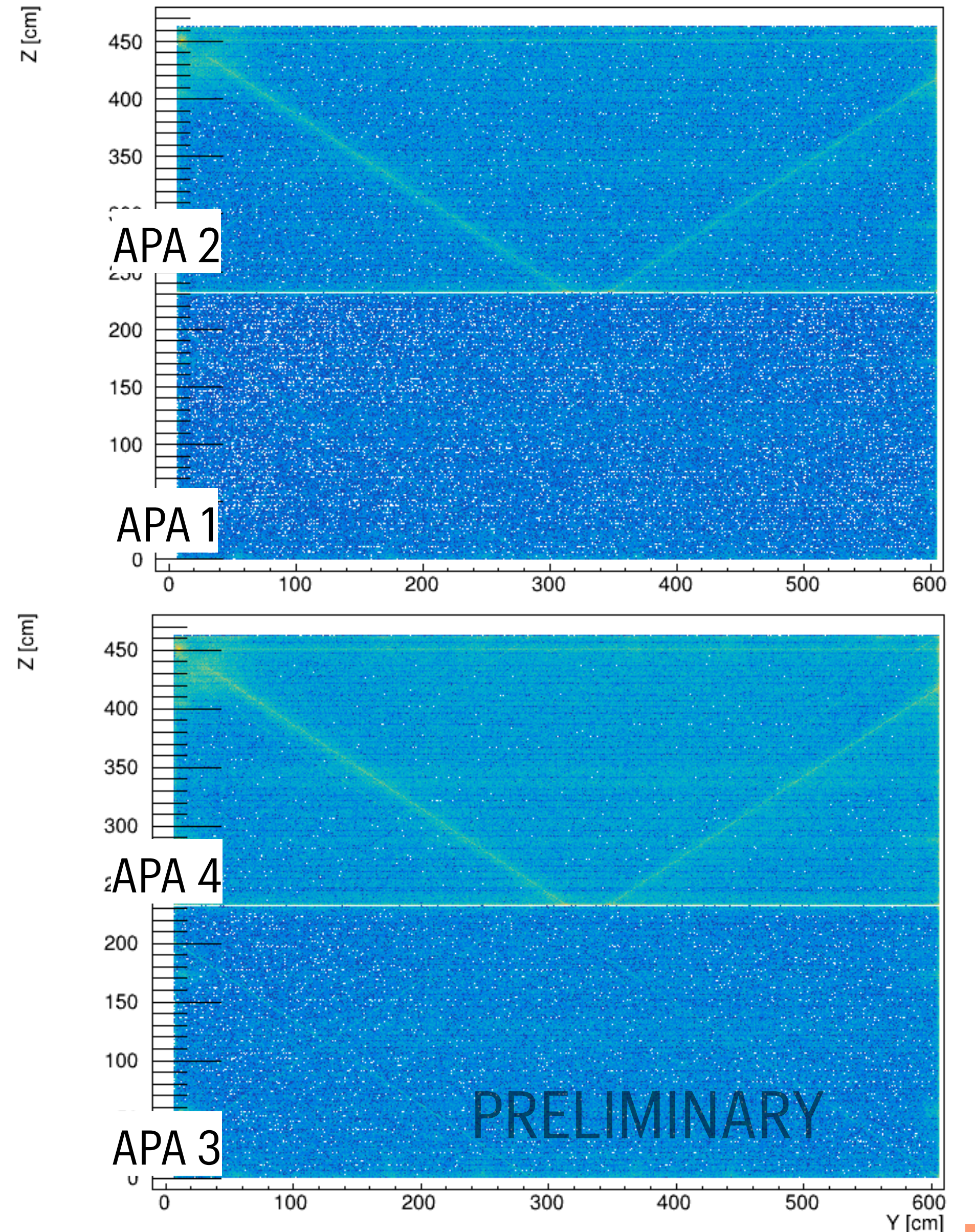
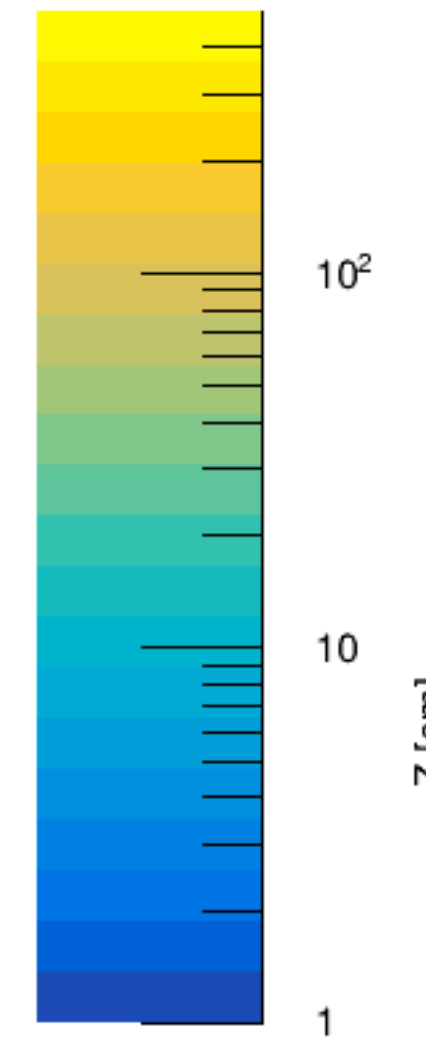


Module has been **optimised** (voxelisation search...) and is ready for large production

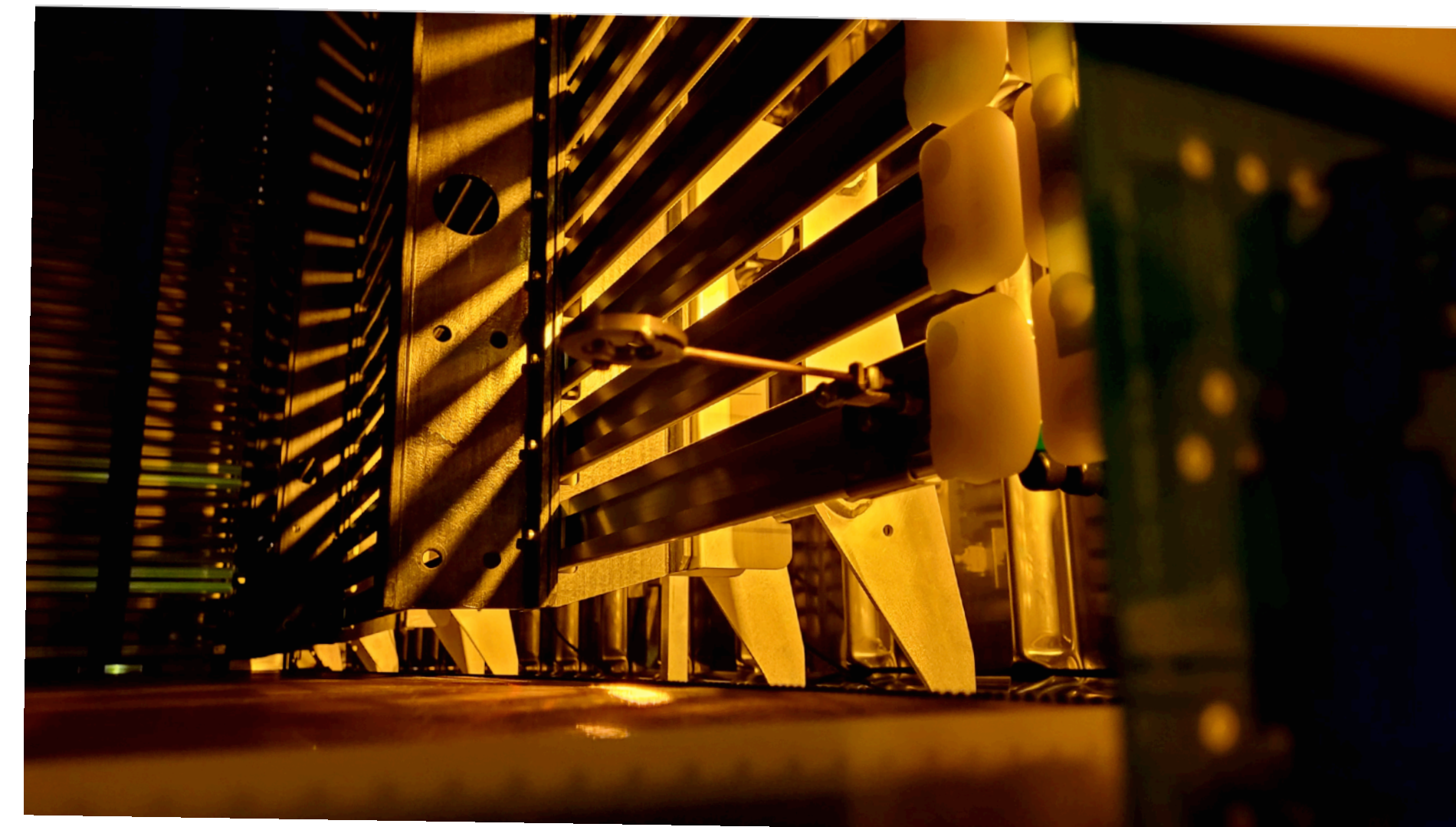
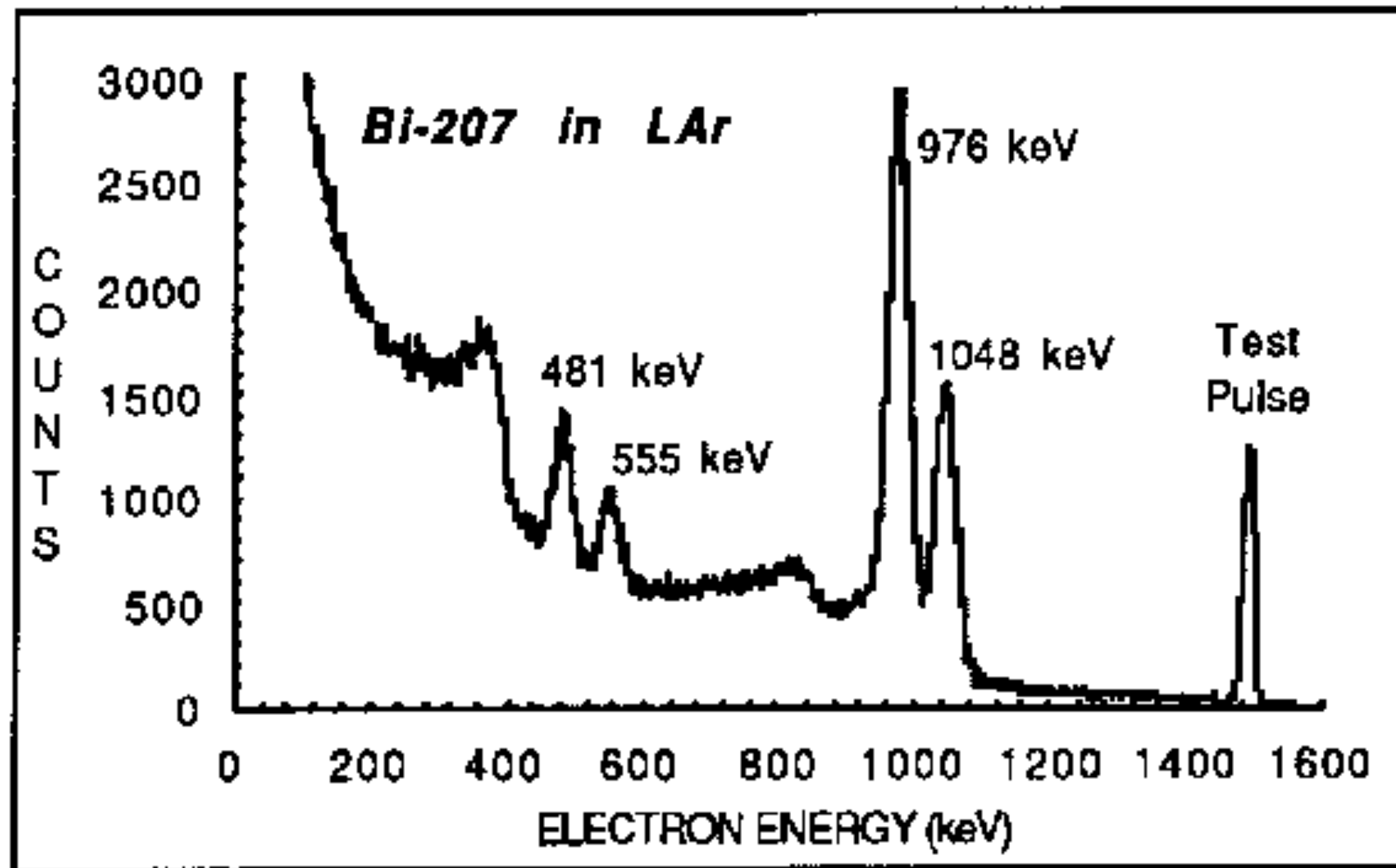
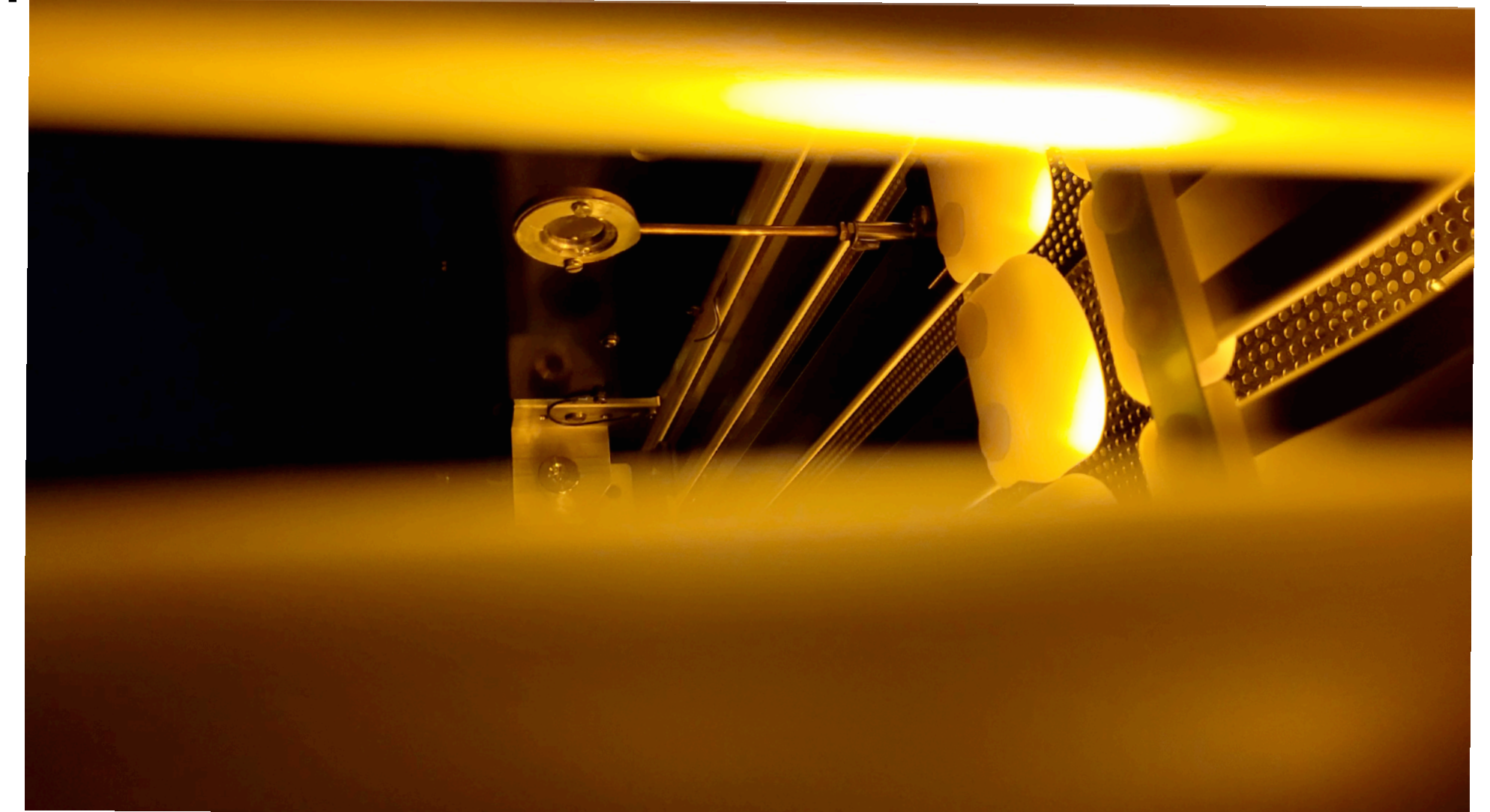
- **Run 28850** (Only cosmics) : 19530 events processed



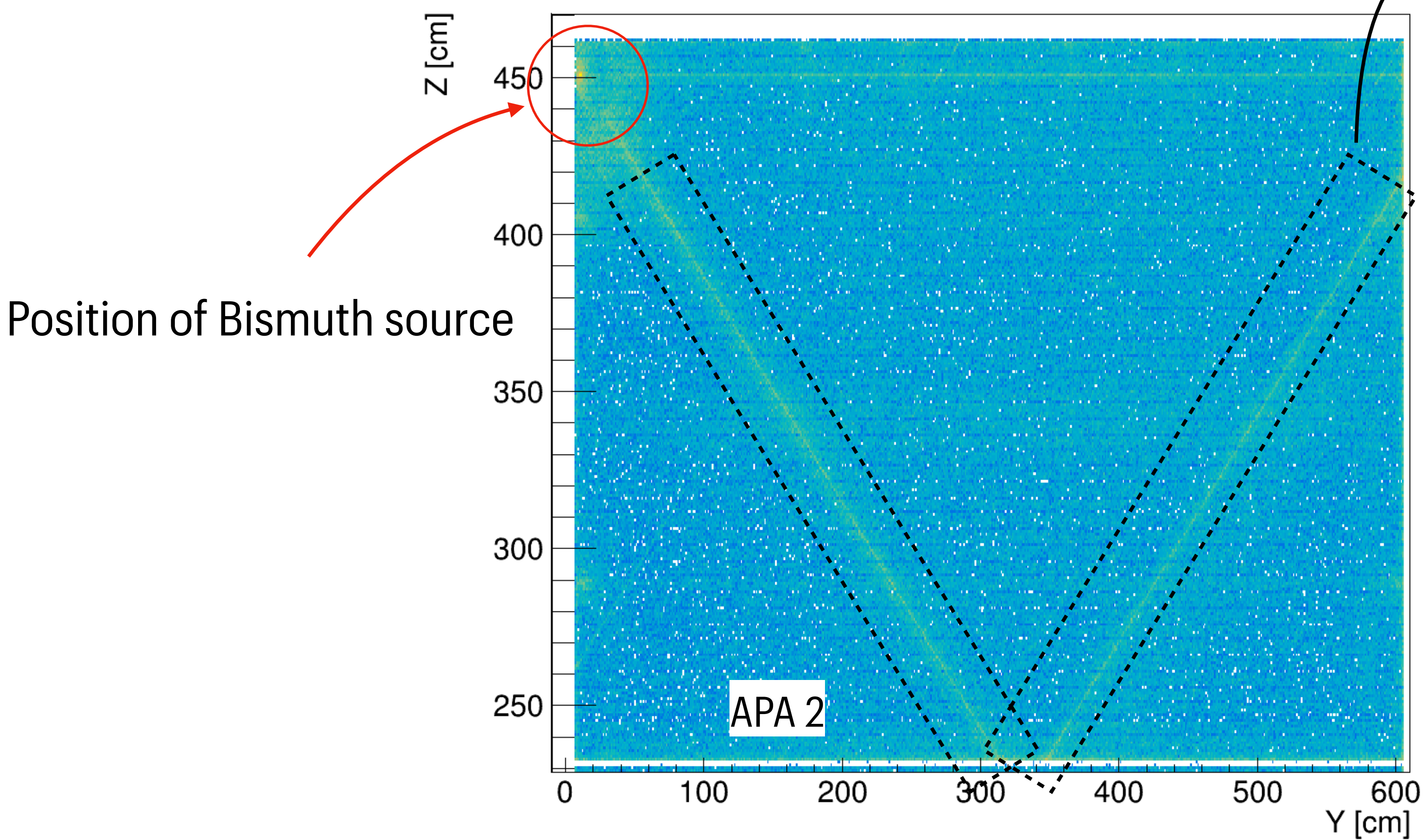
I look at 2 and 3 views hits



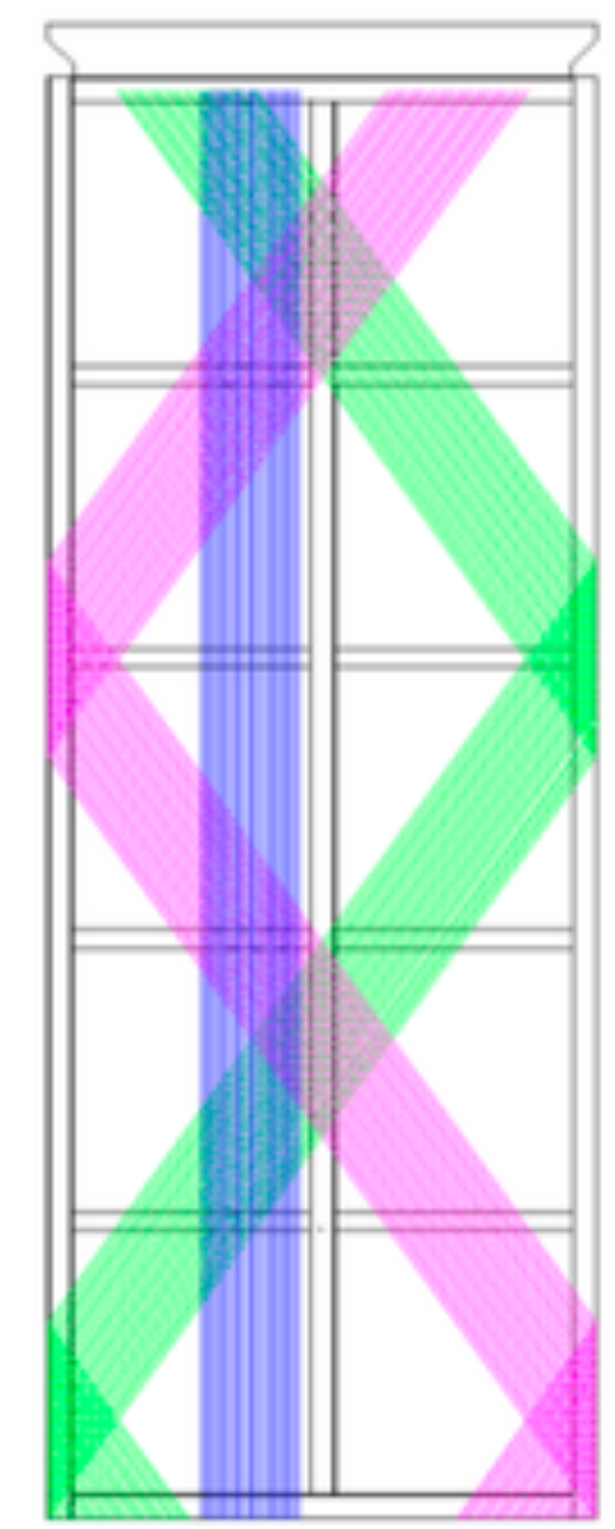
- two **207Bi** has been placed in PDHD in APA 2 volume
 - One on the APA 2 in bottom left corner
 - One on the CPA facing APA 2



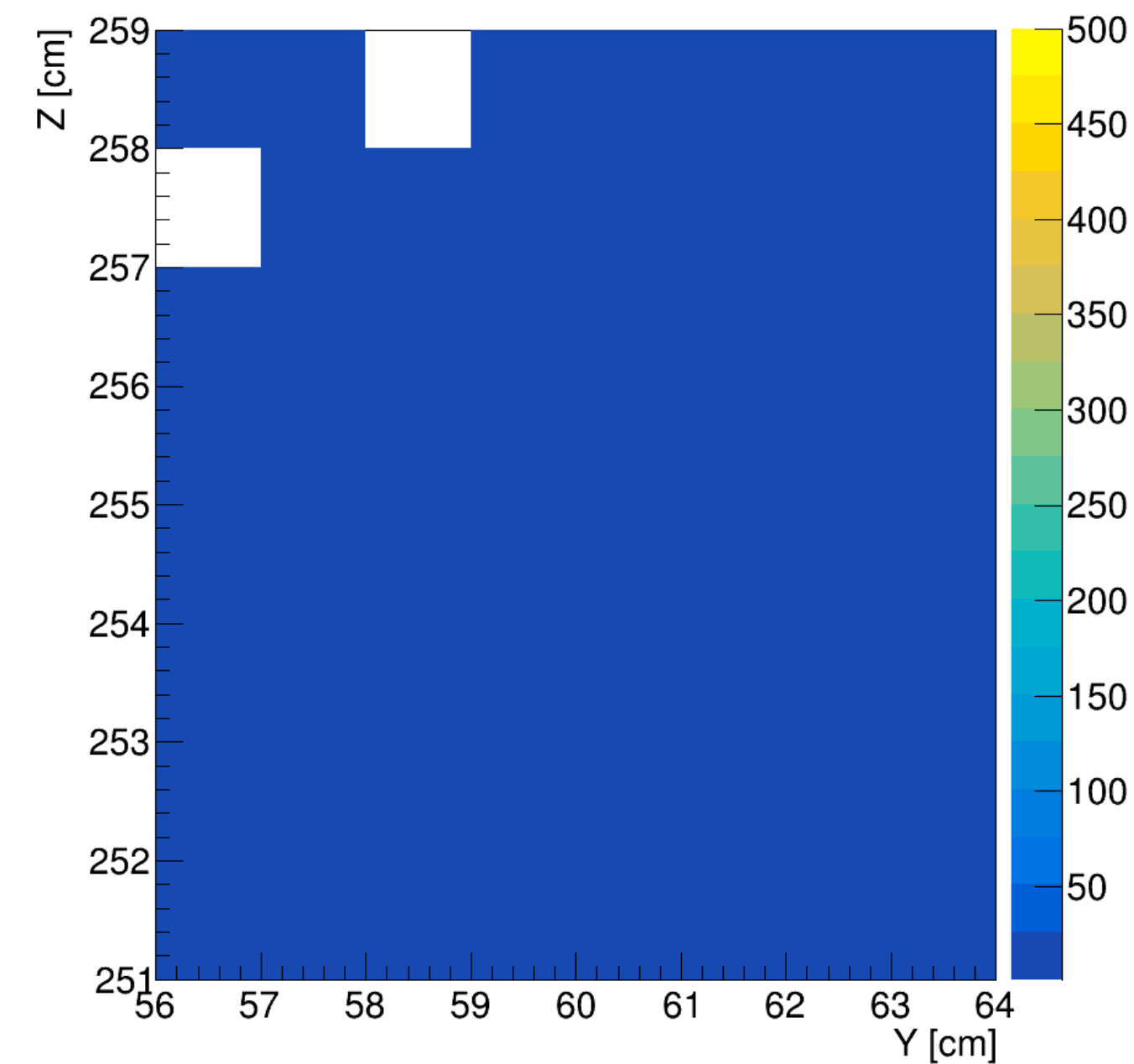
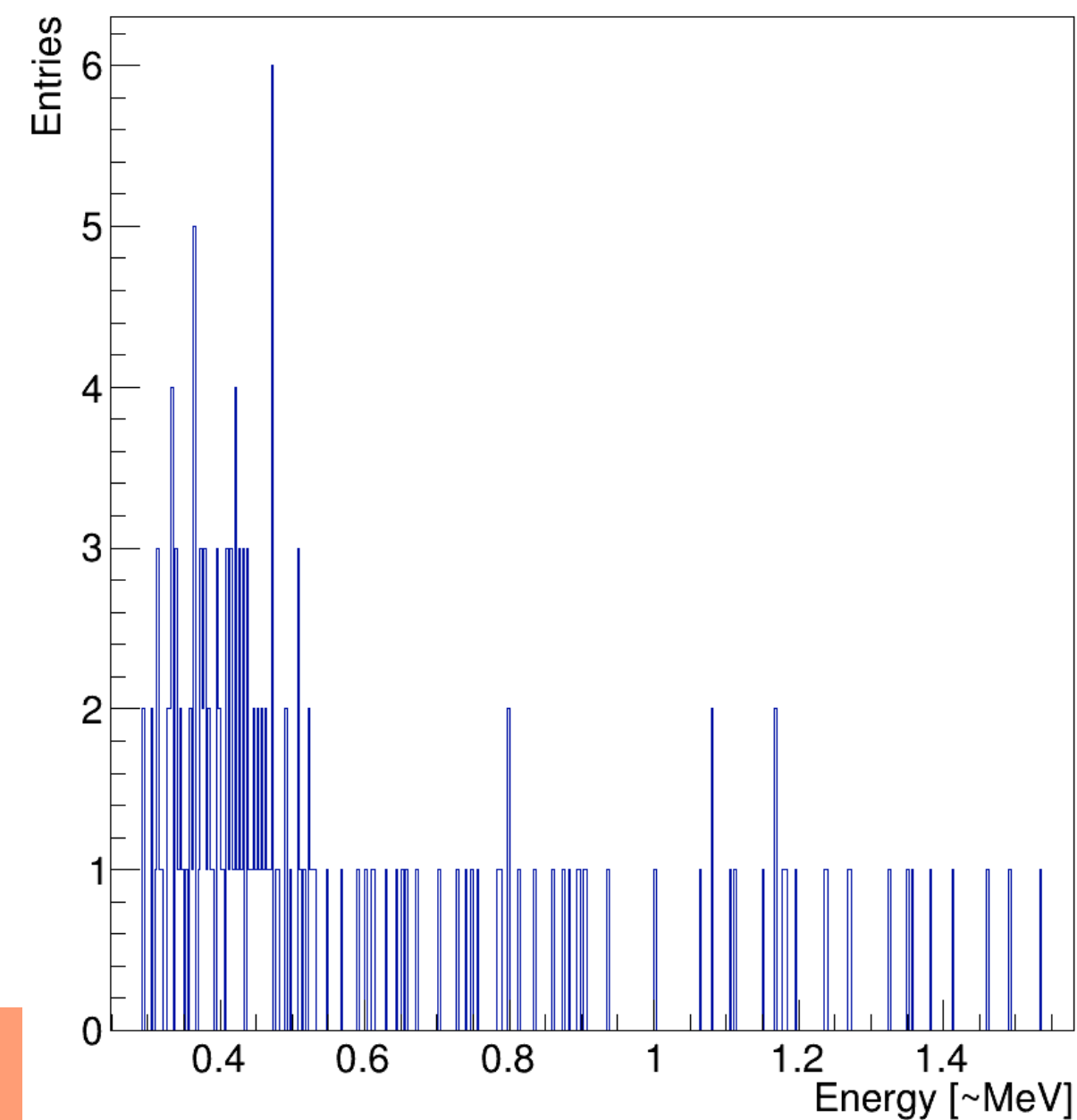
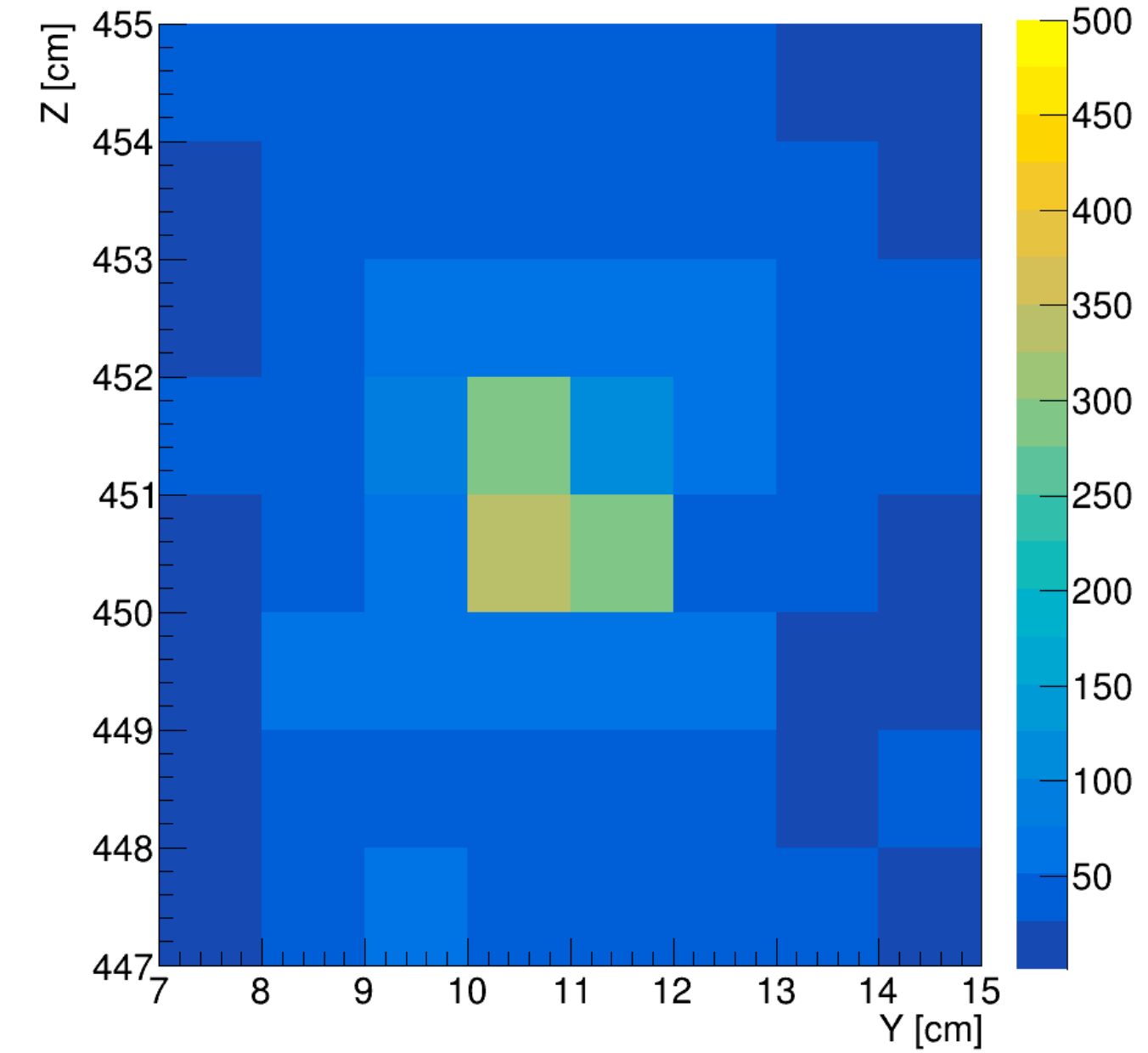
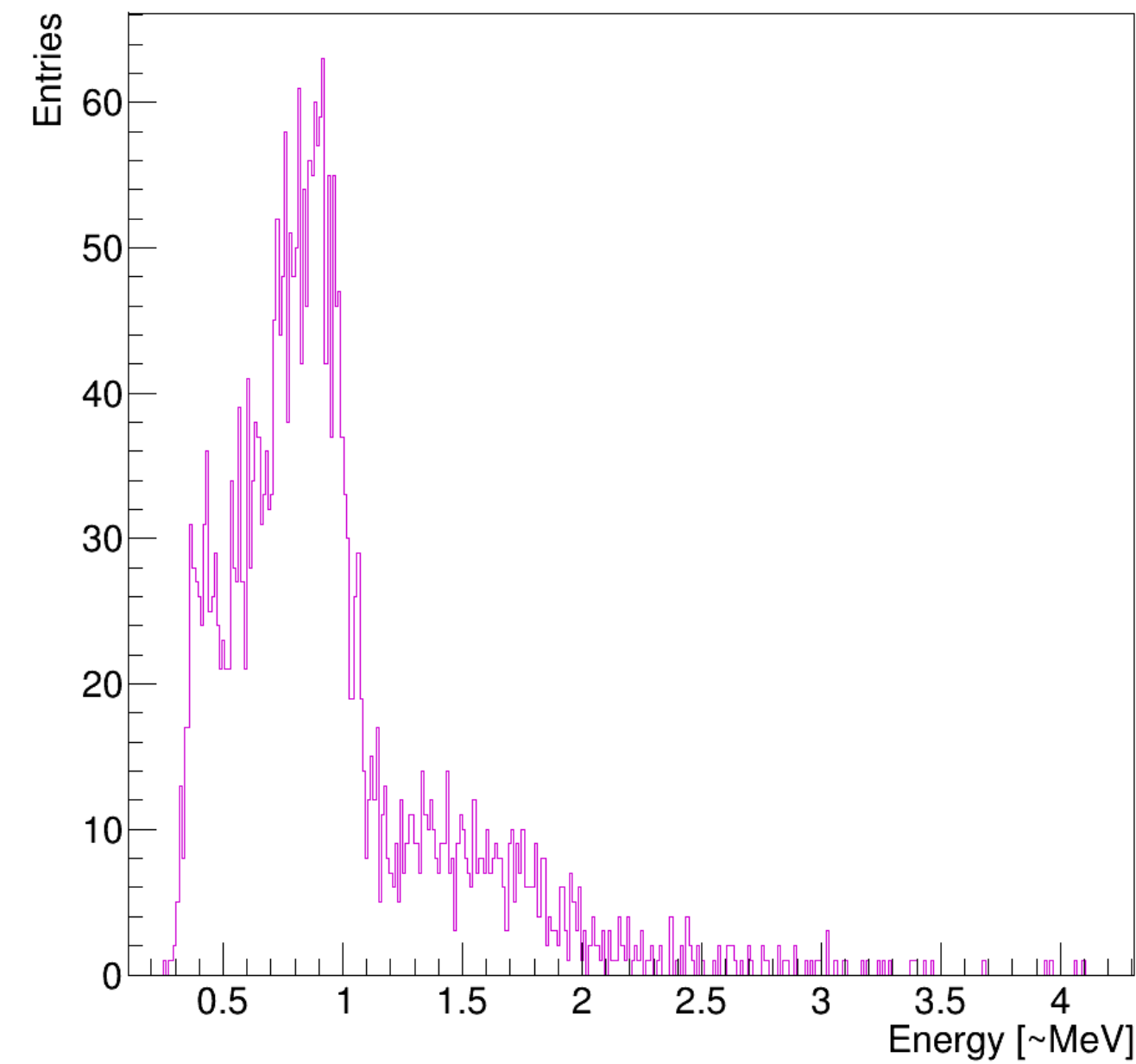
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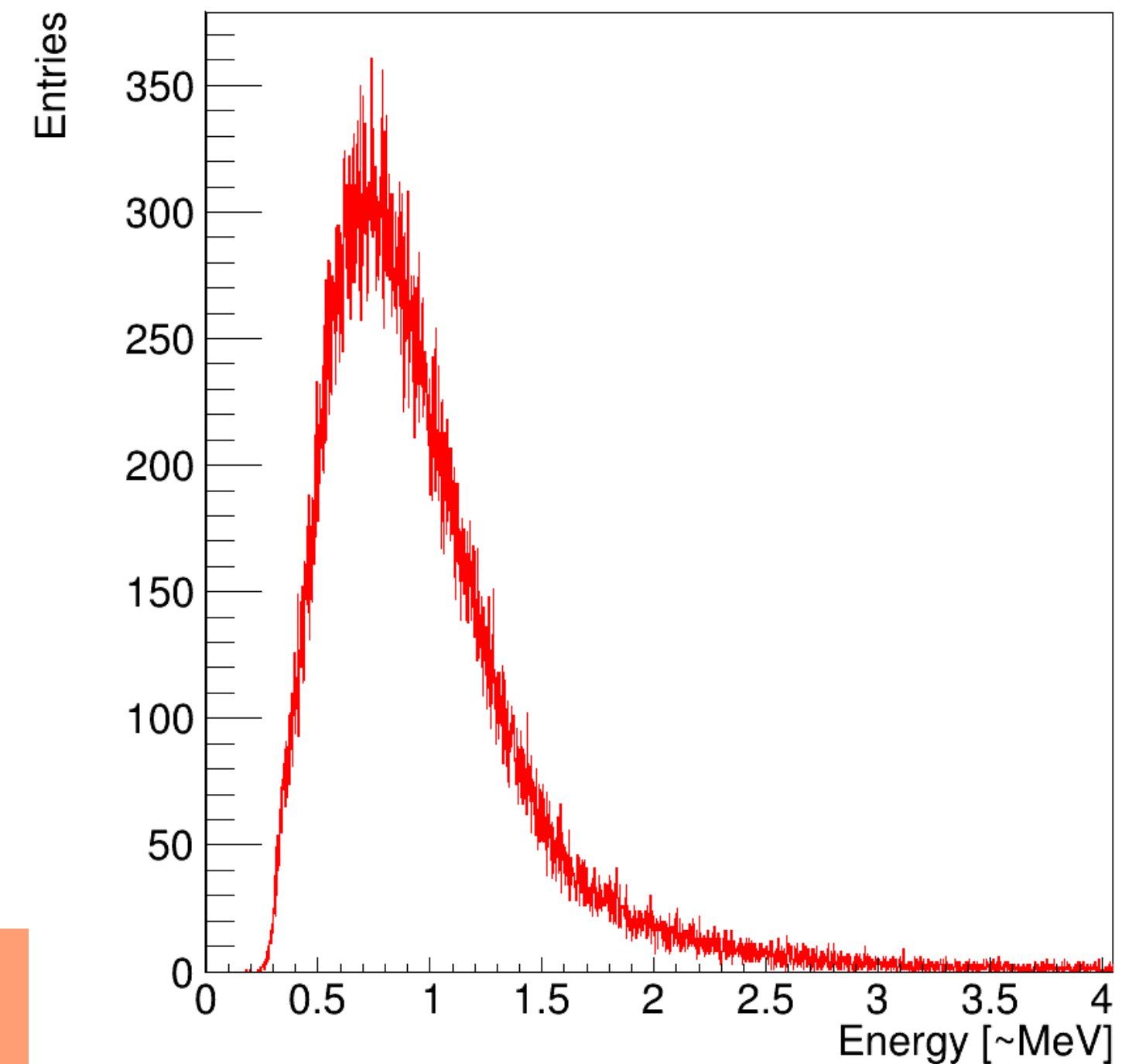
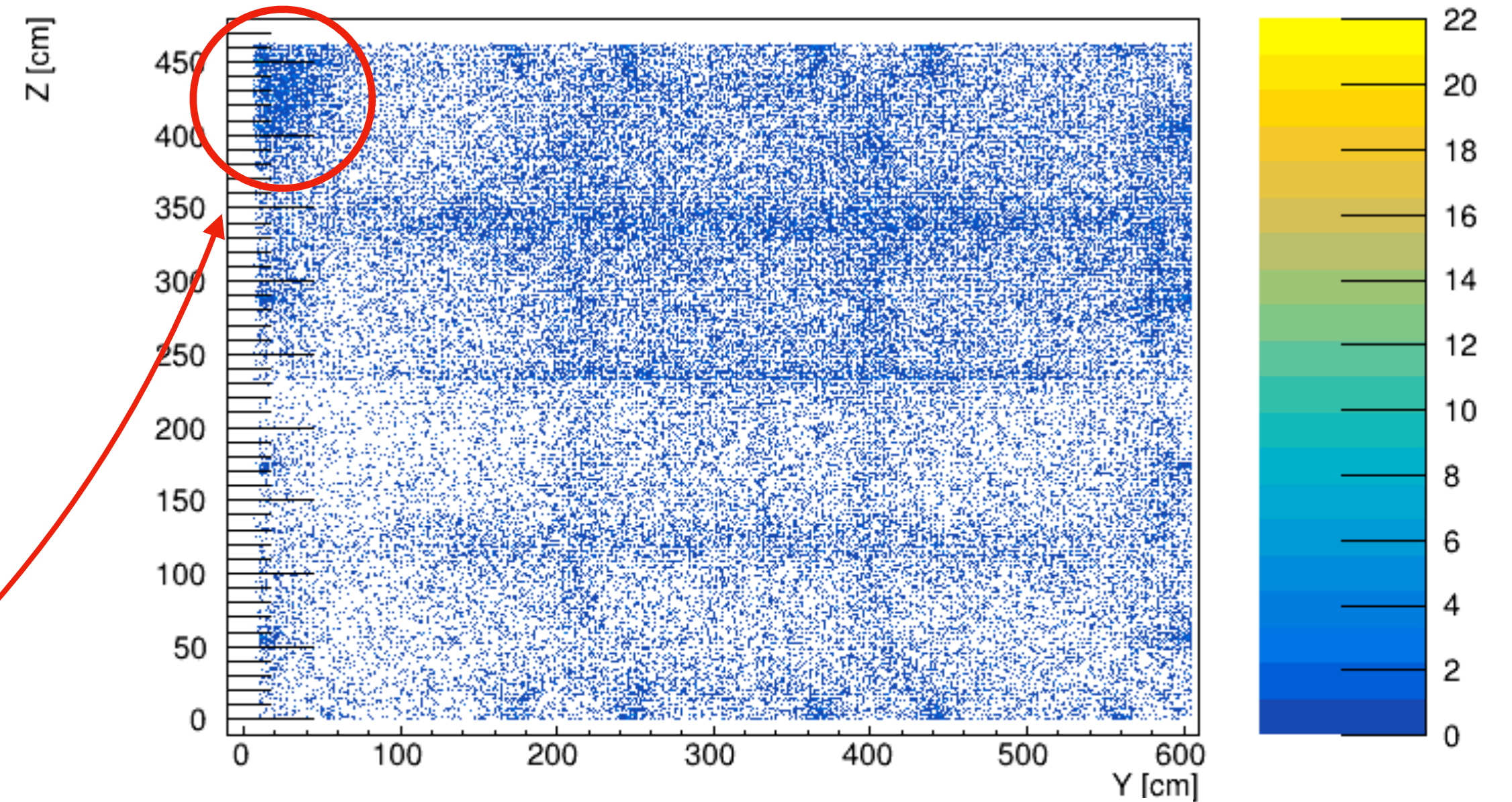
Induction in random coincidence with every other crossing channels



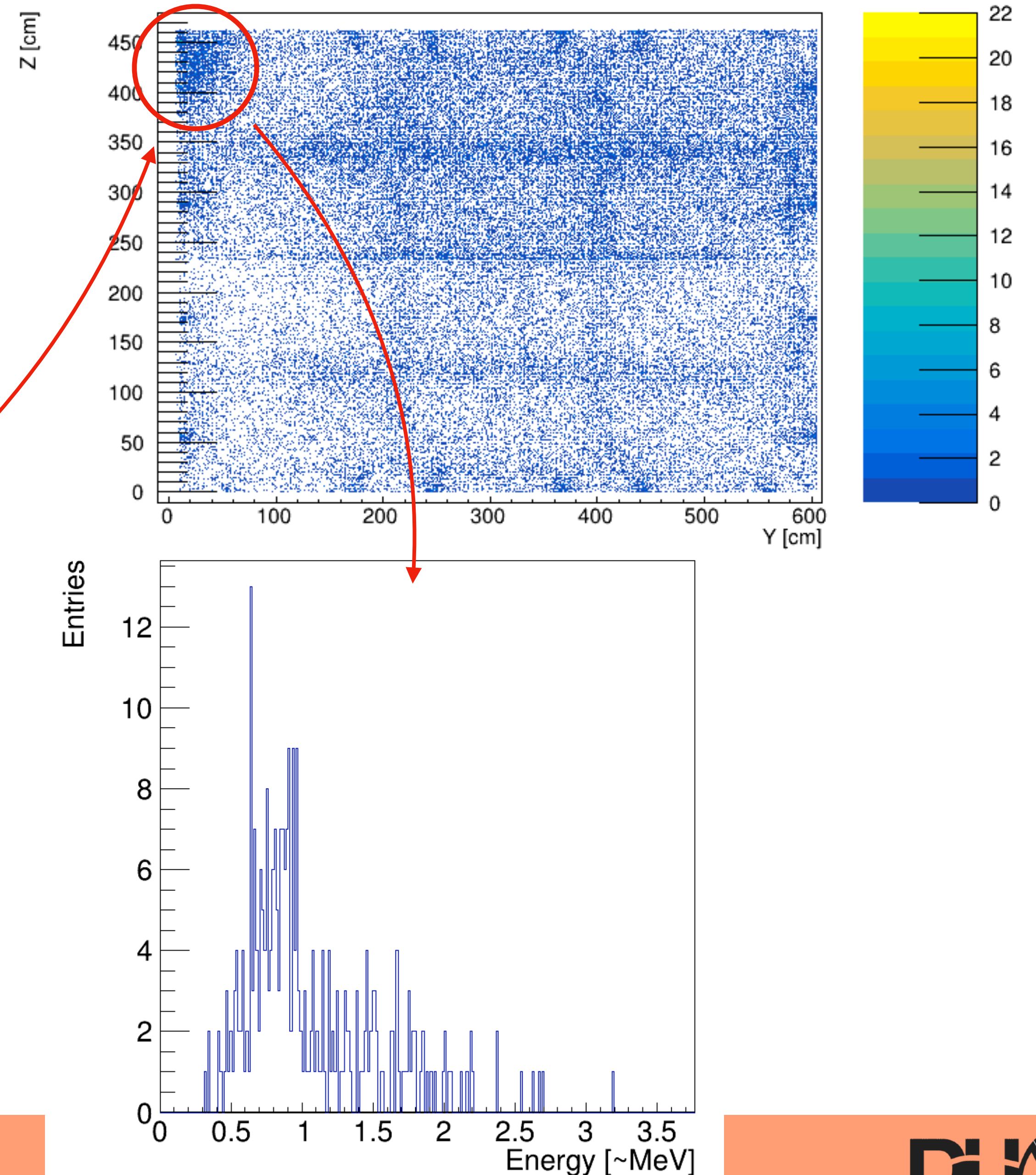
- Zoom in the region of interest
- **Clear difference** between a with and without Bismuth source
- **Source very localised** ($\sim 2 \text{ cm}^2$)
- Seems to see **$\sim 1 \text{ MeV}$ peak**



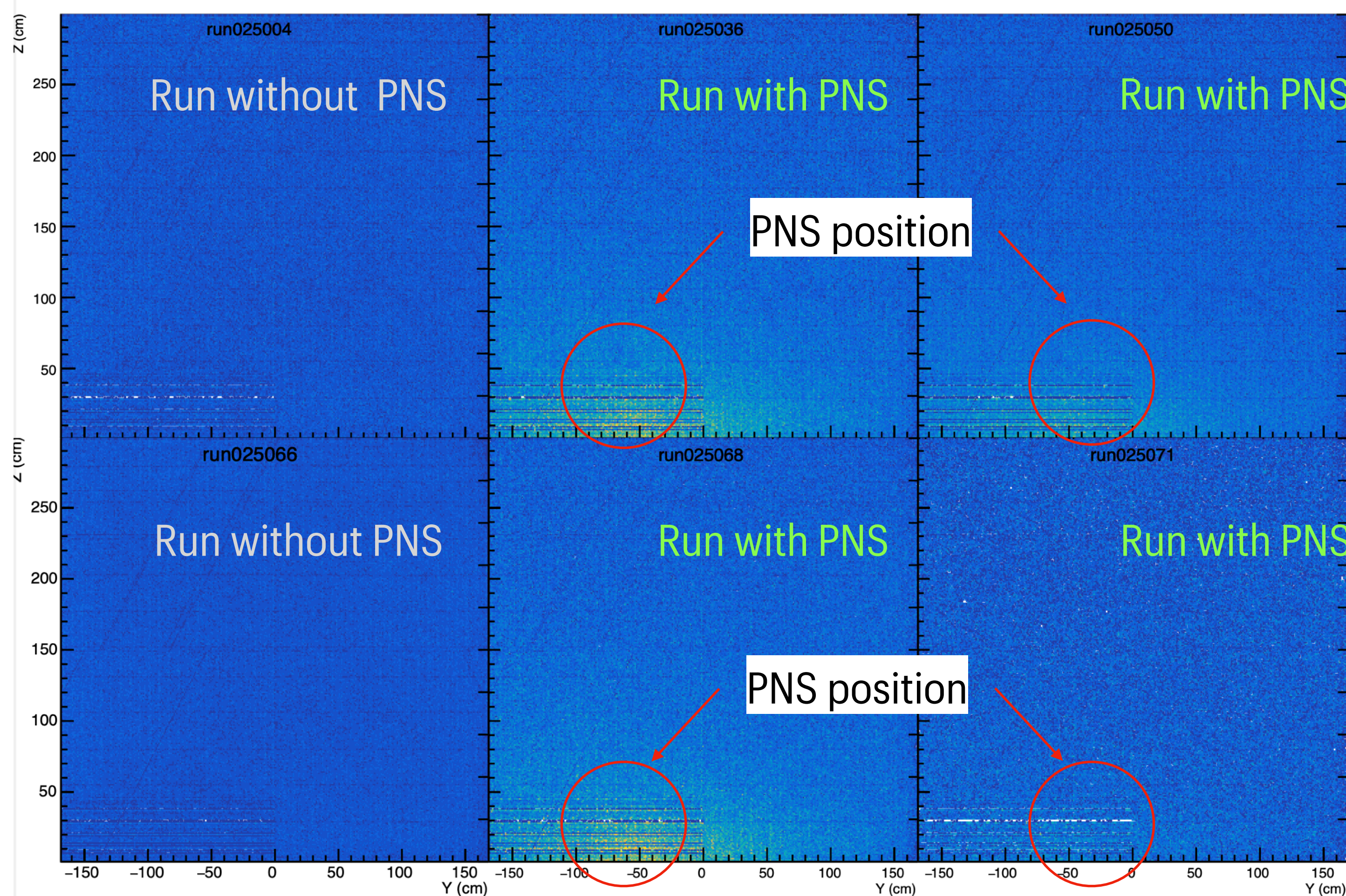
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- **Lots of 3views hits are from Bismuth**
- Need more stat but the spectrum seems to be in agreement with the 2 view

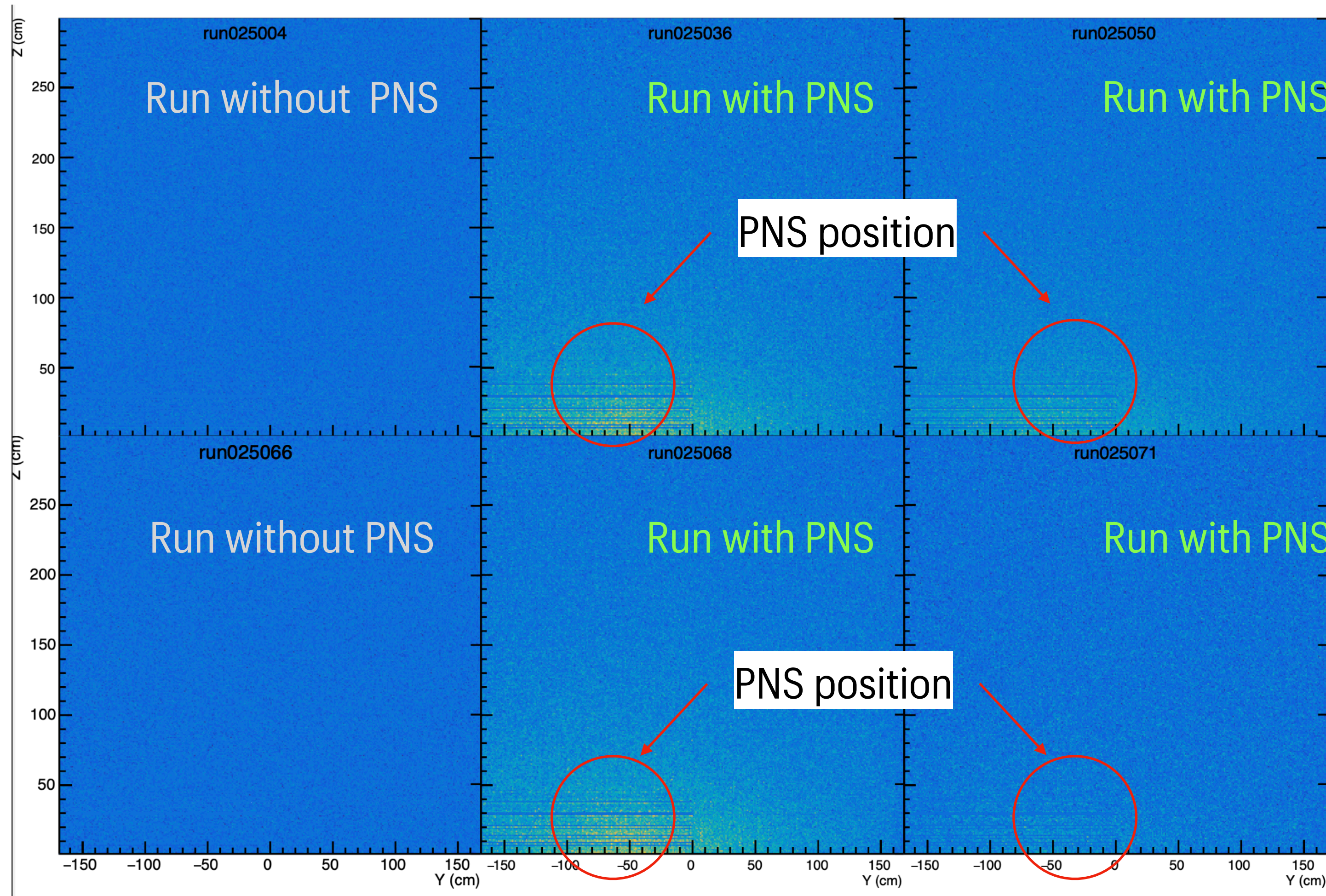
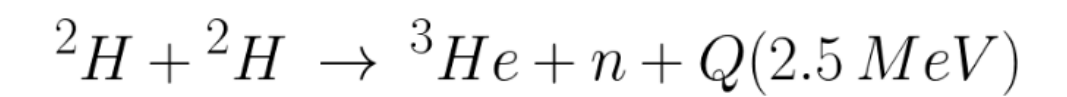


- Monoenergetic neutrons source placed on the side of the ColdBox-VD ${}^2\text{H} + {}^2\text{H} \rightarrow {}^3\text{He} + n + Q(2.5 \text{ MeV})$



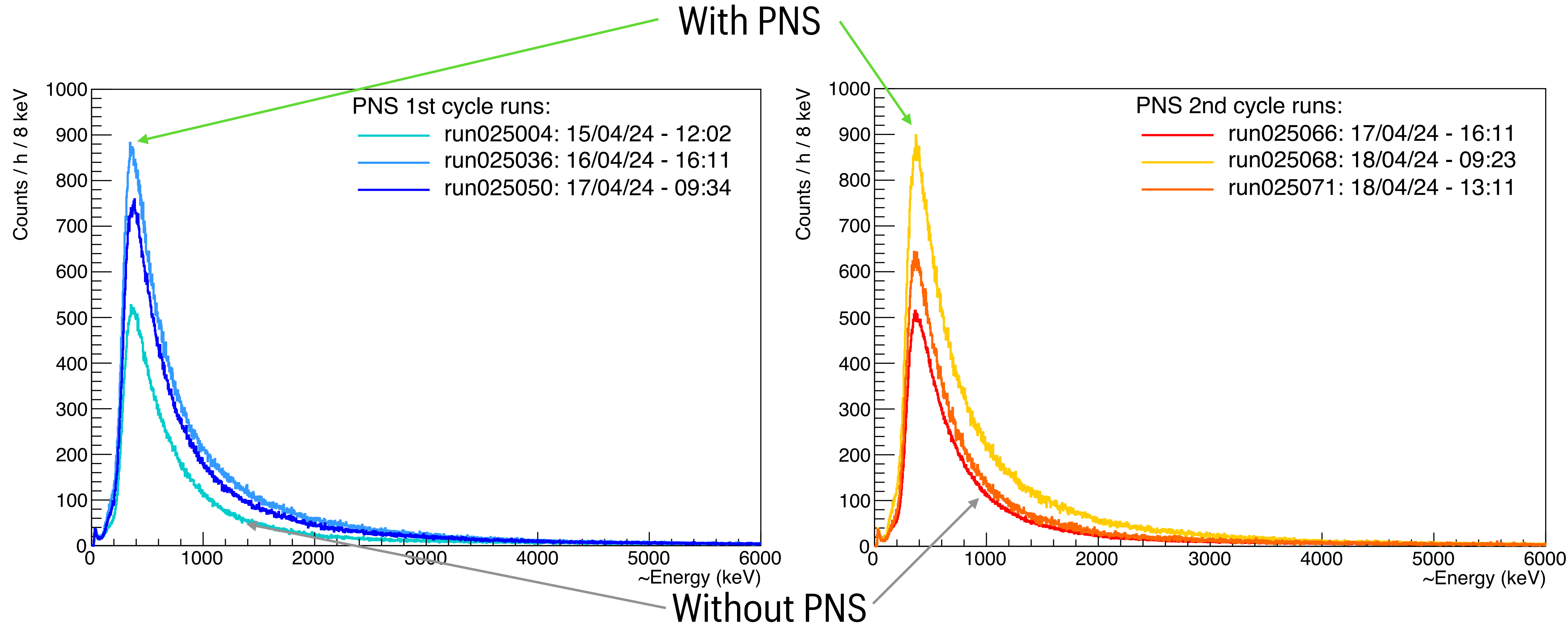
Clear identification of PNS position

- Difference between run with and without PNS



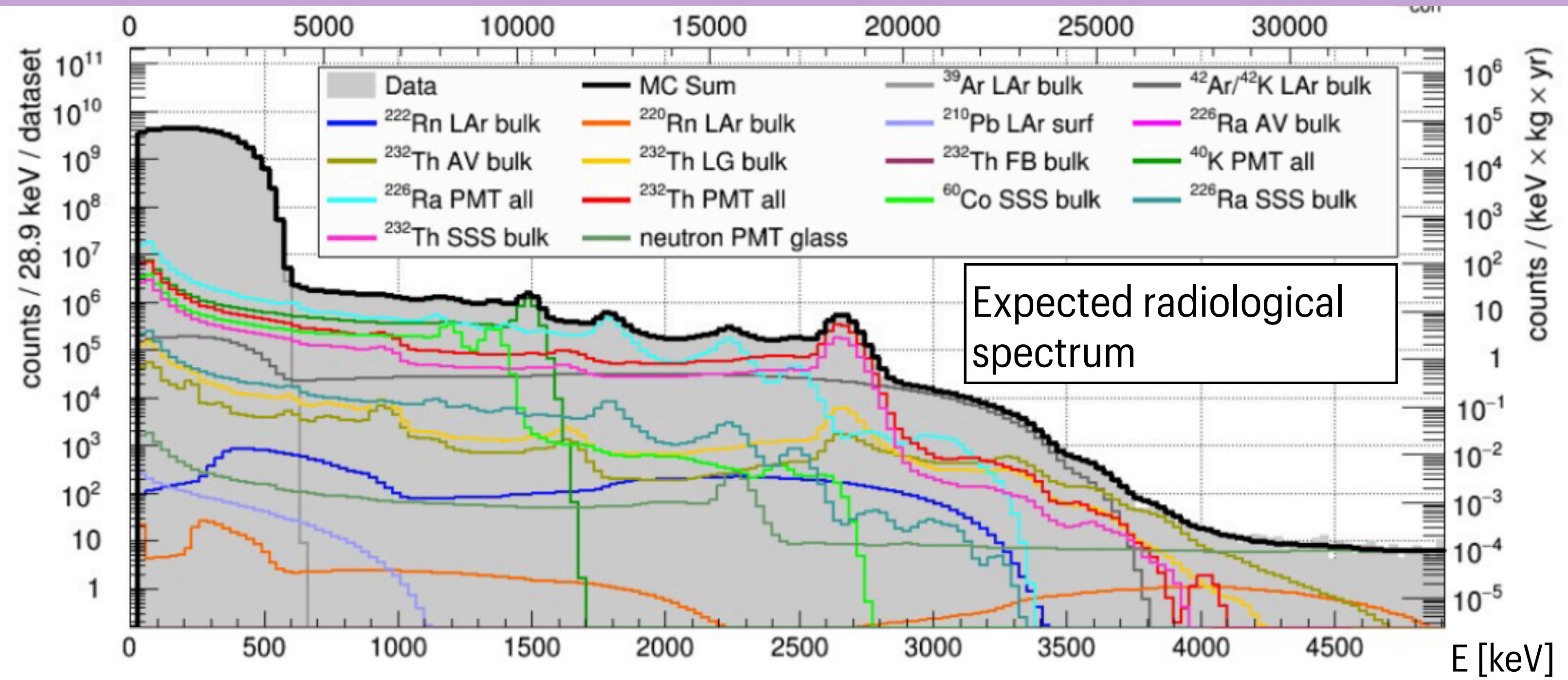
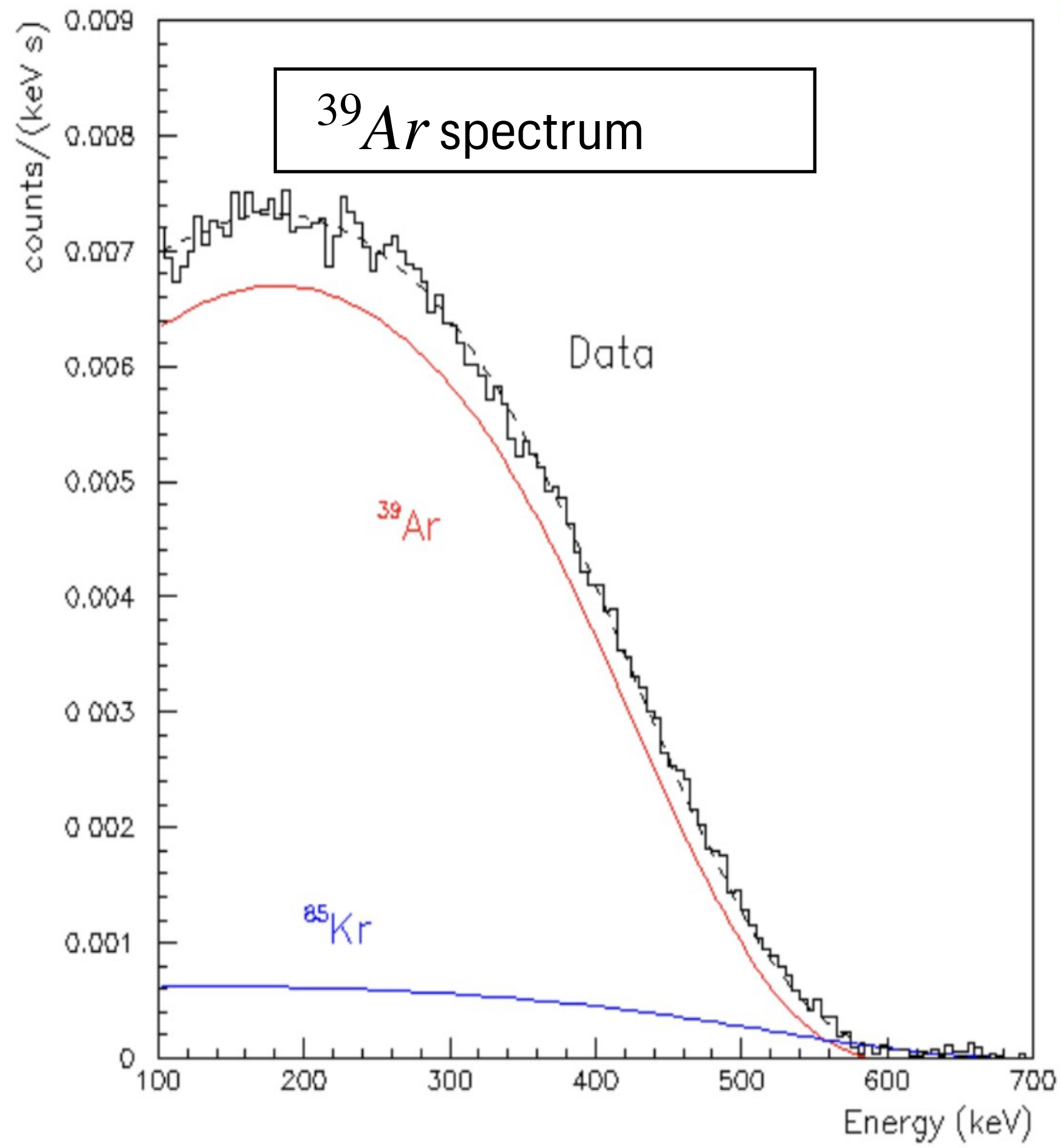
Clear identification of PNS position

- Very similar behaviour from 1 cycle to another if in the same configuration



Starting discussion with PNS team for interpretation

- Module ready for large production phase and CAF-maker
- First analysis at low energy on **PDHD data** and **identification of Bismuth source**
- **Analysis in progress on PNS** in ColdBox → perfect physic case to understand better the module
- Need to understand geometry/signal on APA 4
- Need simulation of Bismuth in PDVD
- Charge light matching for PNS analysis is coming



Background measurement with DEAP-3600 (3.3 tonne LAr dark matter detector at SNOLAB)

- Run 28850 : 19530 events processed

