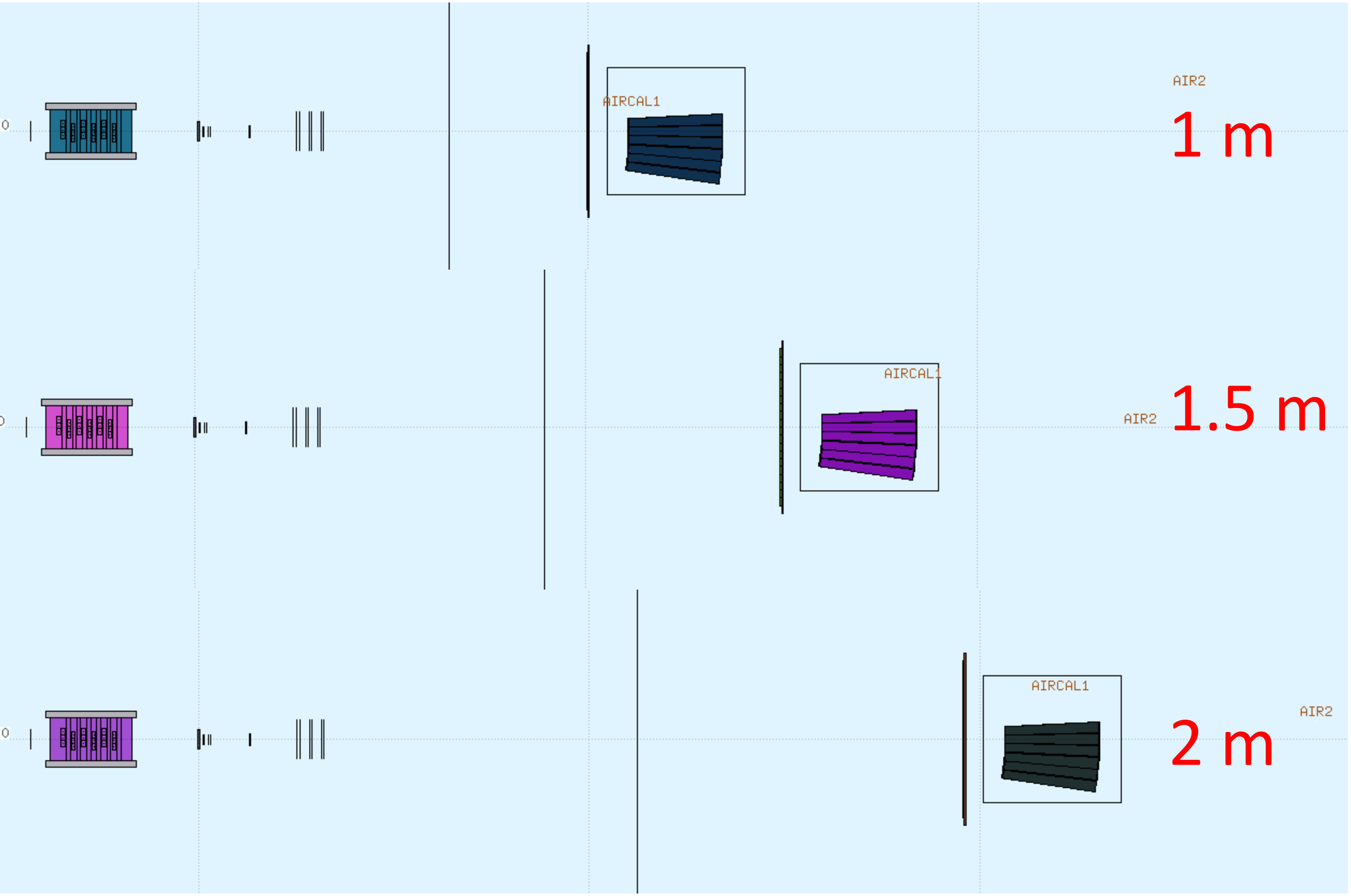
About the setup for December run CNAO2022

G.B.

Topic:

Optimization of distance from target of the TW+Calo detectors: resolution in mass and acceptance for low-Z fragments

Preliminary simulations at 3 different distances



^{12}C 200 MeV/u on 5 mm C target
10^6 events for each geometry

Events reconstructed and tracked using Genfit ($Z = Z_{MC}$)

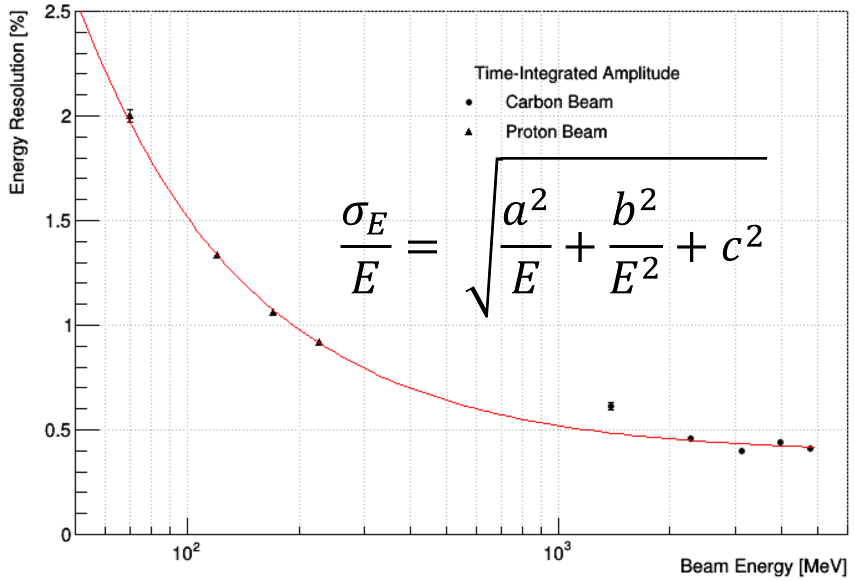
(Thanks to E. Lopez for the calo geometry)

Shoe Reconstruction

Selection: global tracks with a good TW point to which a Calo cluster can be matched

ToF resolution: in MC TW points a resolution fitted to the experimental one is already inserted *(M. Toppi et al.)*

Calo resolution: in the cluster algorithm, for MC events, energy is already smeared according to the fit to test beam data *(available in the Ph.D. of Lorenzo Scavarda)*



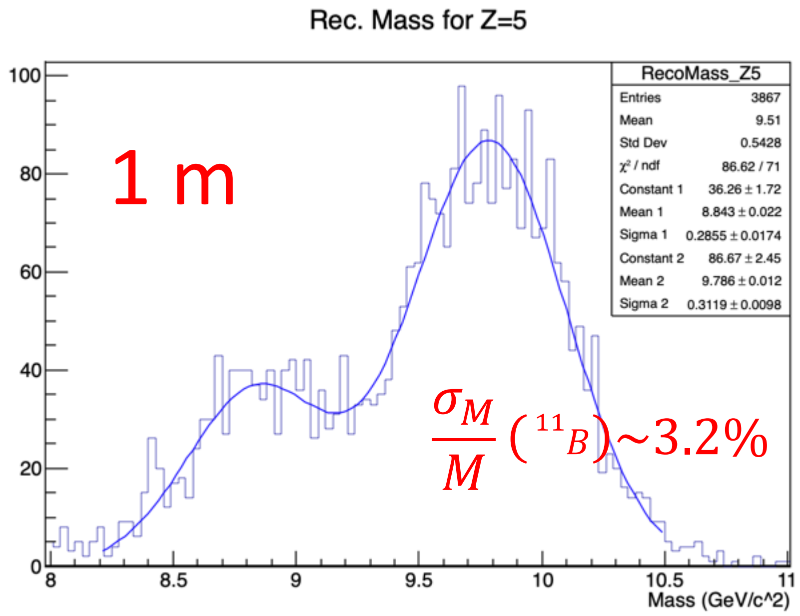
$$\frac{\sigma_E}{E} = \sqrt{\frac{a^2}{E} + \frac{b^2}{E^2} + c^2}$$

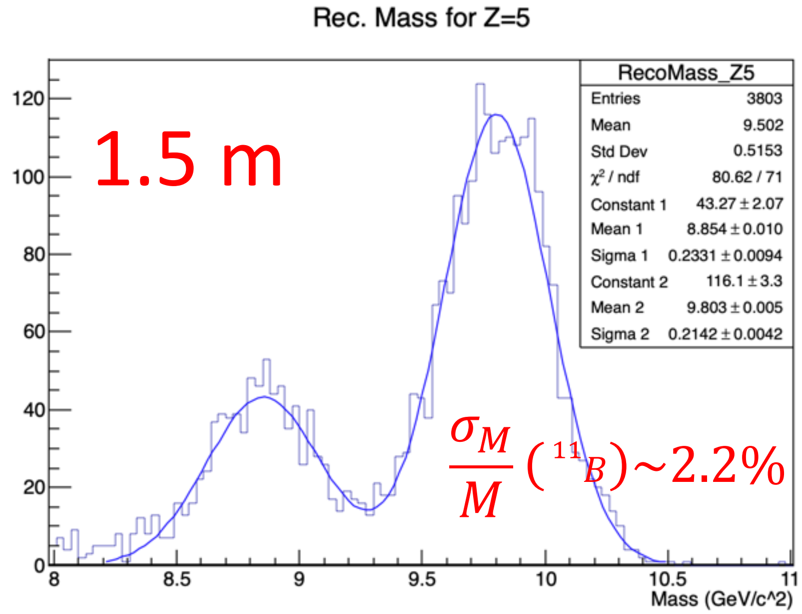
Then mass is reconstructed by the usual combination of E from calo and gamma from ToF:

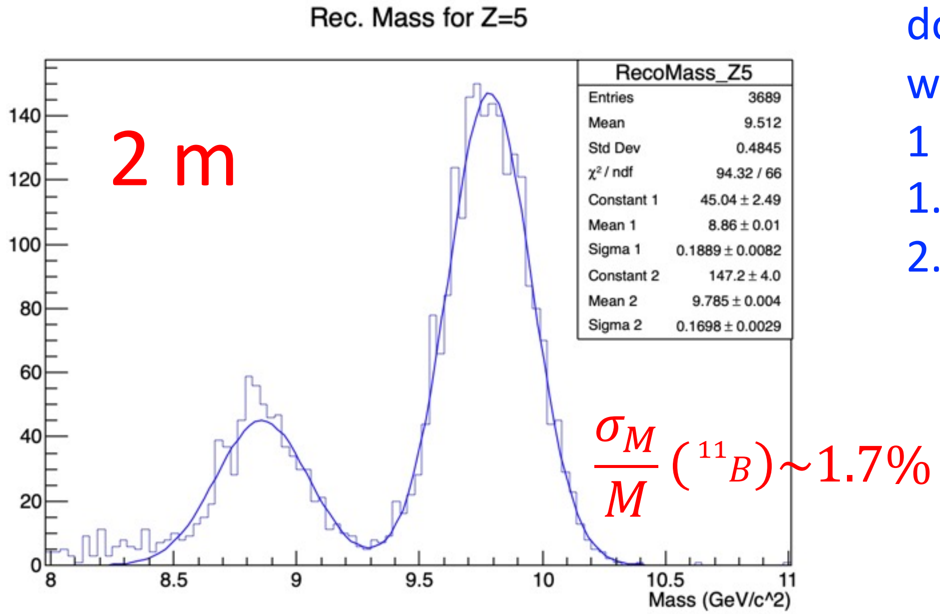
$$M = \frac{E_k}{(\gamma - 1)}$$

Of course in MC all crystals are perfectly equalized

Z = 5 case
(^{10}B and ^{11}B)



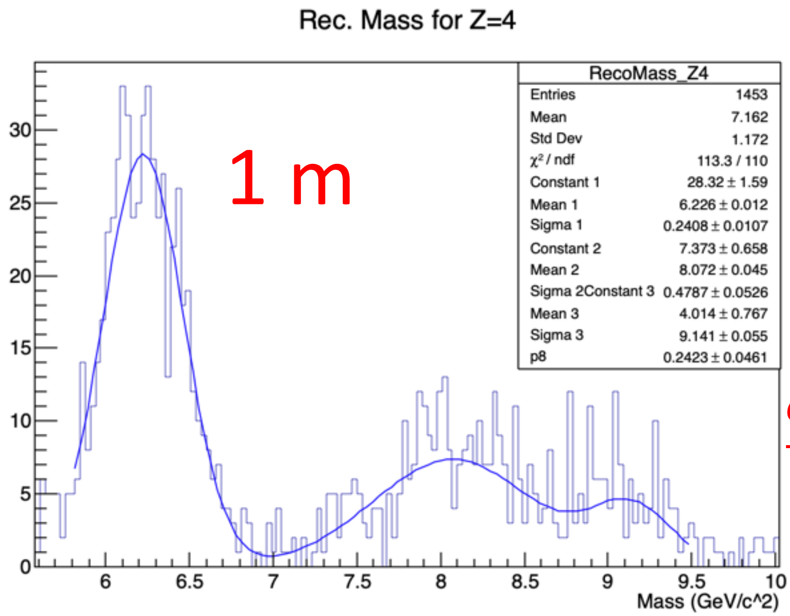




No. of selected events does not change much with distance:
1 m: 3870
1.5 m: 3800
2.0 m: 3690

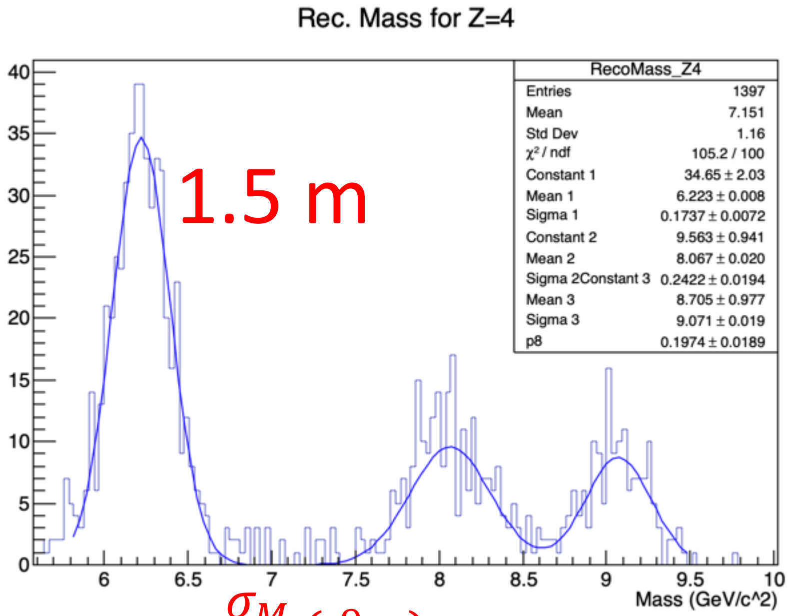
Notice: masses are peaked to a value which is lower than the true value. Don't know exactly the answer, but **at the moment there is no attempt to correct E_{meas} for the energy loss in VTX, MSD, IT and TW**

Z = 4 case
(^{7}Be, ^{9}Be and ^{10}Be)

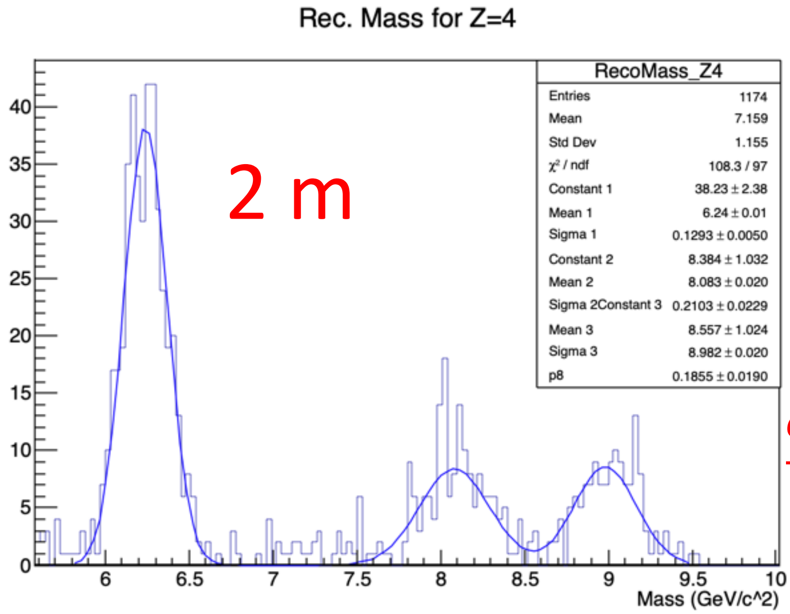


$\frac{\sigma_M}{M}(\,^{9}Be) \sim 5.9\%$

No. of selected events:
1 m: 1450
1.5 m: 1400
2 m: 1170

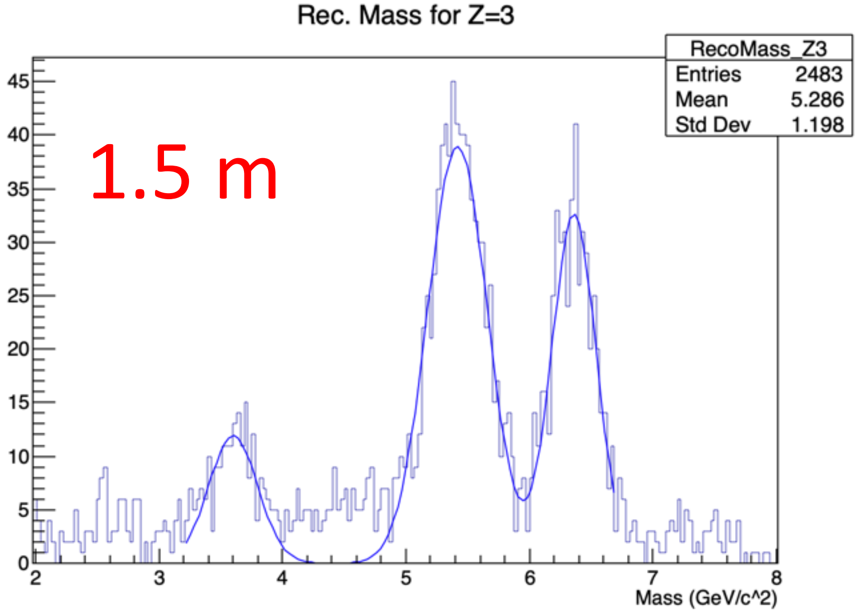


$\frac{\sigma_M}{M}(\,^{9}Be) \sim 3.0\%$



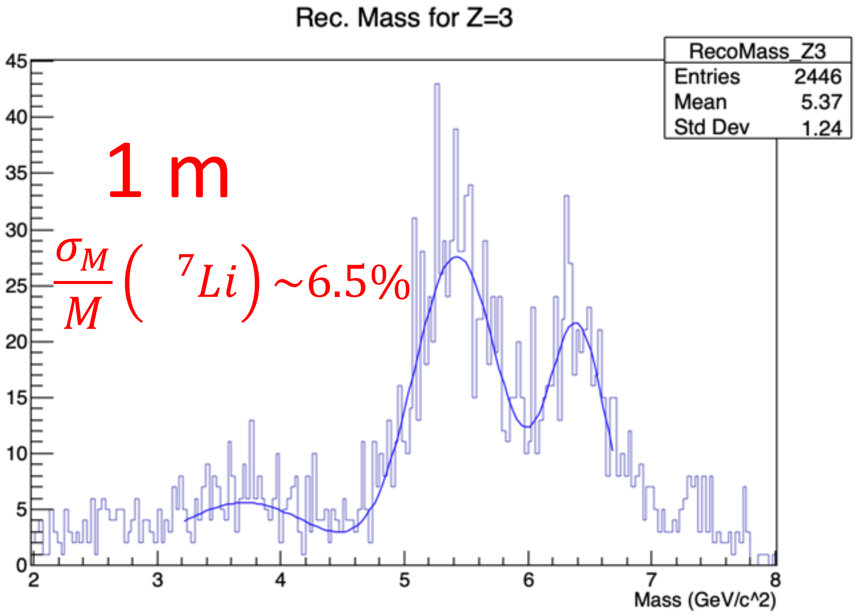
$\frac{\sigma_M}{M}(\,^{9}Be) \sim 2.6\%$

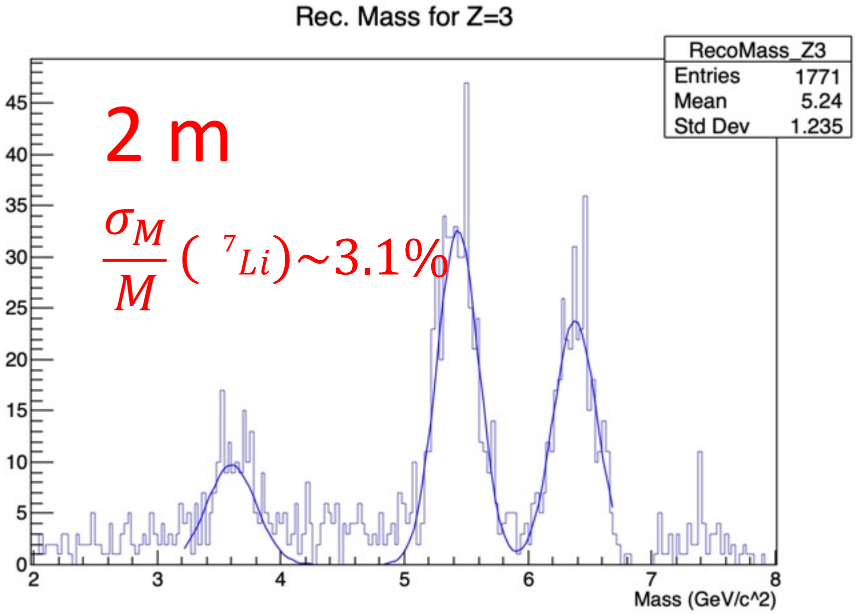
Z = 3 case
(^{6}Li, ^{7}Li, ^{8}Li [and a bit of ^{9}Li])



$\frac{\sigma_M}{M}(\,^{7}Li) \sim 4.5\%$

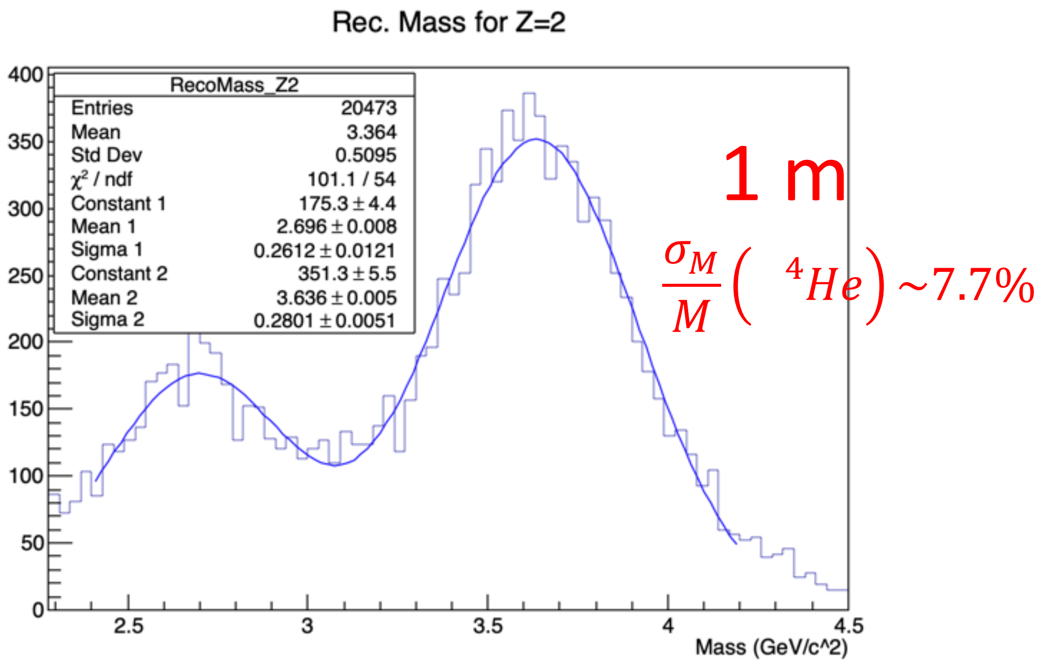
No. of selected events:
1 m: 2450
1.5 m: 2480
2 m: 1770

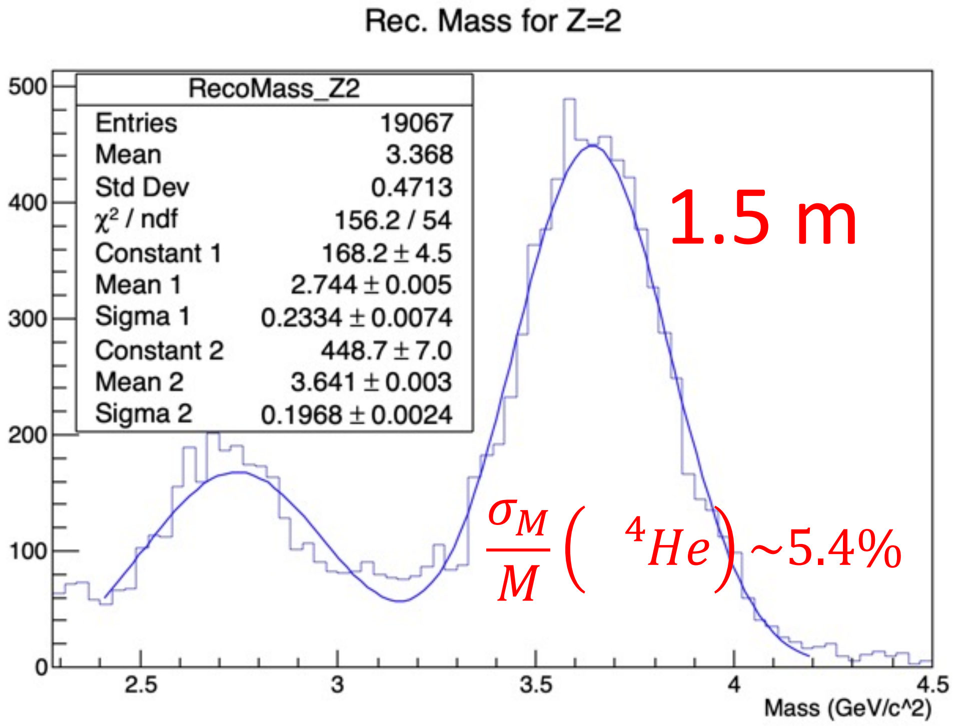


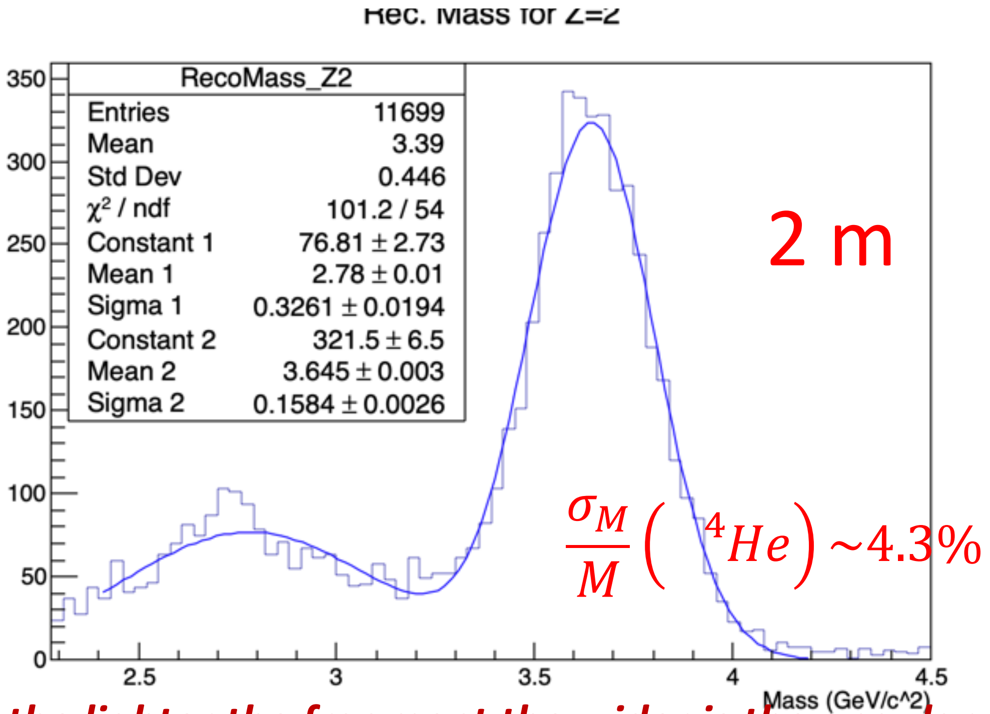


Z = 2 case (^3He, ^4He)

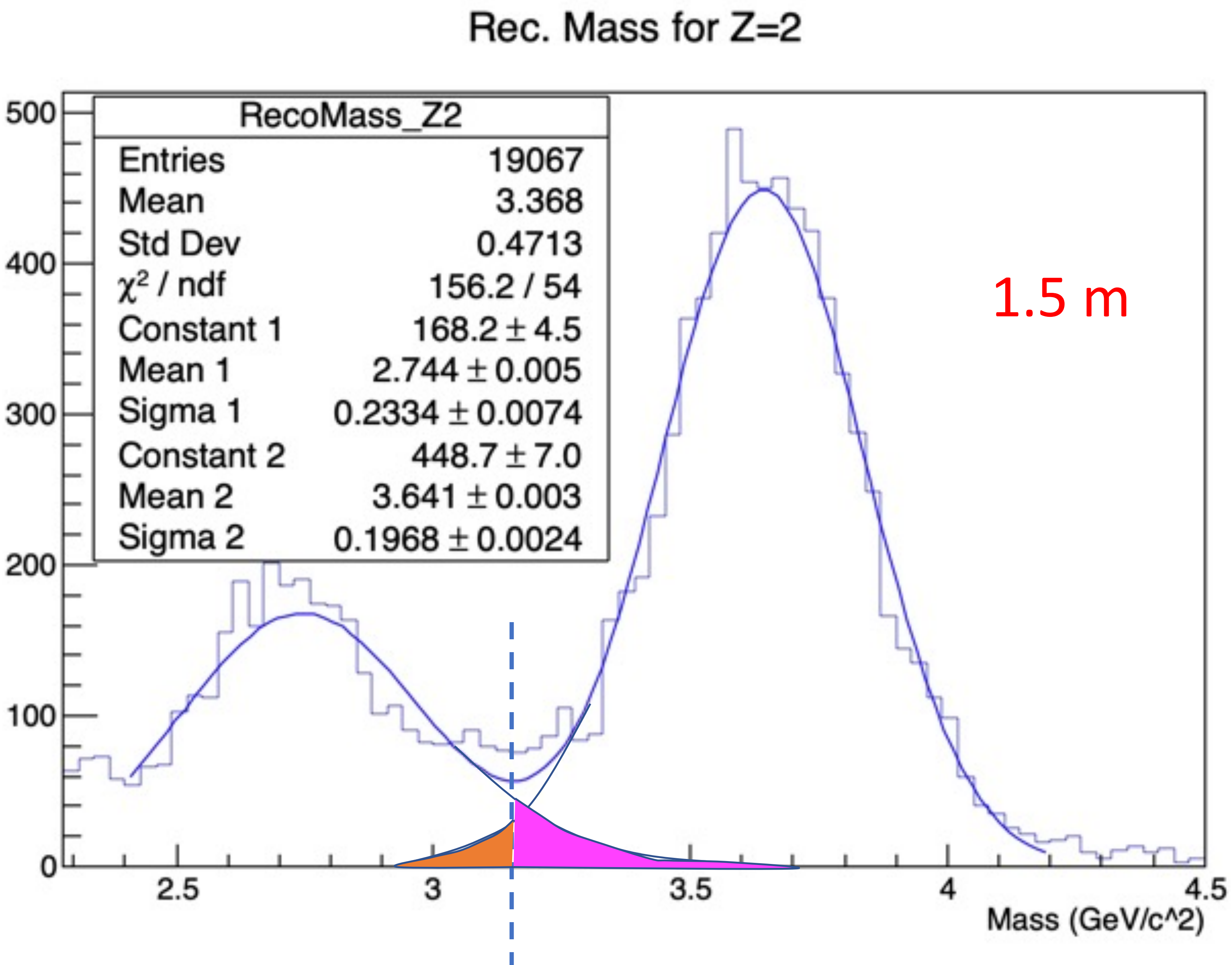
No. of selected events:
1 m: 20470
1.5 m: 19070
2 m: 11700







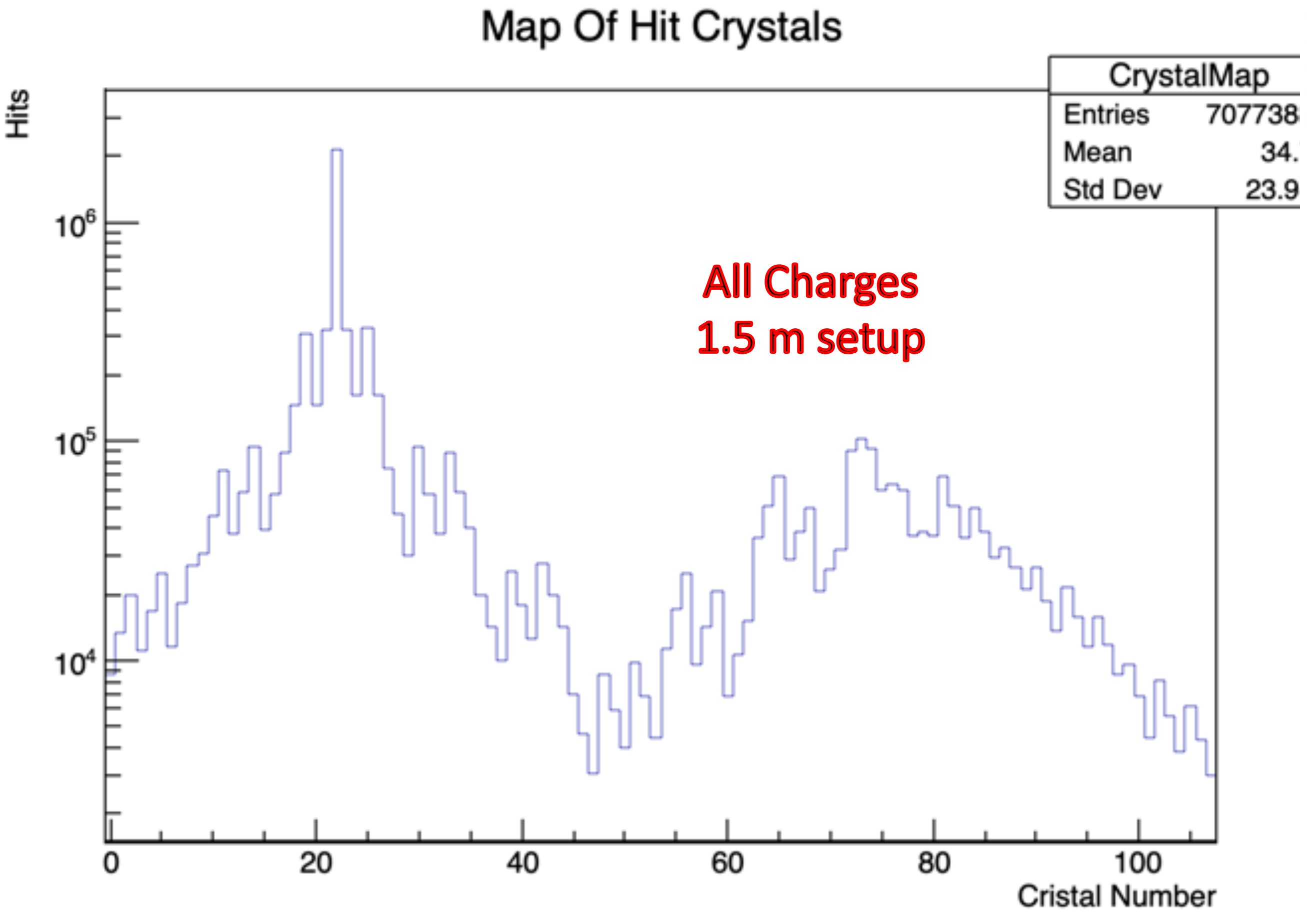
➔ For increasing distance the ratio of detected ^4He/ ^3He increases: the lighter the fragment the wider is the angular spread

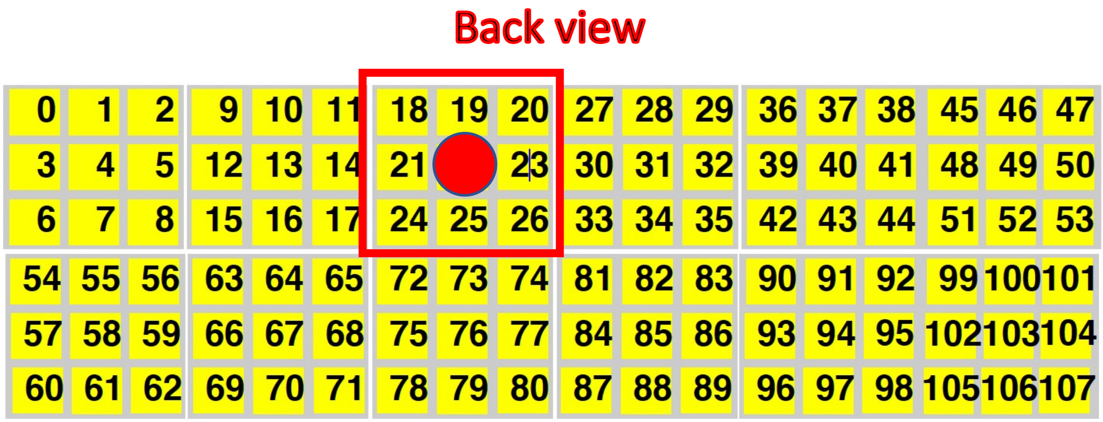


Probability for ^{3}He to be taken as ^{4}He: 4.1% (~overstimated)

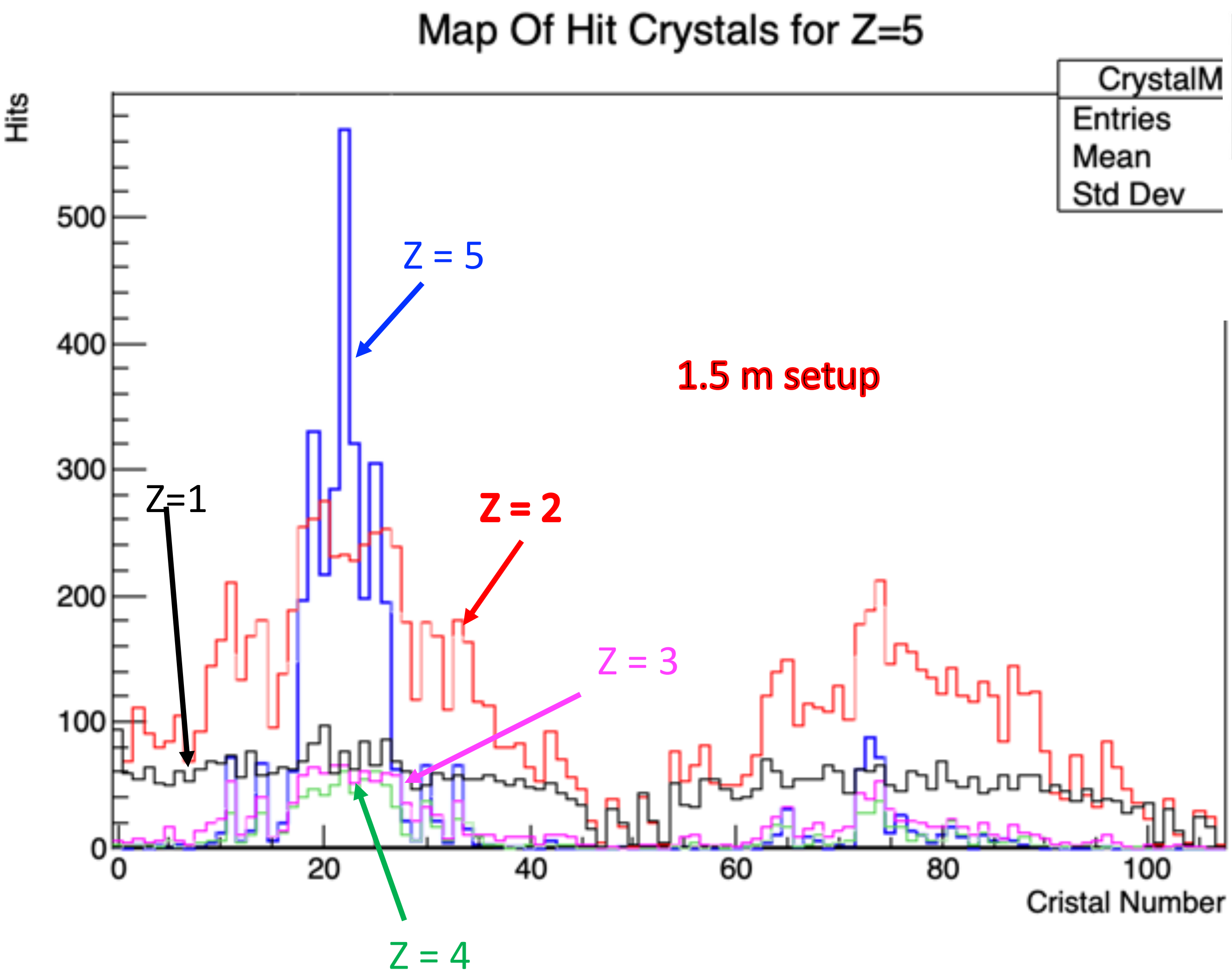
Probability for ^{4}He to be taken as ^{3}He: 0.6%

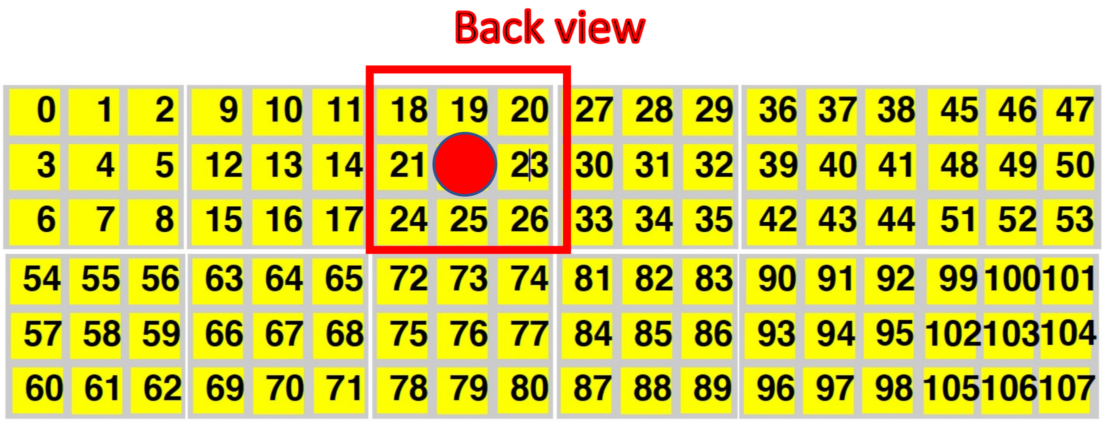
Map of hit crystals - 1





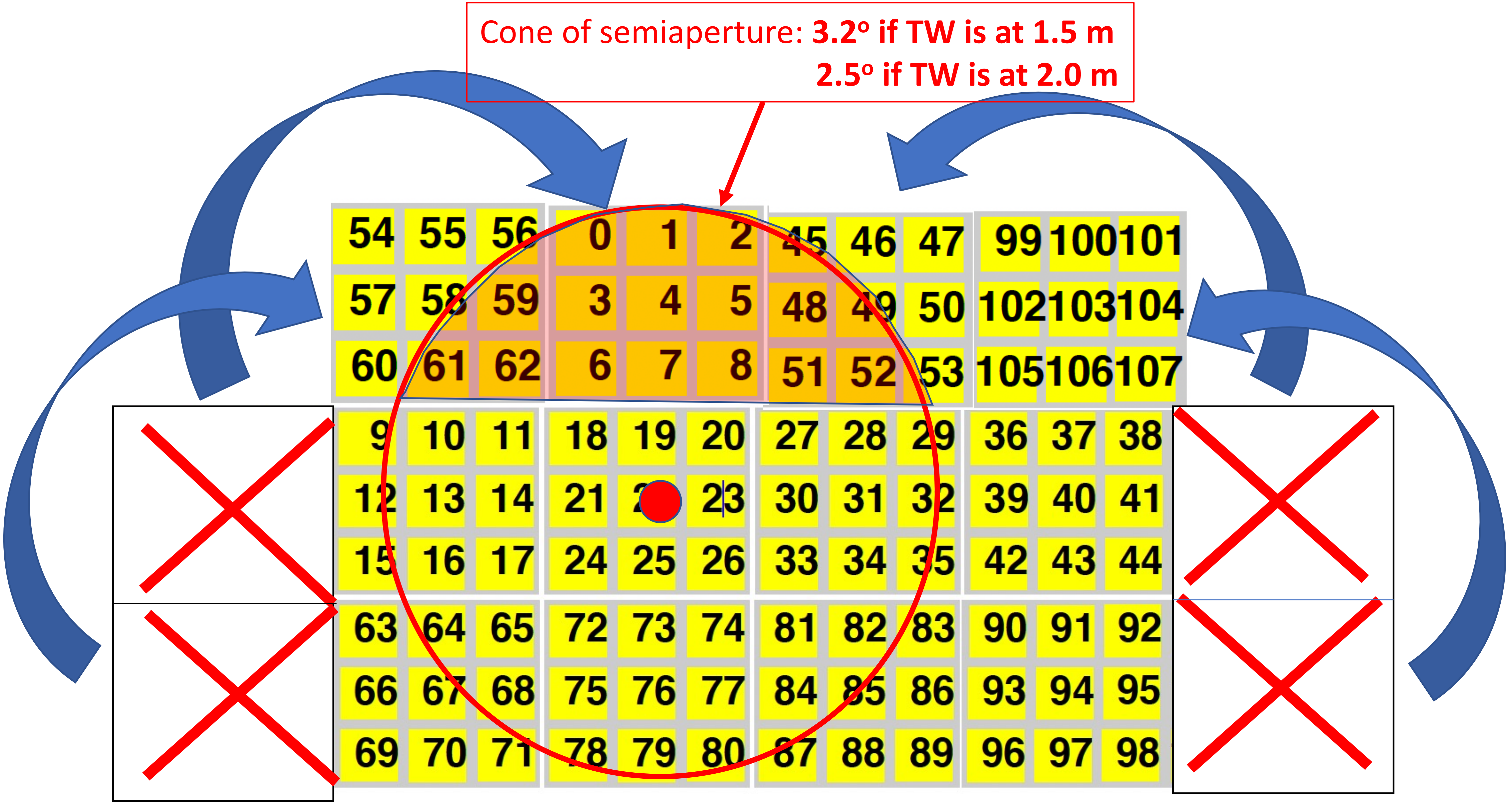
Map of hit crystals - 2





Should we think if it is convenient to re-assemble the calo modules in a different way?

For instance, something like that (or similar)?



We should gain useful solid angle for Z≥2

Conclusions

- I withdraw my early proposal for the 1 m solution
- *Provided that the calo resolution is analogous to what has been measured in the dedicated test beams,* for distances ≥1.5 m, the ToF error contribution seems to become less relevant: there is not an important difference between 1.5 and 2 m
- At 1.5 m there is some gain in acceptance for Z≤3-4 with respet to the 2 m case *(do not think only to the small solid angle of the calorimeter, but to all that is arriving to TW)*

1) My proposal is then to set the distance of 1.5 m as the best trade-off between mass resolution and acceptance: the mass resolution is very close to what you get at 2 m and there is some gain in statistics

2) Should we re-assemble the calorimeter modules in a different way? ➔This would require one day more (in advance to Dec. 4) for mechanical operation/recabling …

Appendix

- For those who wish to play a litte bit with expectations for November run, in Tier3 you can find a 10^6 simulated event (200 MeV/u) sample in:

/gpfs_data/local/foot/Simulation/CNAO2022_MC/12C_C_200_nov2022_shoereg.root

- Geometry includes also the small drift chamber (not producing hits, just to take into account the material):