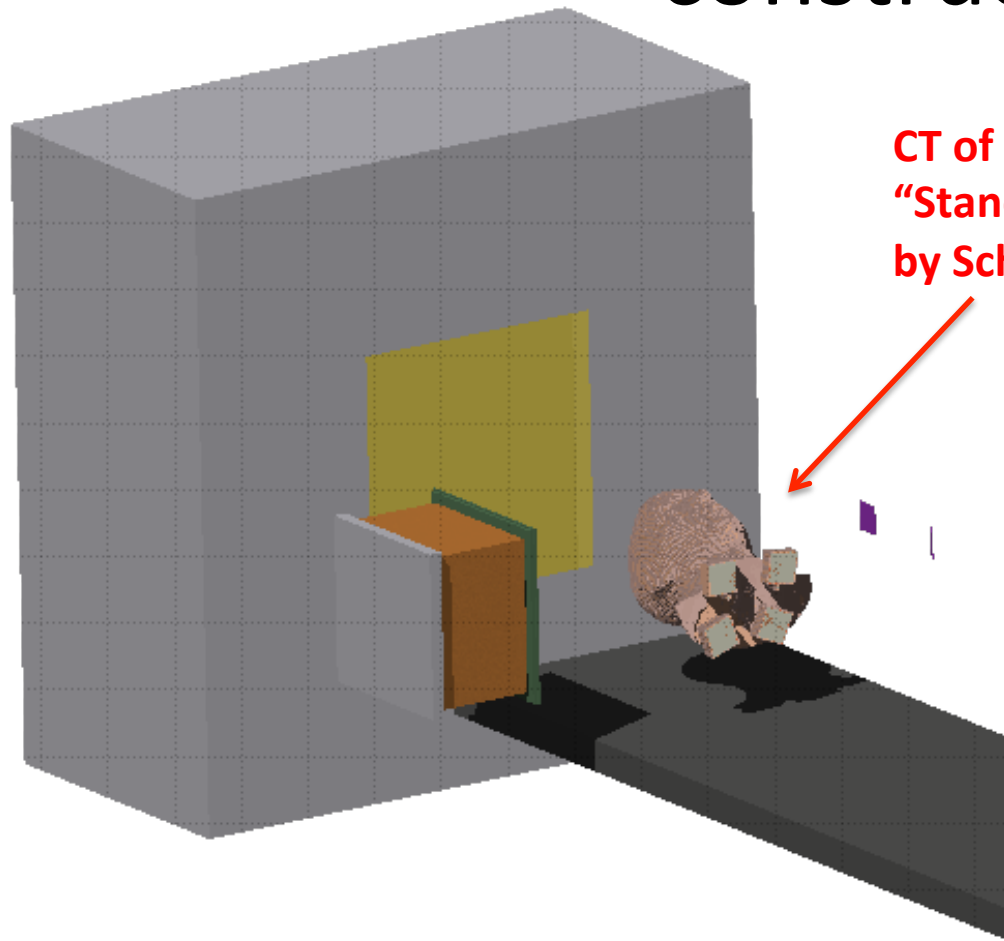


A very preliminary simulation of
a ^{12}C beam on RANDO + DP

G.B., I.M., S.V

Setup of CNAO Test Beam under construction

U&V

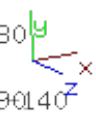


CT of RANDO
"Standard" HU to material conversion
by Schneider/Parodi

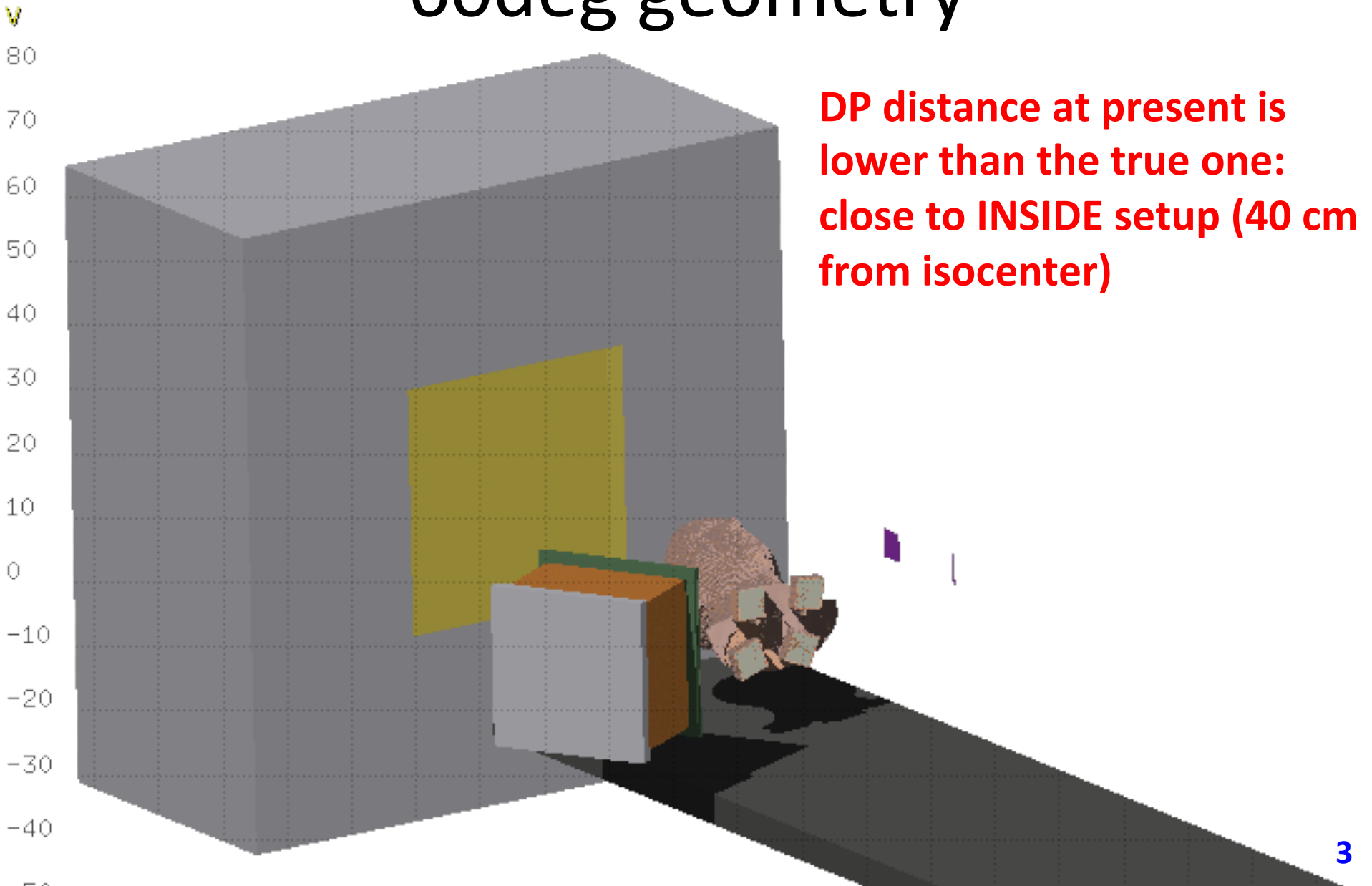
The purposes of this first exercise are:

- 1) make progresses on the study of Inside operation;**
- 2) start to understand how to setup the simulation for the analysis of July Test Beam data**

Not yet ready in all details



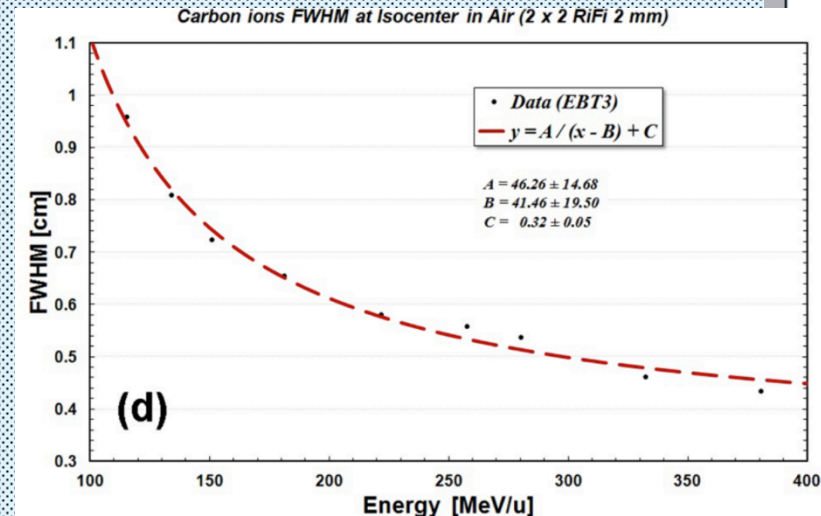
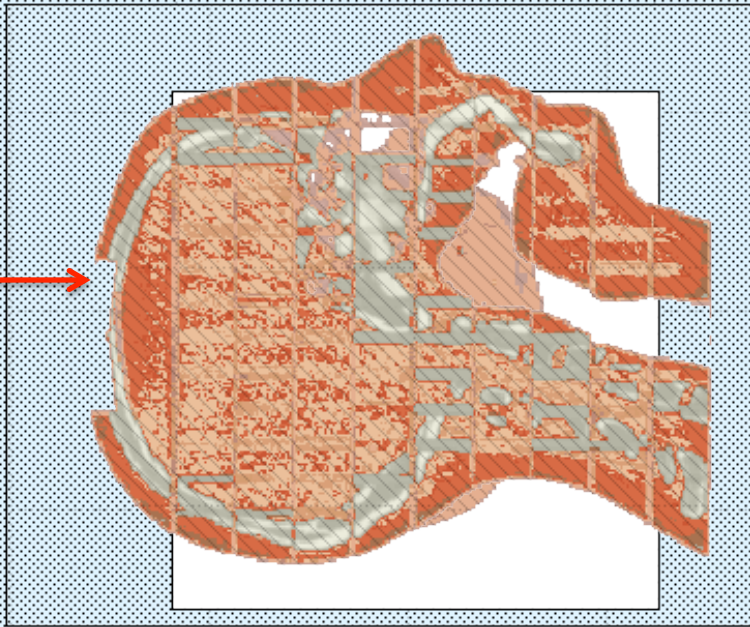
60deg geometry



DP distance at present is lower than the true one: close to INSIDE setup (40 cm from isocenter)

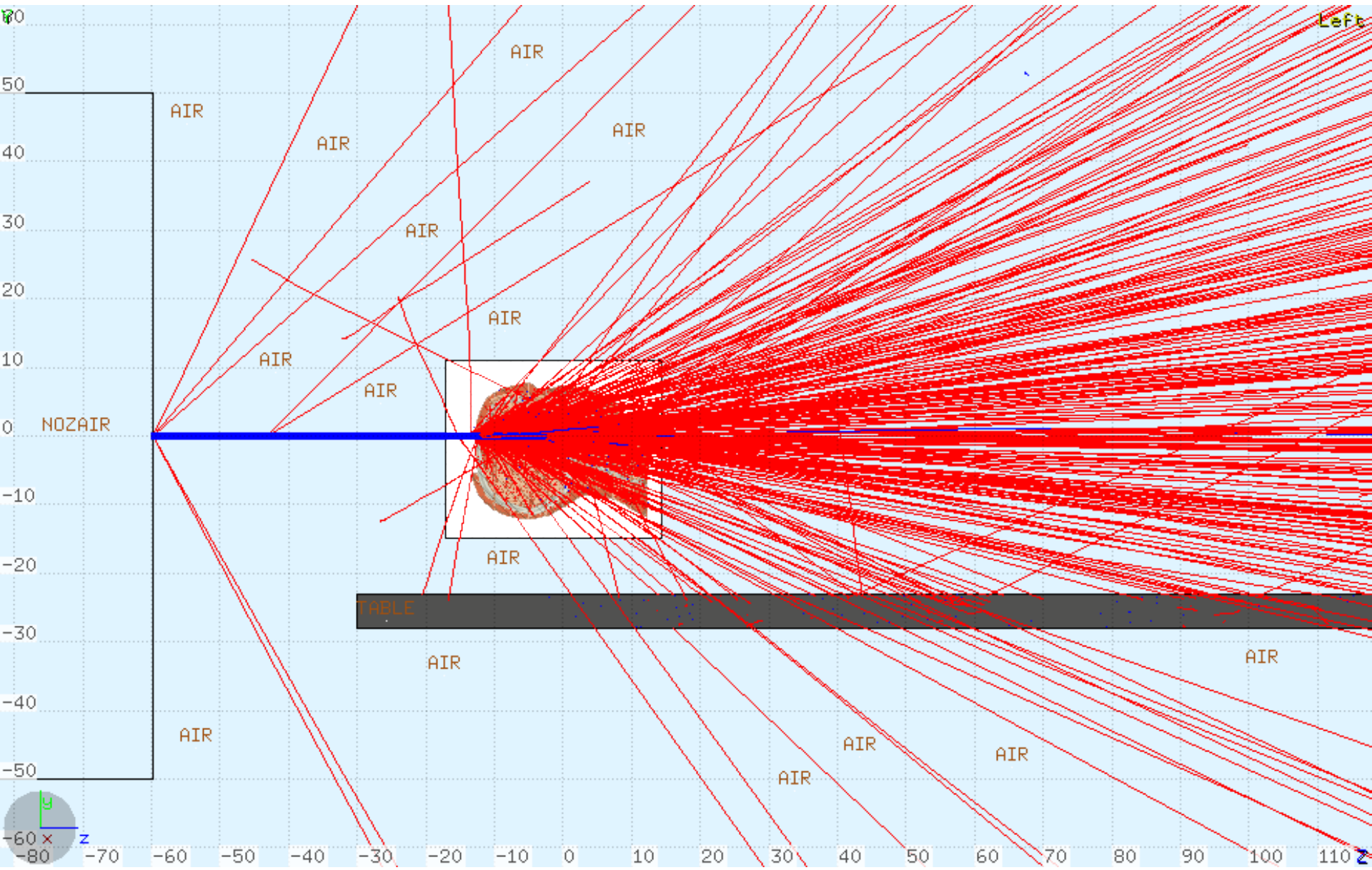
**^{12}C beam 221.45 MeV/u with expected gaussian profile @isocenter
(as from Mirandola et al. Med. Phys 2015)**

Left



**10^6 primaries ~eq to 3 times a single spot beam for a distal slice
at this energy in a single standard treatment fraction**

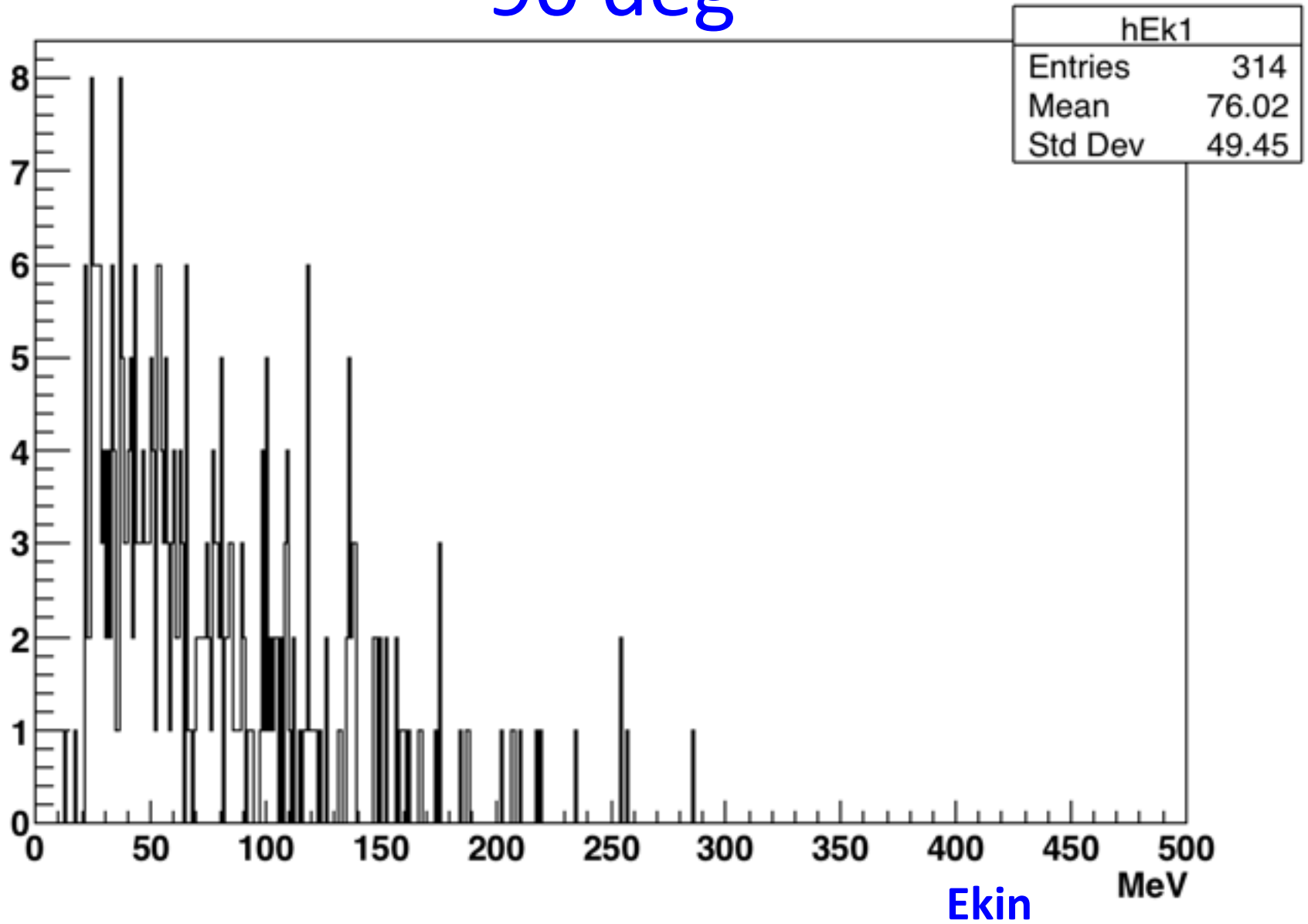
TABLE



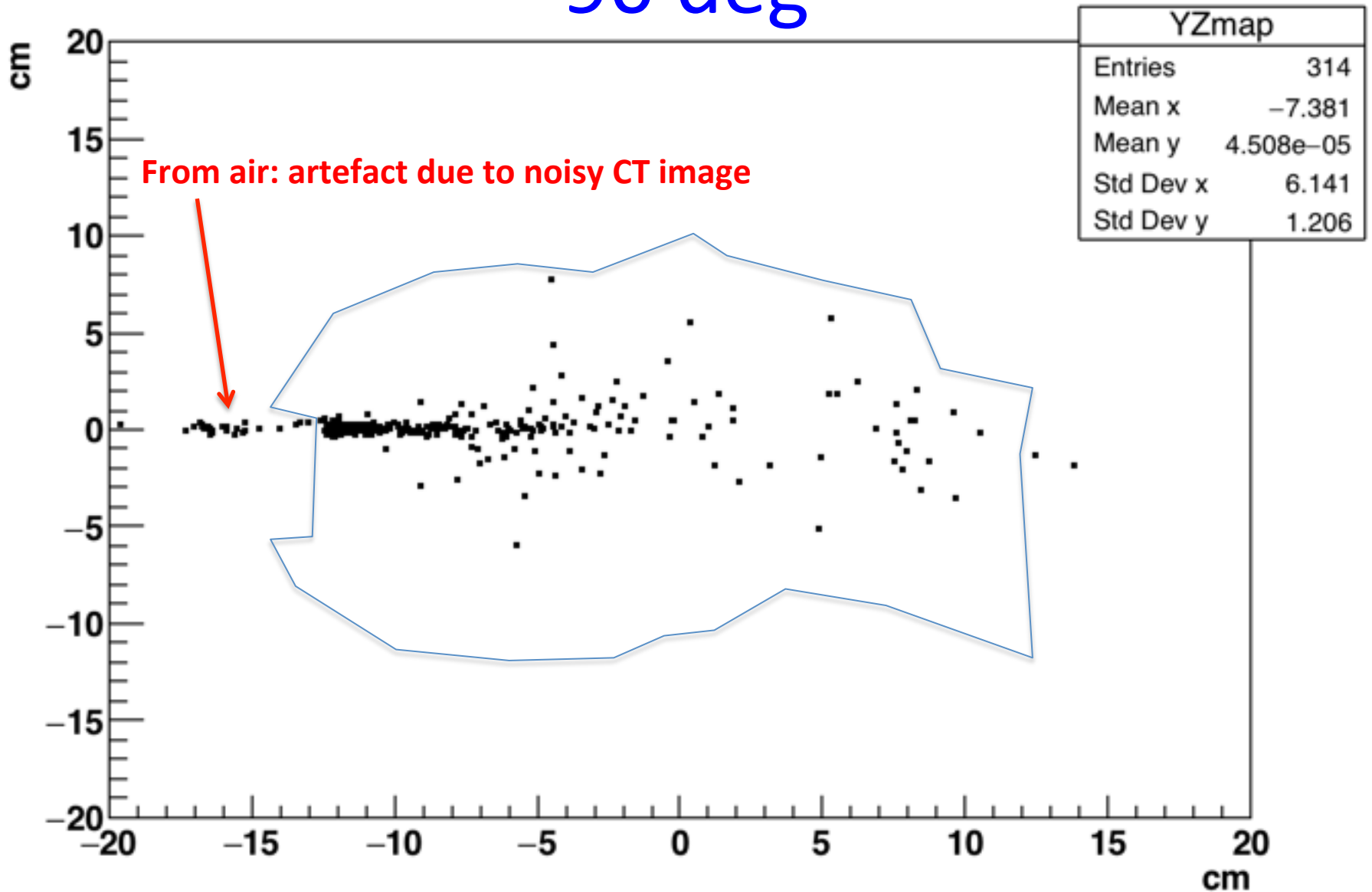
Very Simplified analysis

Counting proton tracks impinging on the 1st layer of fibers and asking for >10 fiber hits in the event

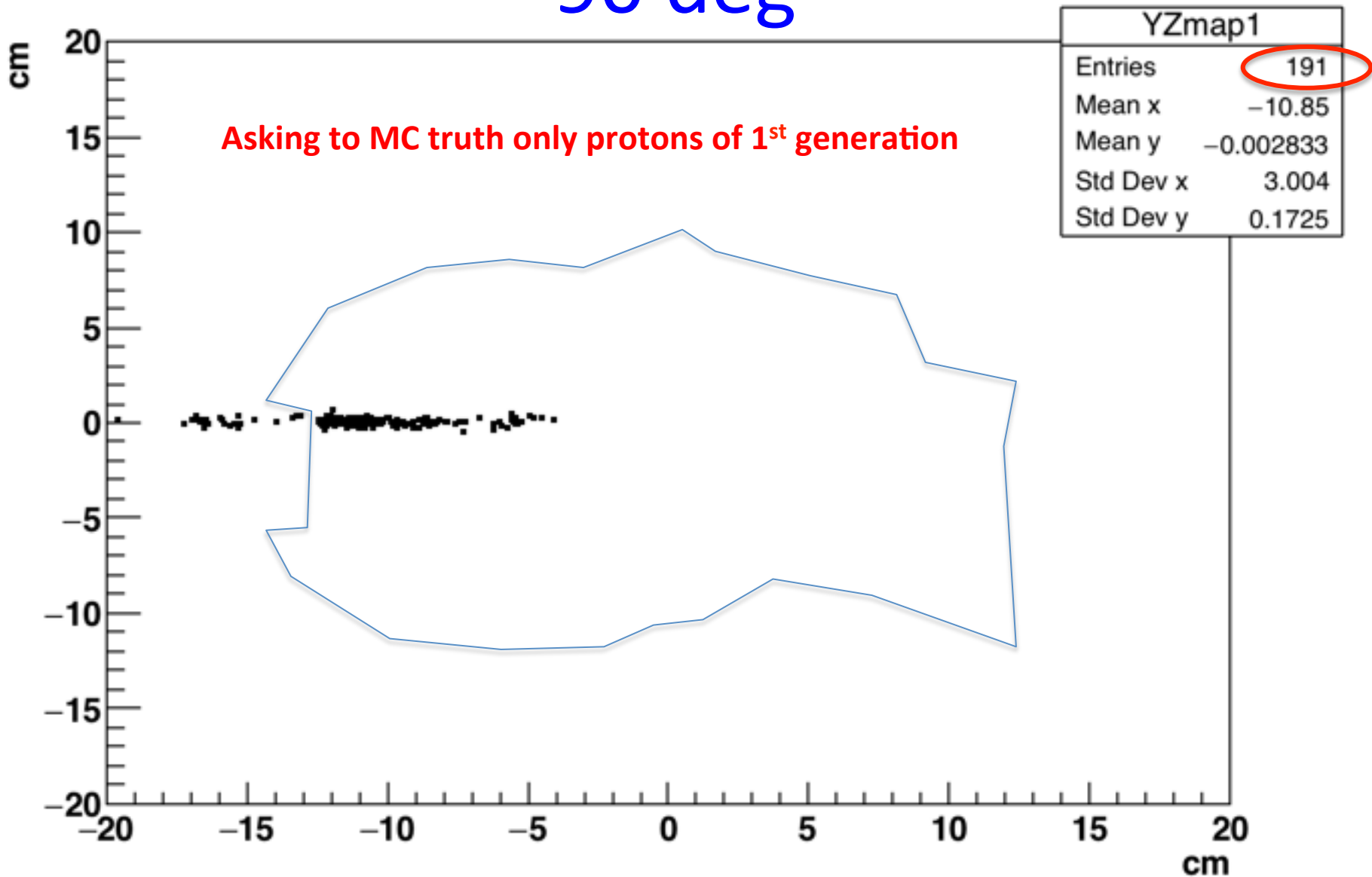
90 deg



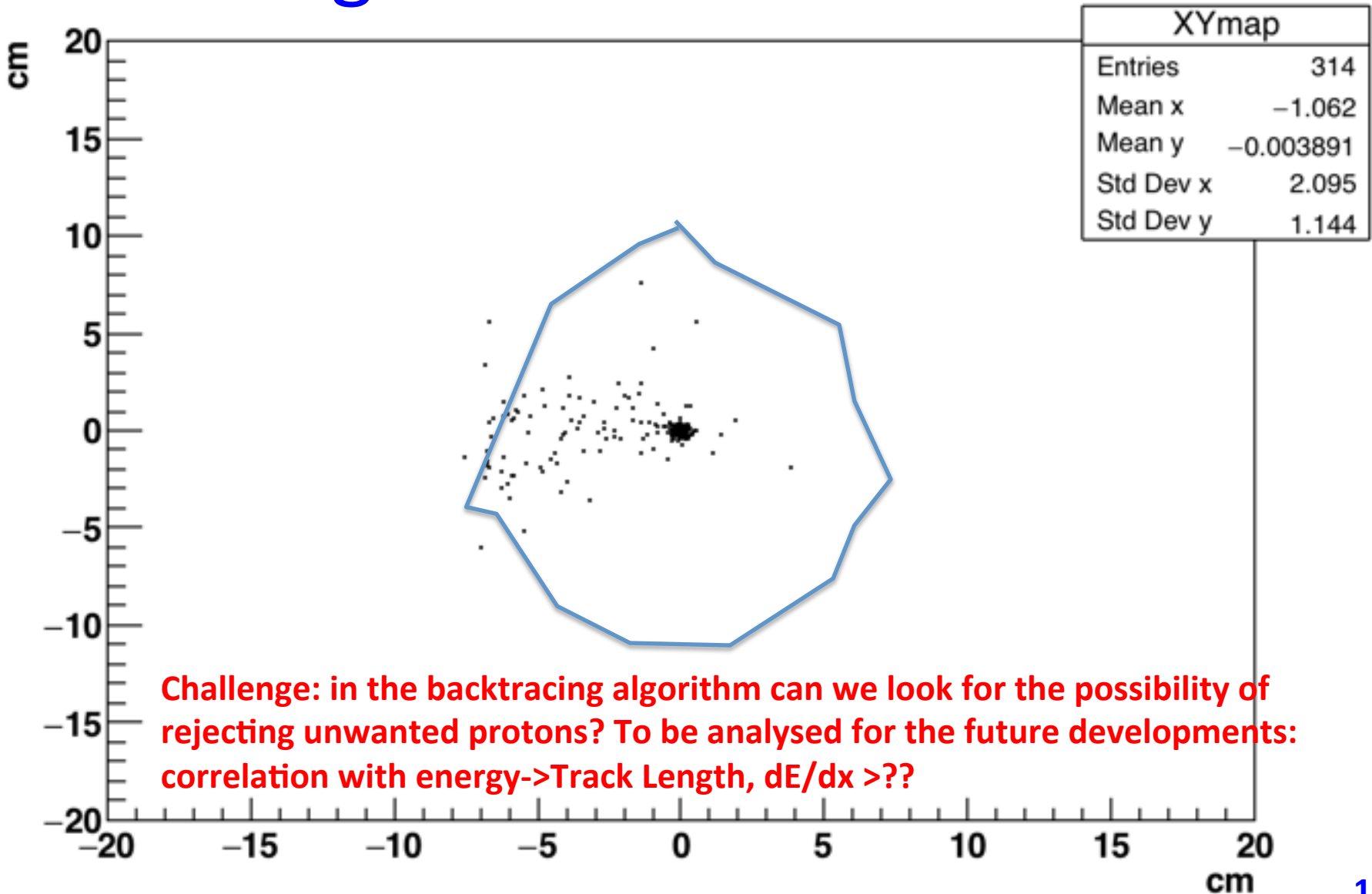
90 deg



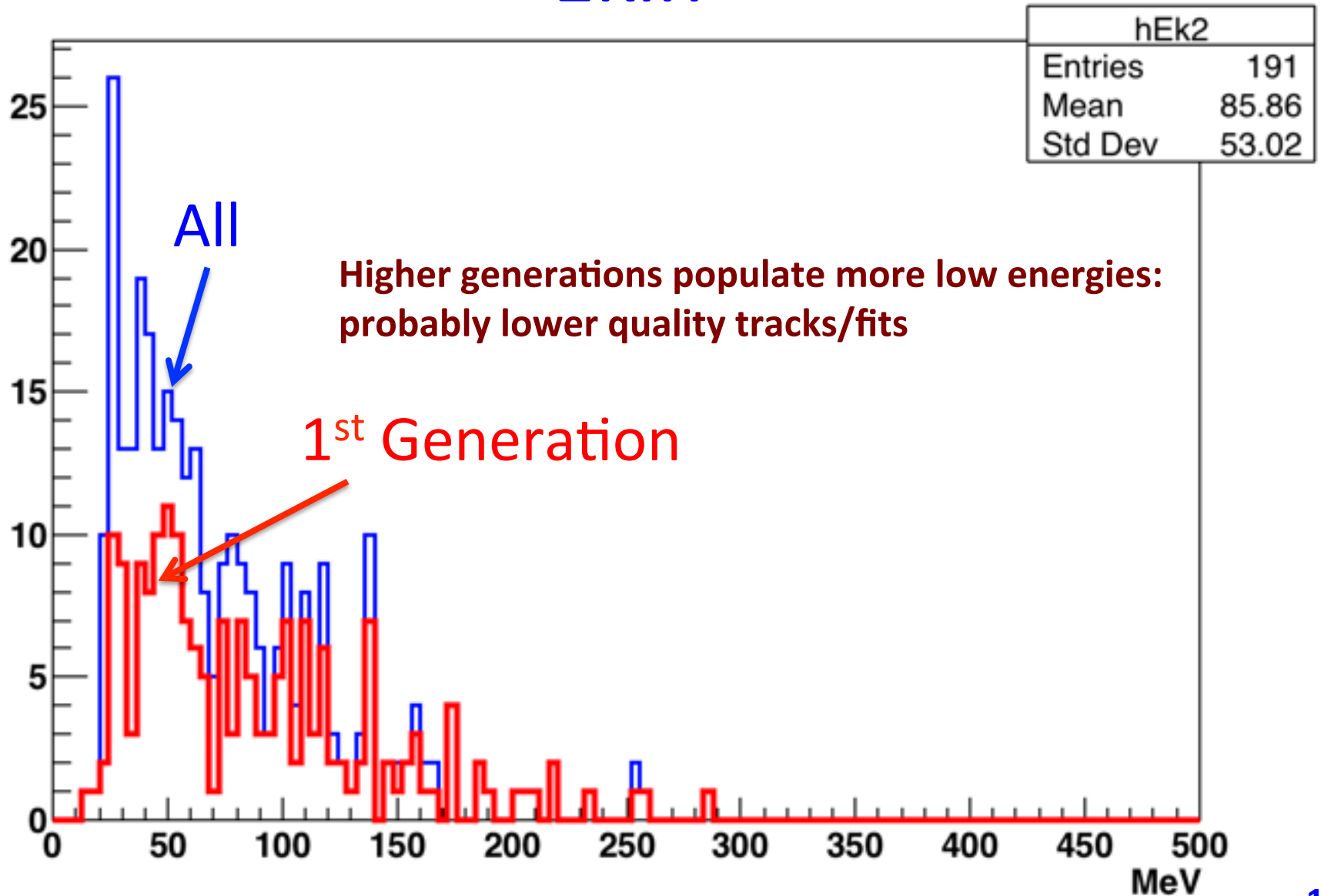
90 deg



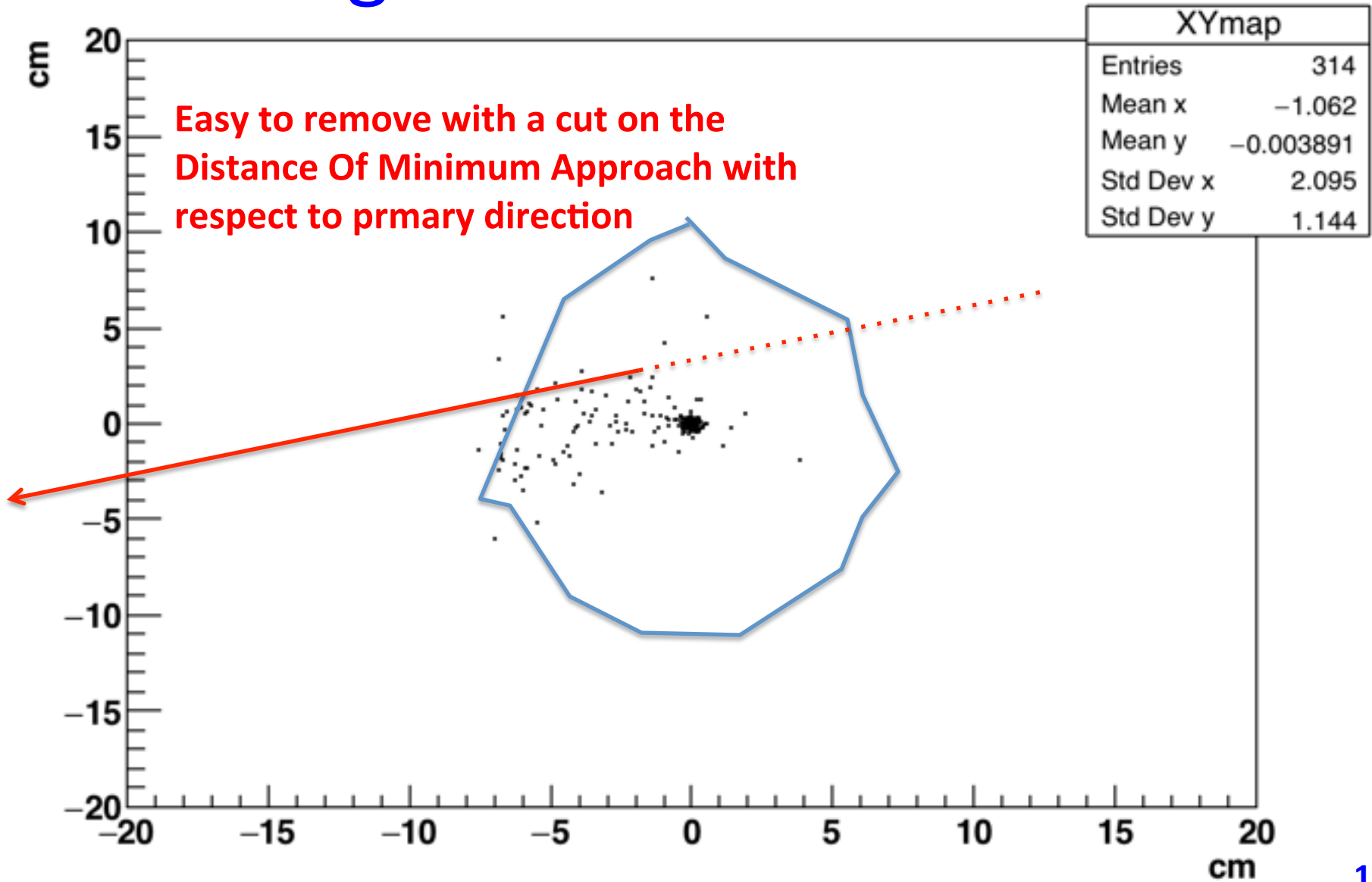
90deg in the transverse view



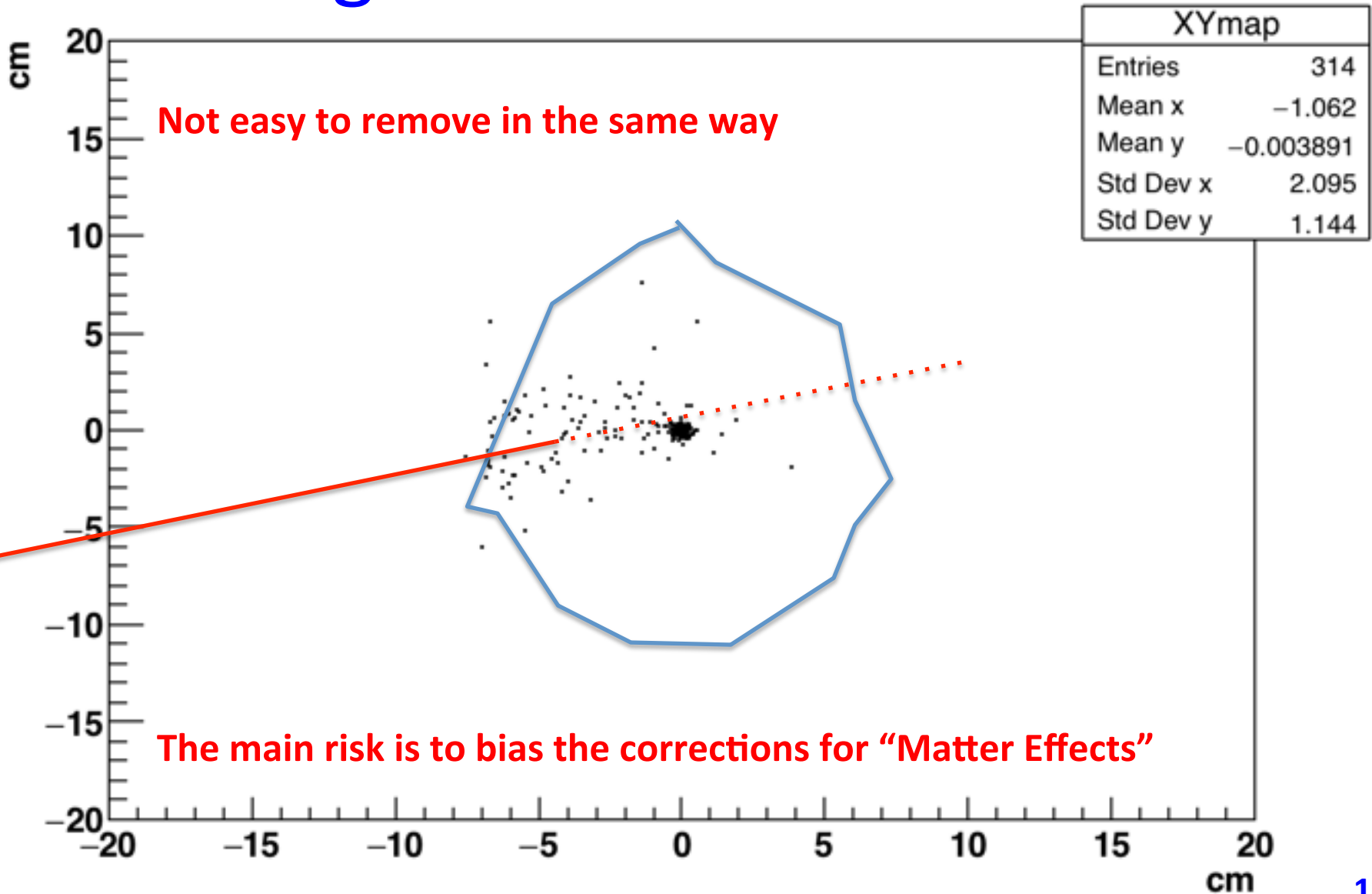
Ekin



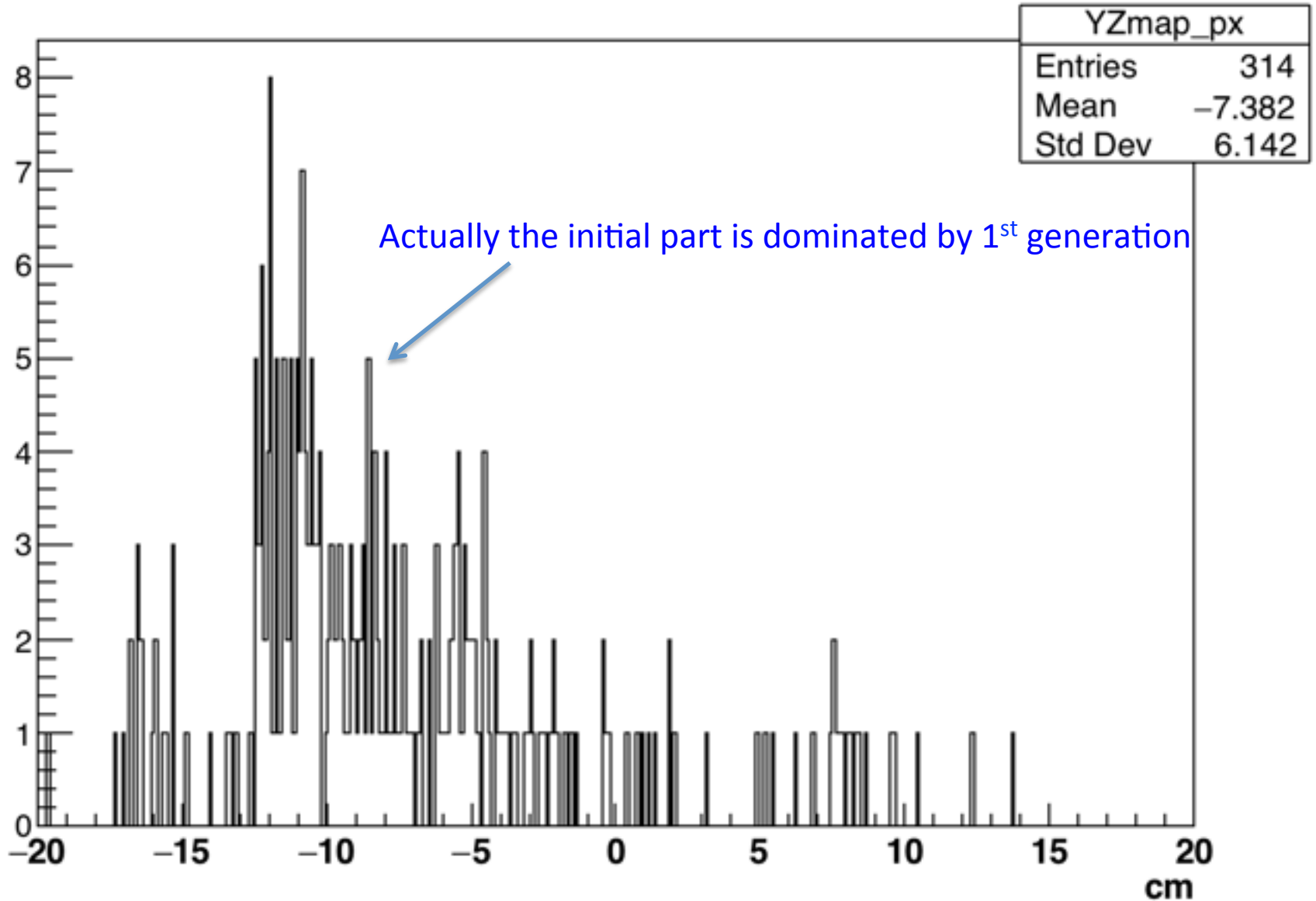
90deg in the transverse view



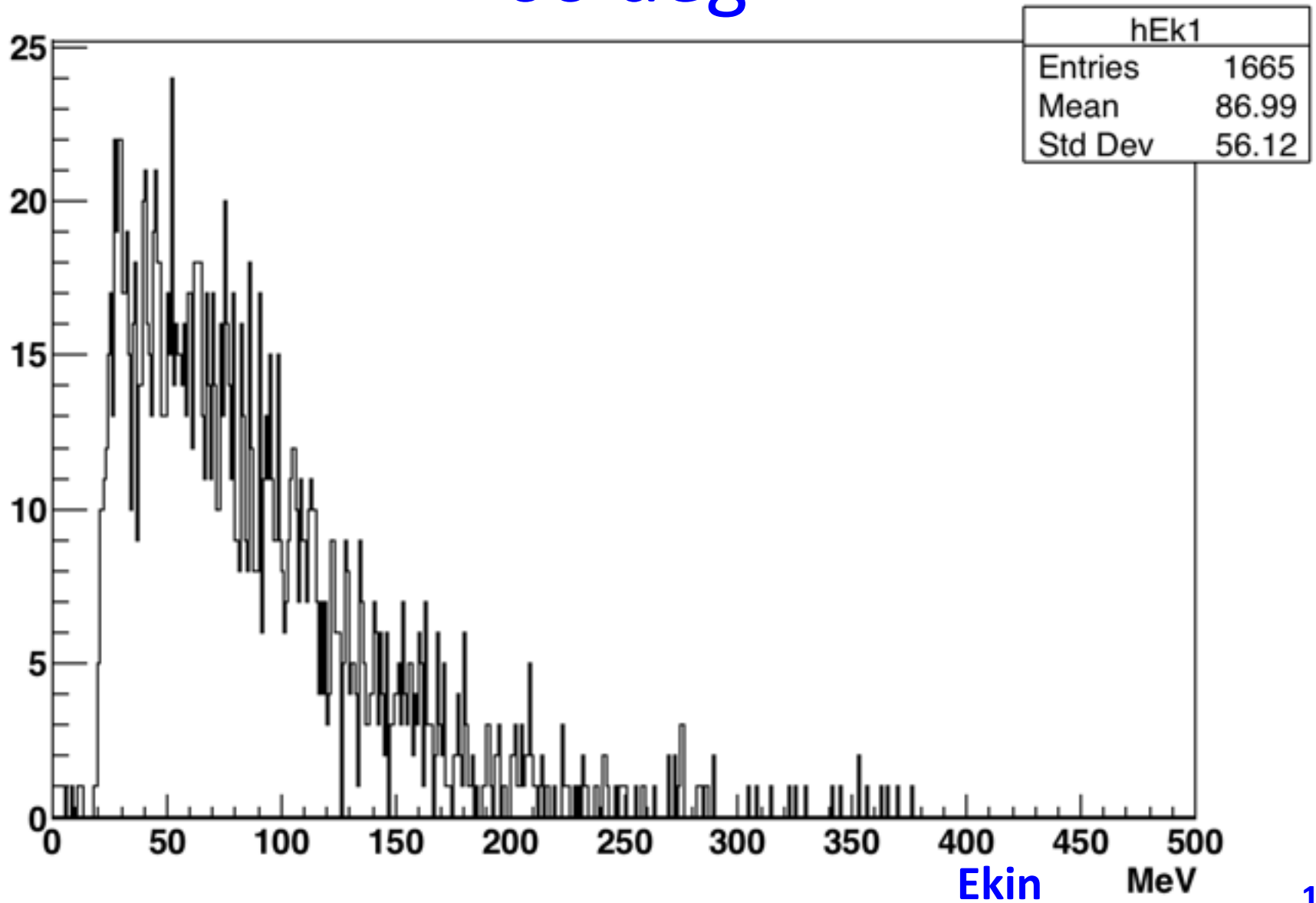
90deg in the transverse view



90deg Emission Profile



60 deg



On the absolute prediction of MC:

Roughly, using the flux for C @ 220 MeV/u measured at GSI at 60 deg
 $11.3 \cdot 10^{-3} \text{ p/sr/prim} * (19 \times 19 / (40 \times 40)) \text{ sr} * 10^6 \text{ prim}$:

~2550 proton in DP acceptance @60deg

Some absorption should be taken into account because of the larger thickness



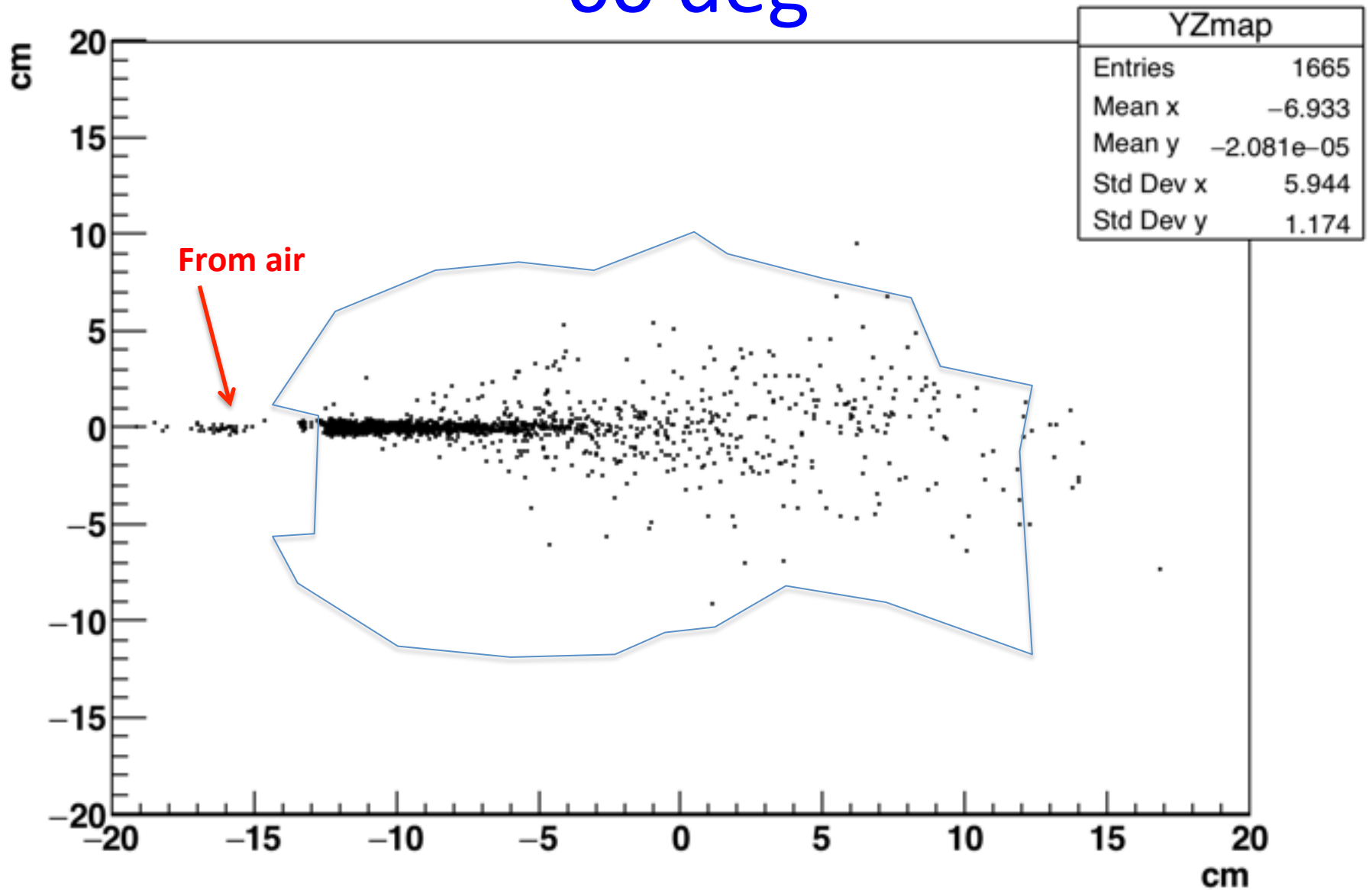
Prediction should not be too far from reality

at 90 deg the comparison is worse $4.3 \cdot 10^{-3} \text{ p/sr/prim} * (19 \times 19 / (40 \times 40)) \text{ sr} * 10^6 \text{ prim}$:
~970 against ~300. Something better with absorption, but we know that at 90 deg
FLUKA model has still problems. In any case not relevant for Inside

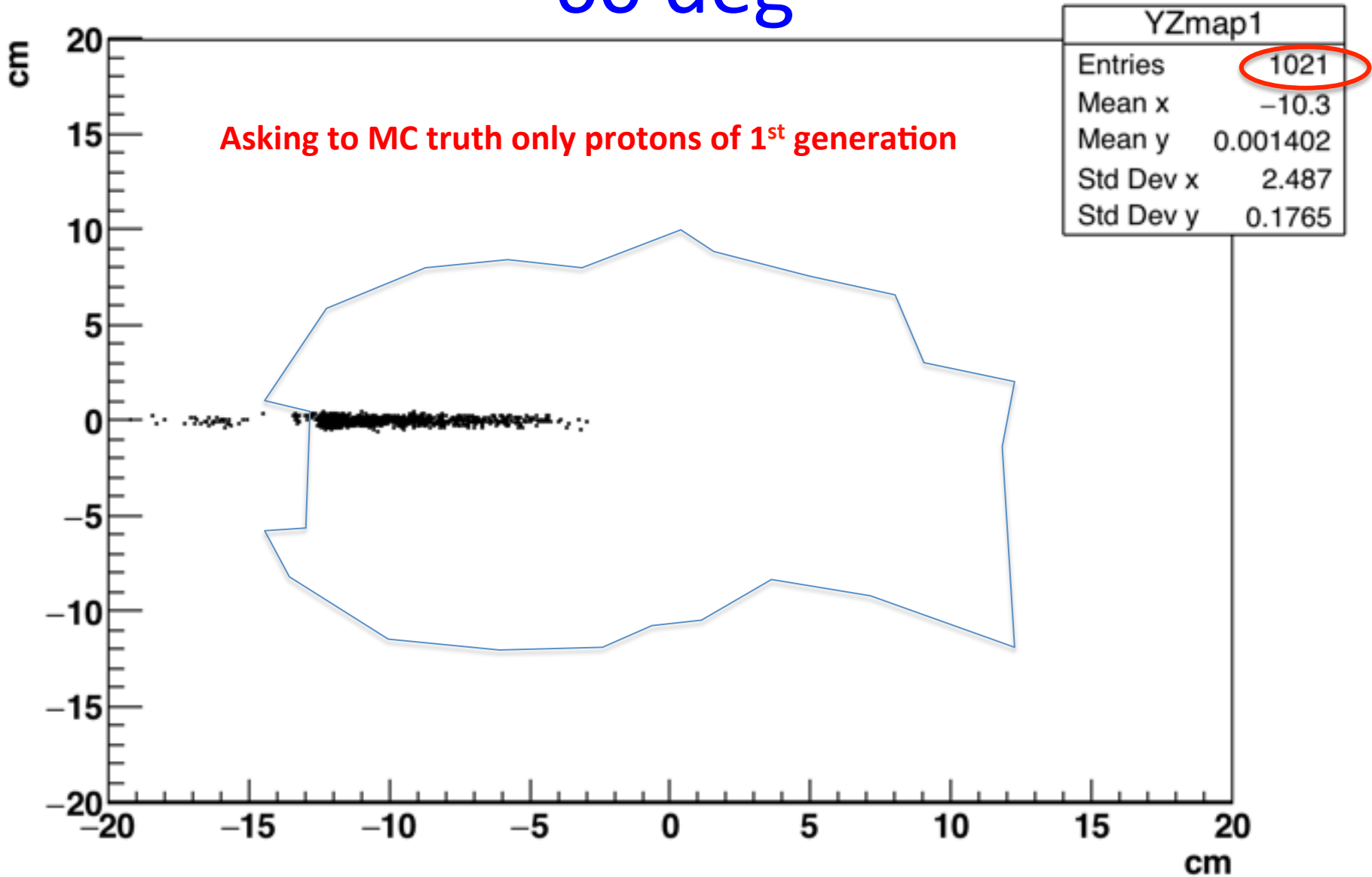
Rough considerations on rate

- a) if MC absolute number is correct at 60 deg for 10^6 primaries we expect in DP ~ 1500 good tracks
- b) Considering a single PB in a standard fraction this number reduces to ~ 500
- c) At treatment full intensity ($\sim 10^8$ C/sec) we have $3 \cdot 10^5$ primaries in ~ 3 msec.
- d) This would give an instantaneous rate of p in DP of $\sim 1.7 \cdot 10^5$ Hz
- e) If it is true that our saturation rate is 12 kHz we could have a strong reduction of measurable tracks (factor of 14) ~ 40 proton instead of 500

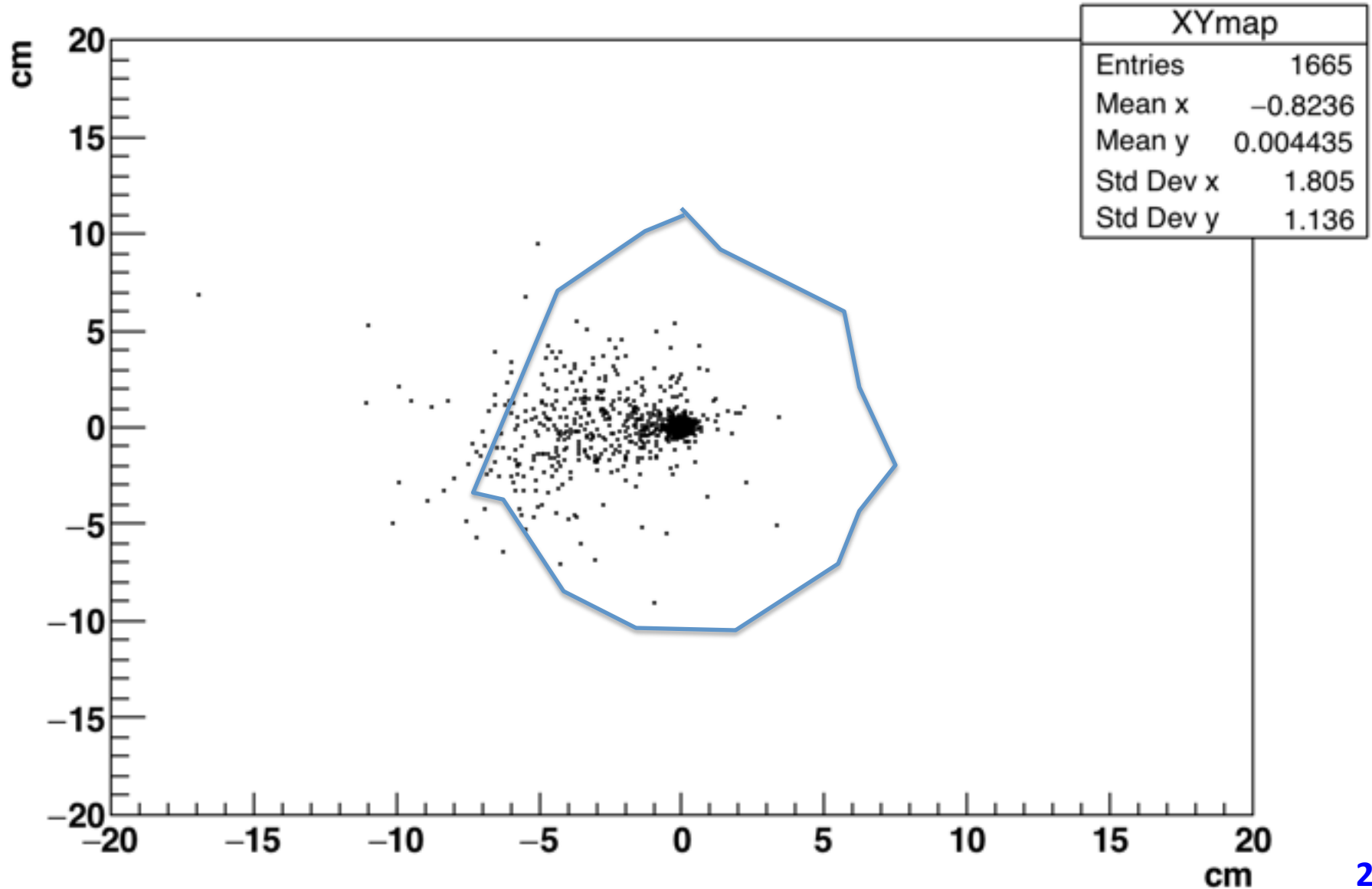
60 deg



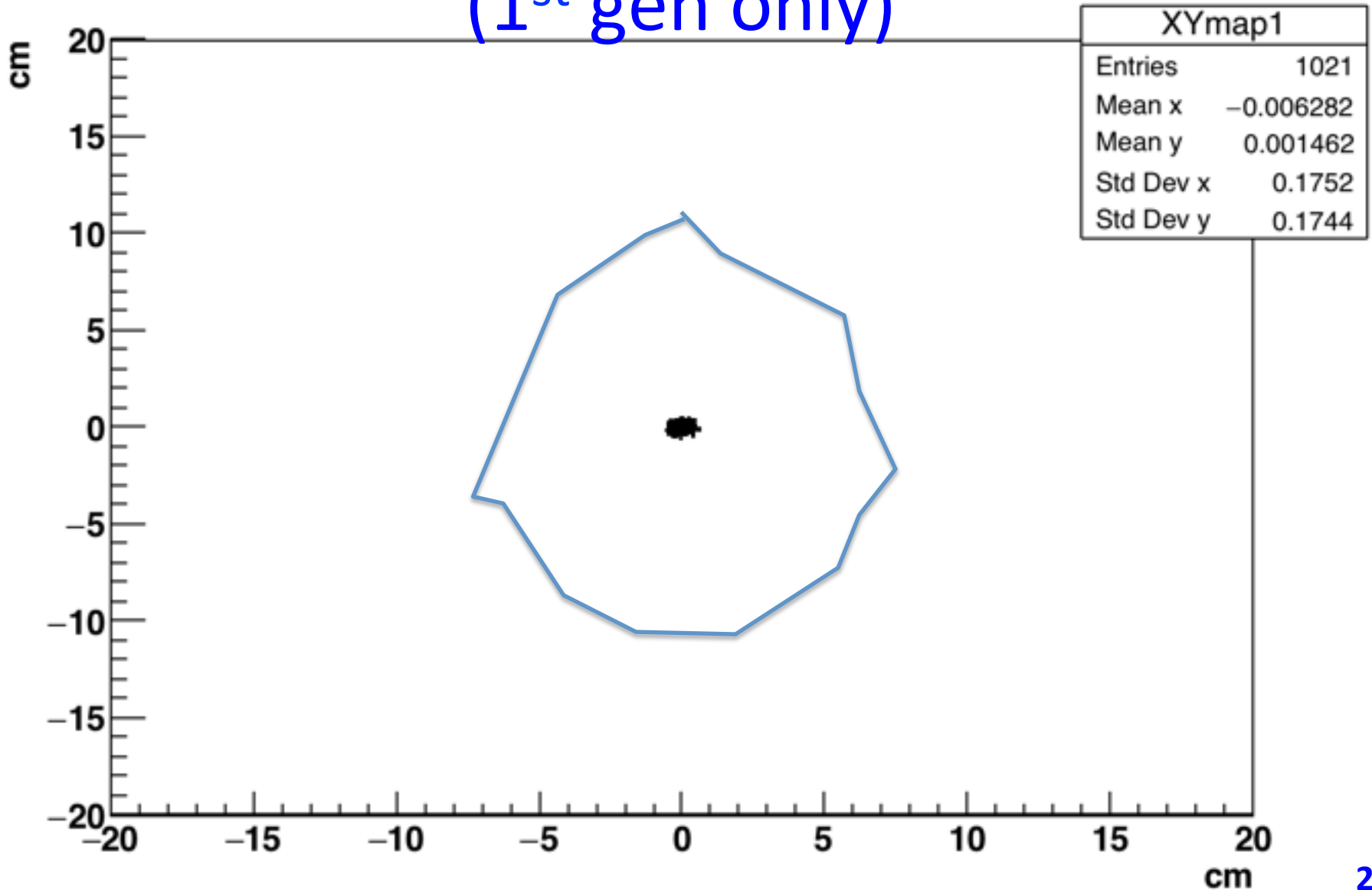
60 deg



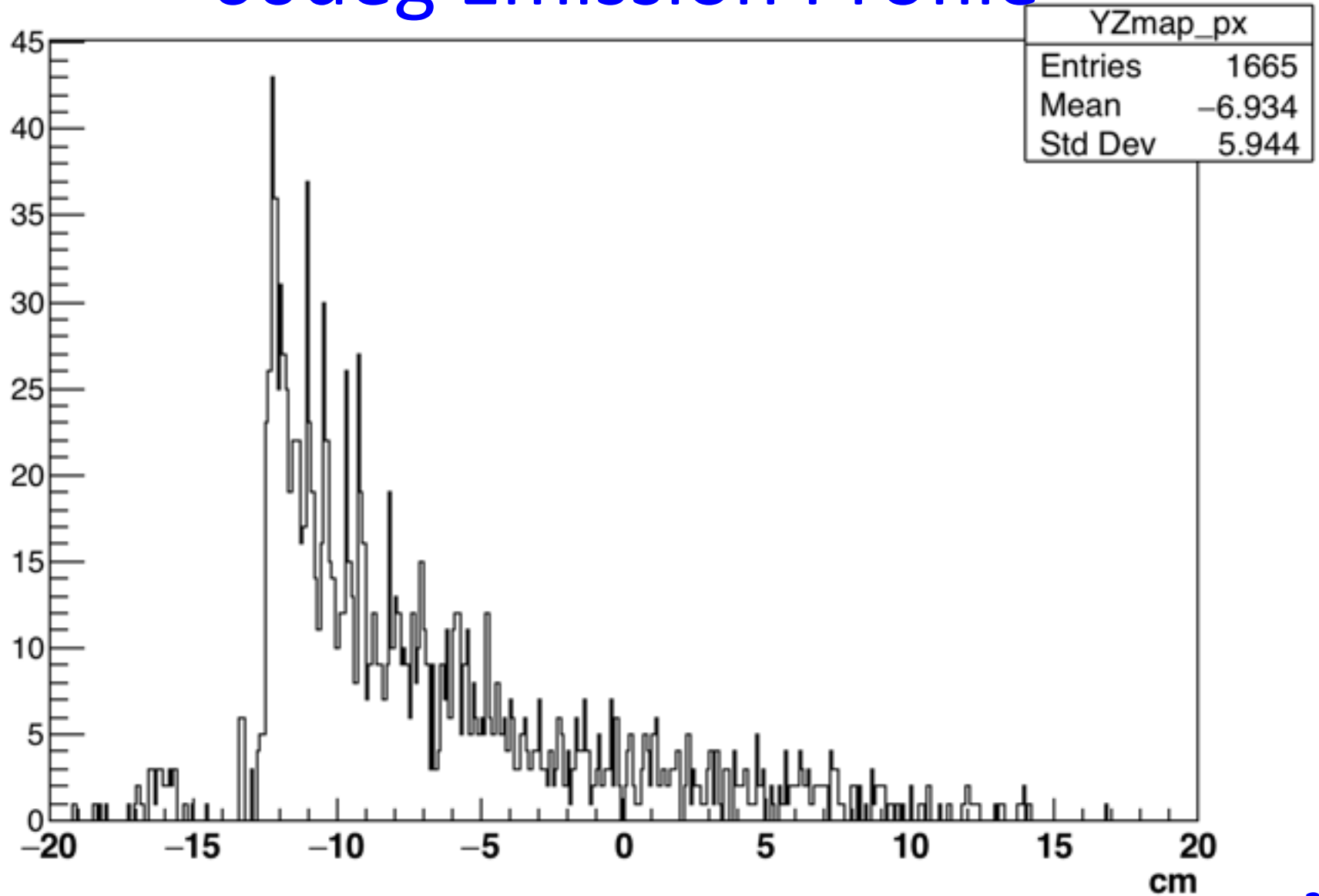
60deg in the transverse view



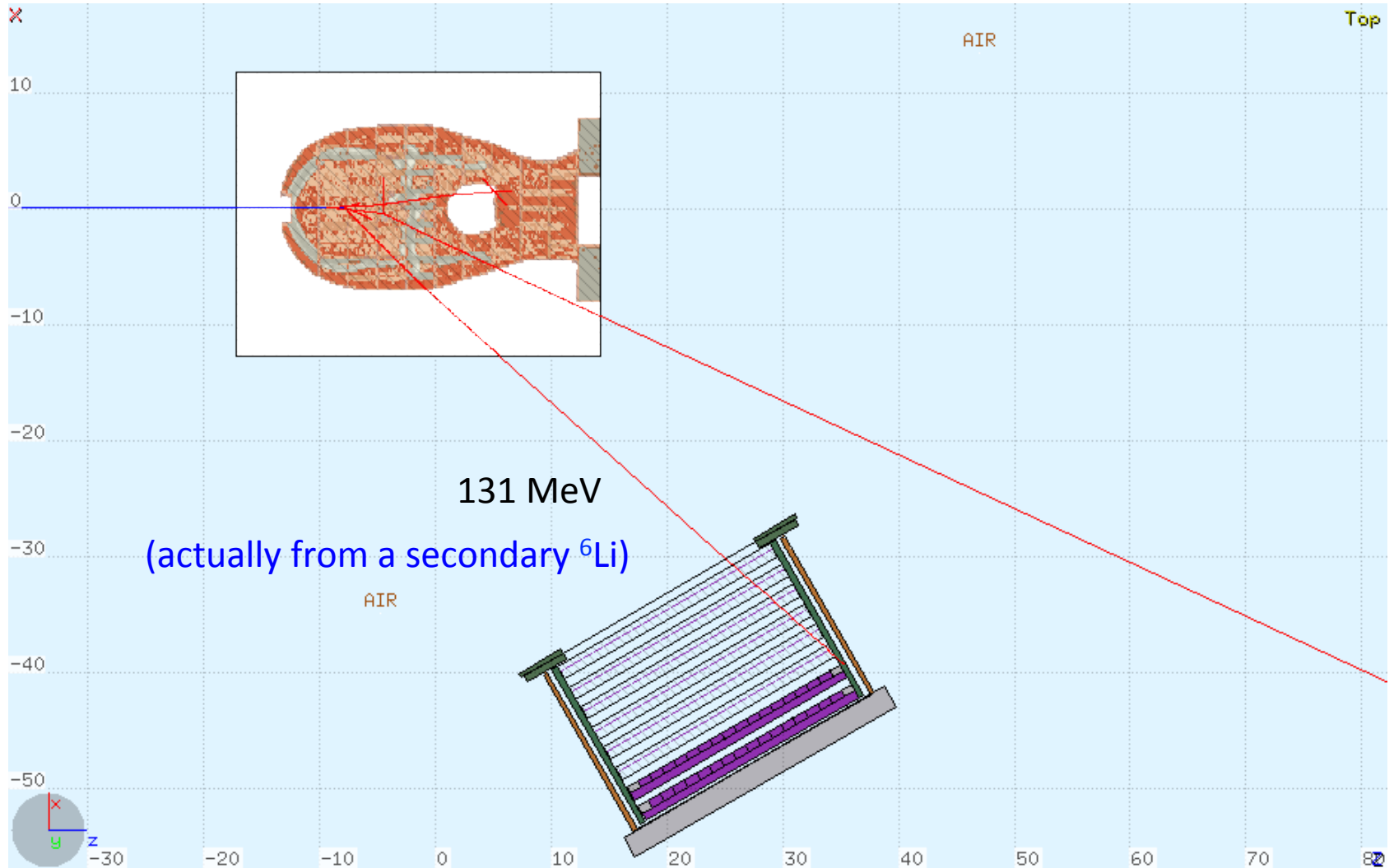
60deg ideal transverse view (1st gen only)



60deg Emission Profile

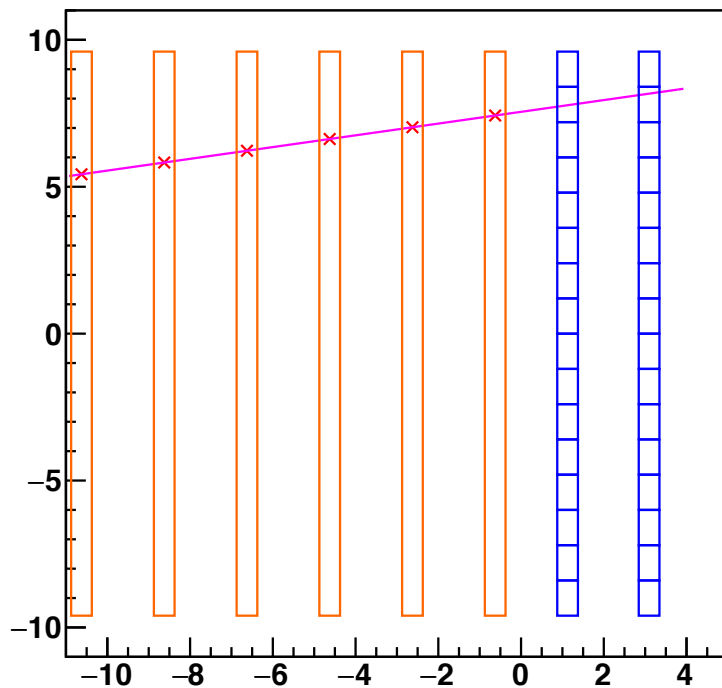


Event example

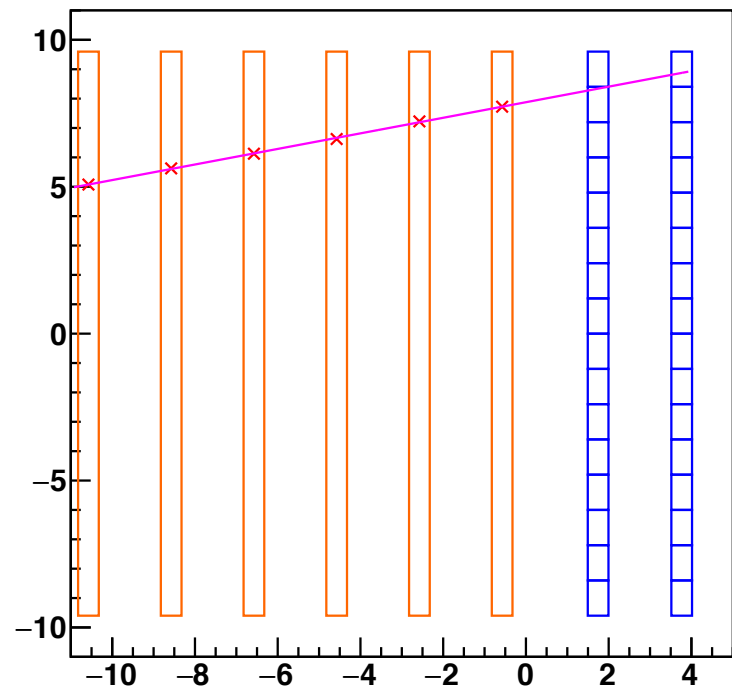


Tracing the same event with Profiler Code

X-Z planes - Ev::0 (6 hits)

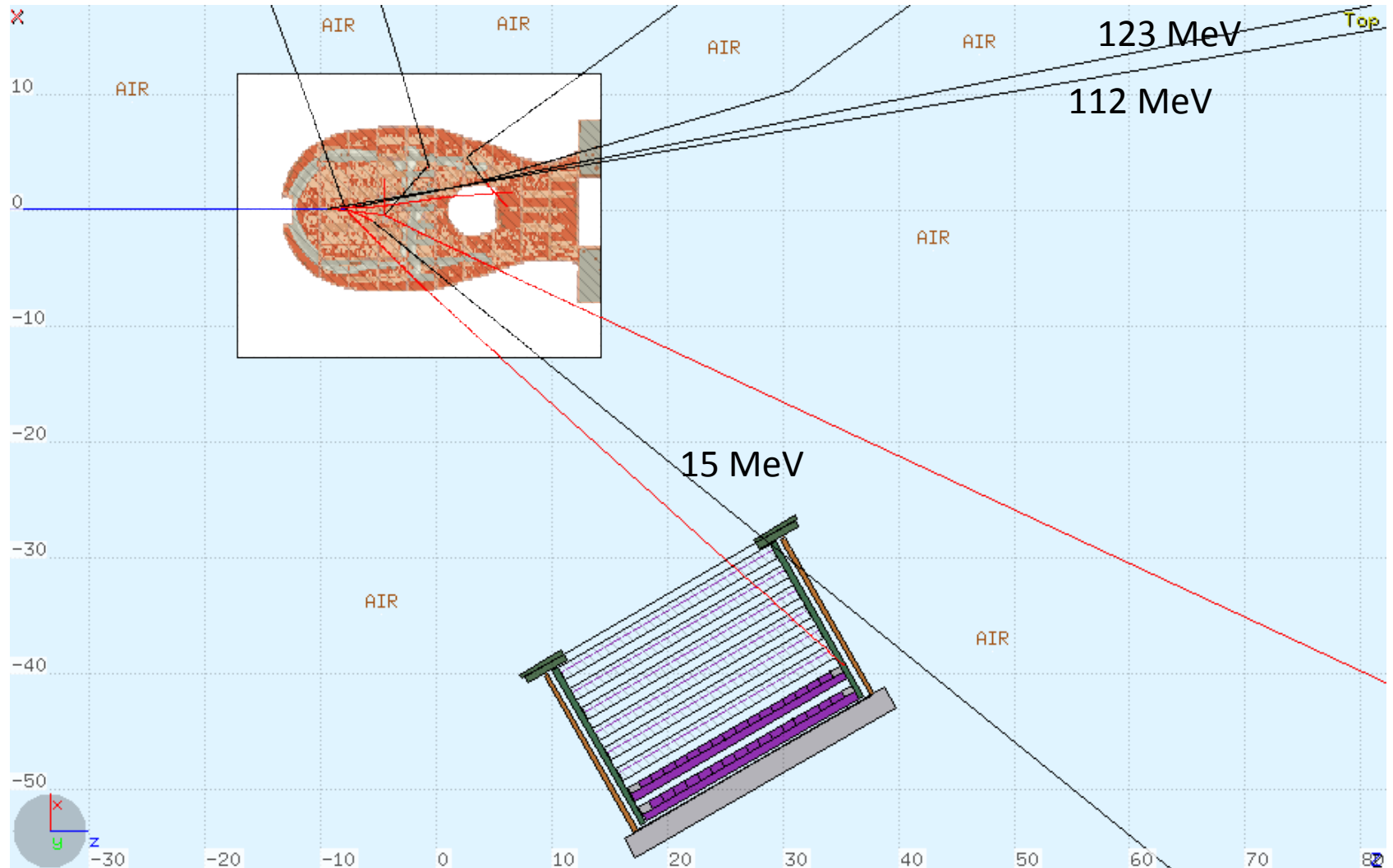


Y-Z planes - Ev::0 (6 hits)



The code makes use only of local DP coordinates

For MONDO people: of course also neutrons are produced



$n(E > 20 \text{ MeV})$ in the acceptance of DP @ 60 deg

