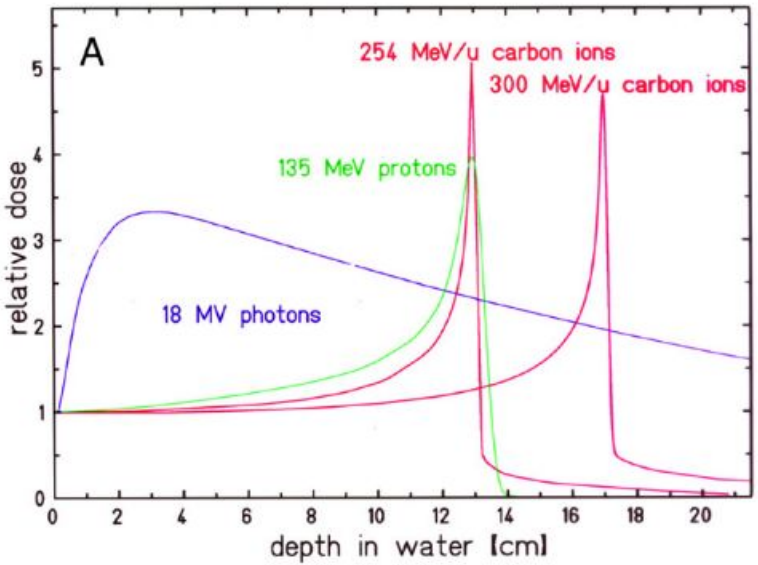
The first approach to the range of a proton beam determination in phantoms

Szymon Niedźwiecki

Plan

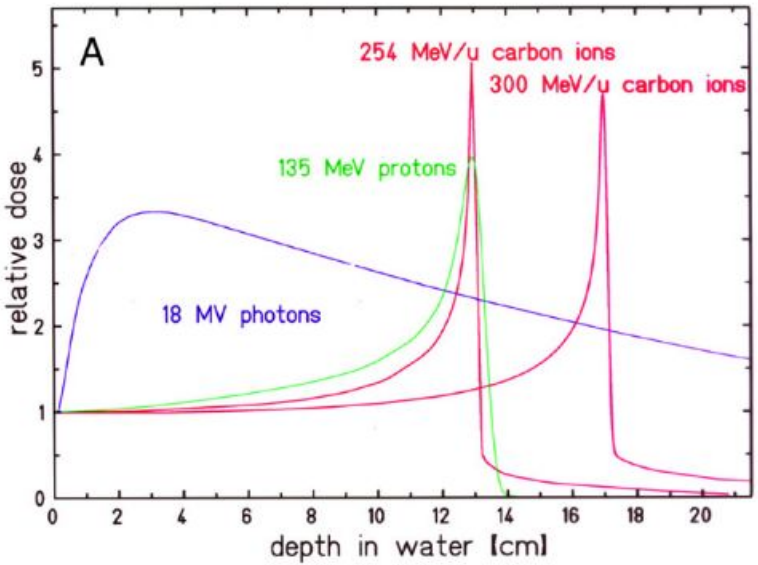
1. Motivation
2. Experimental setup
3. Data selection
4. Preliminary raw, FBP and MLEM results
5. Discussion

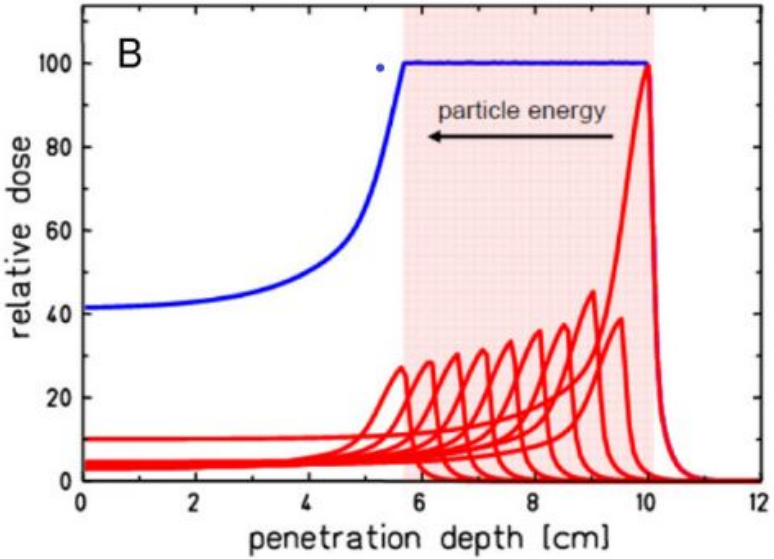
Motivation



J. Baran, PhD thesis

Motivation





J. Baran, PhD thesis

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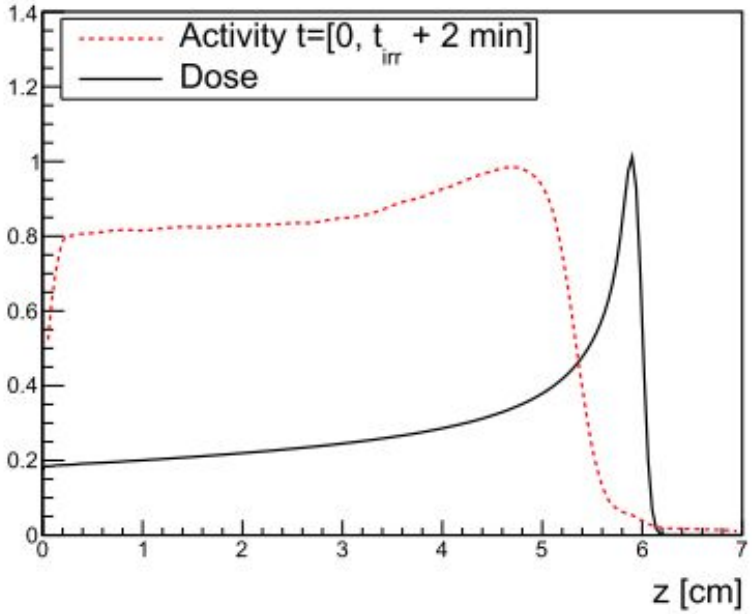
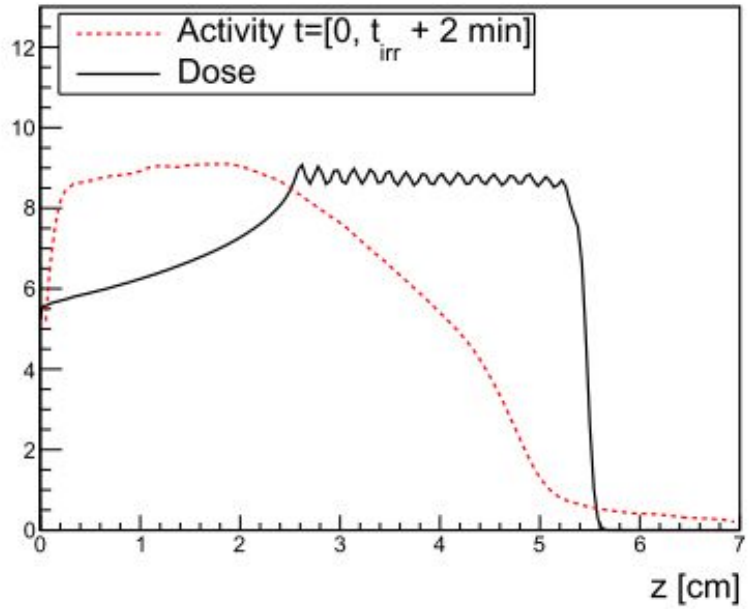
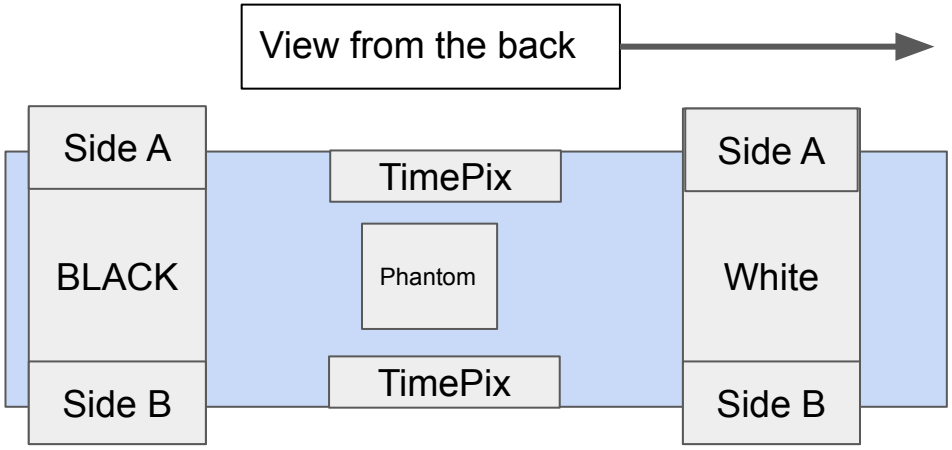




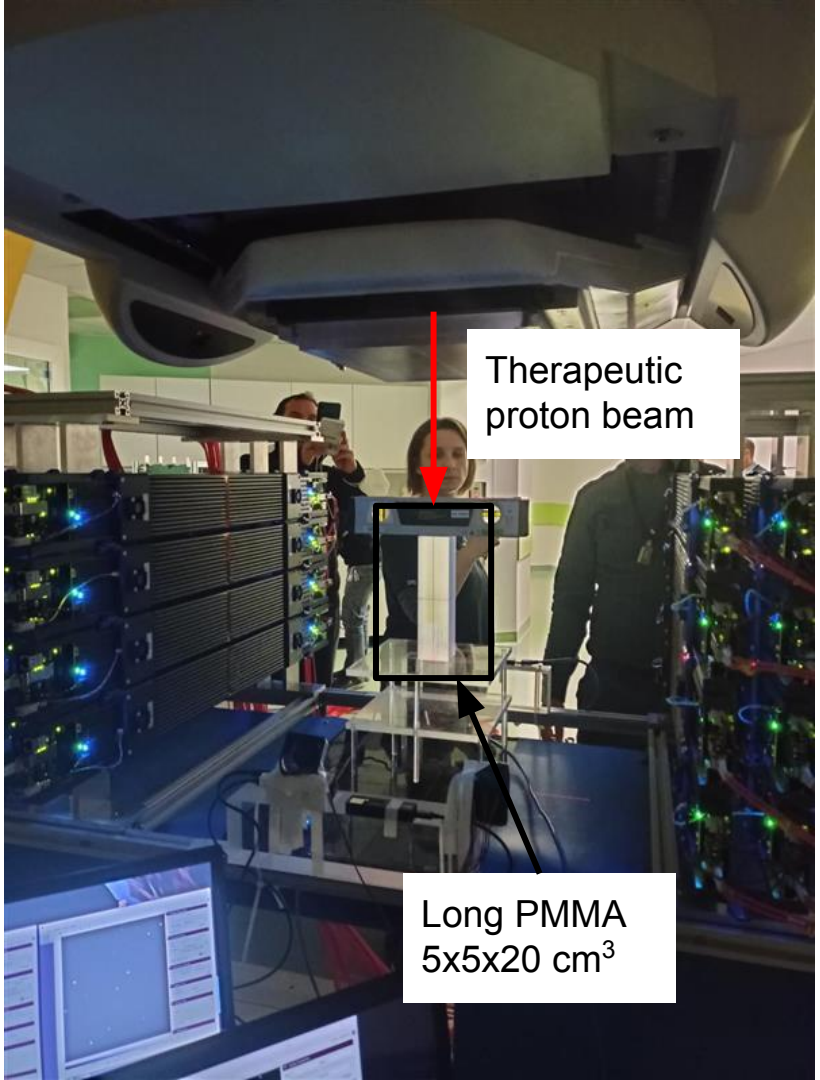
J. Baran, PhD thesis

Experimental setup

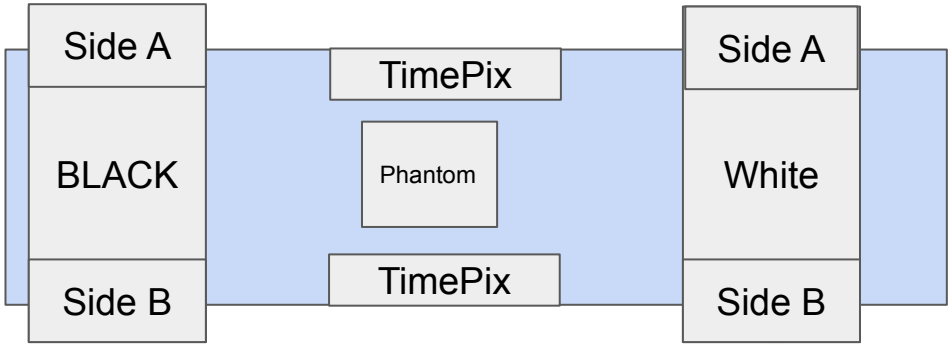


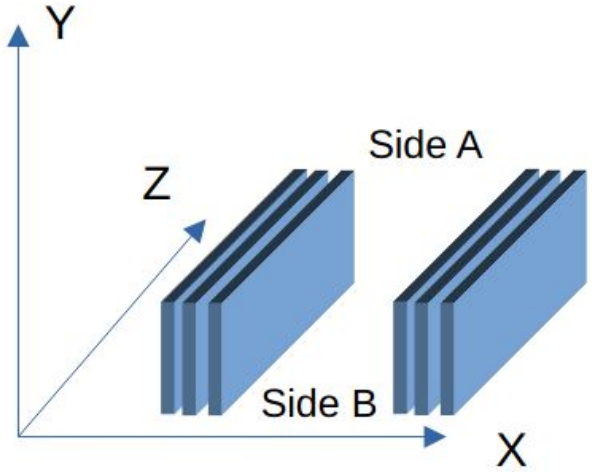
View from the front

NOTE: pencil beam was used for this phantom



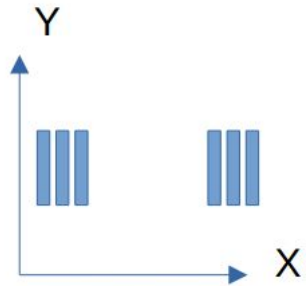
Experimental setup



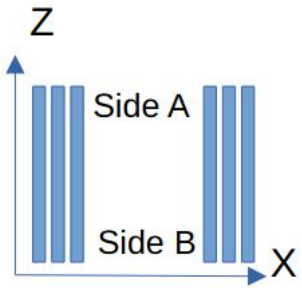


Note: left-handed!

View from the front

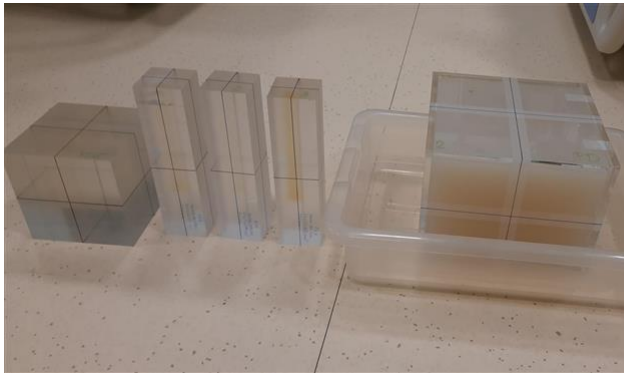


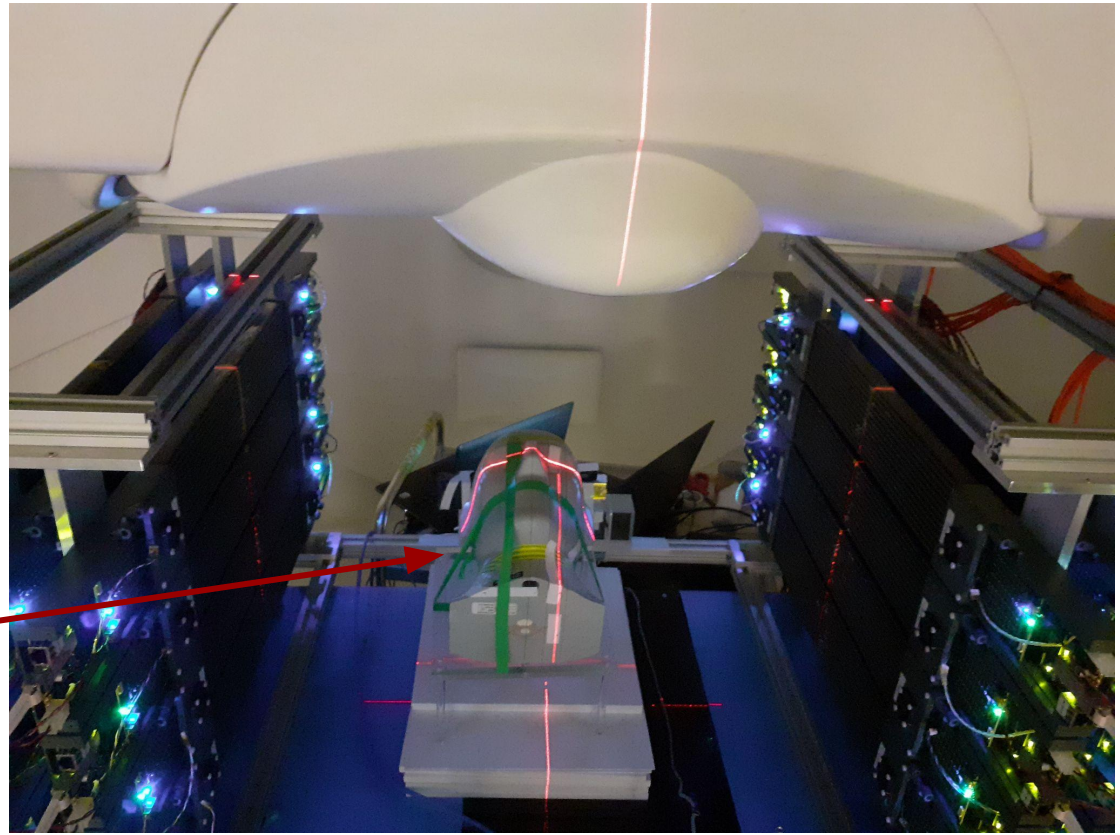
Front view from side B



View from the top

Experimental setup



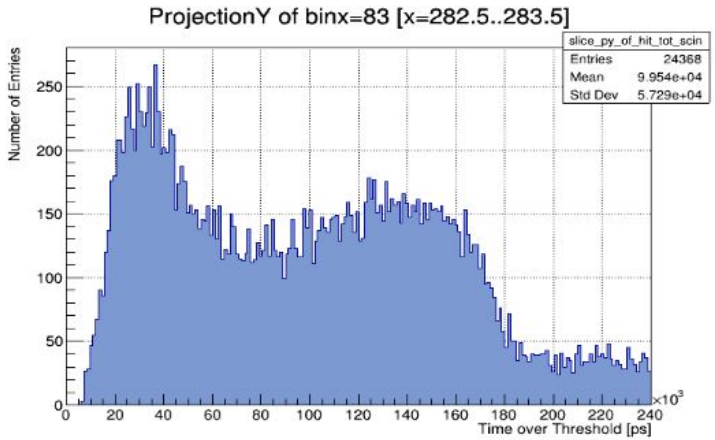


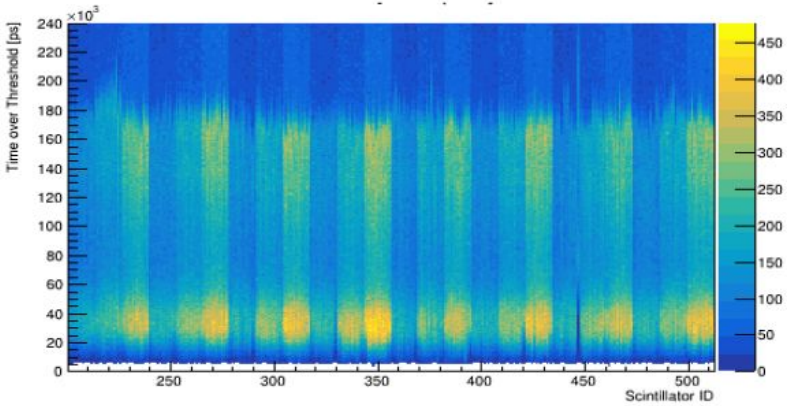
Cirs head phantom

Data selection

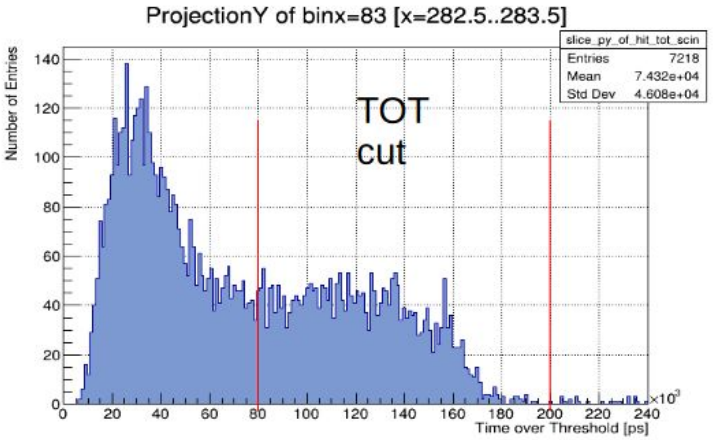
TOT

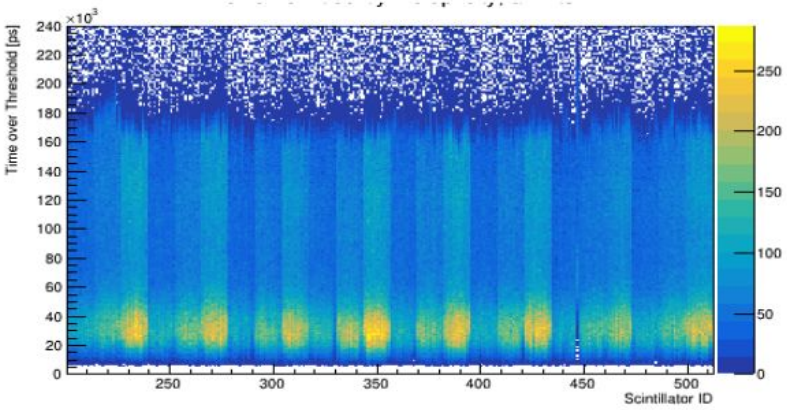
22Na source, @WFAIS





Phantom, @CCB





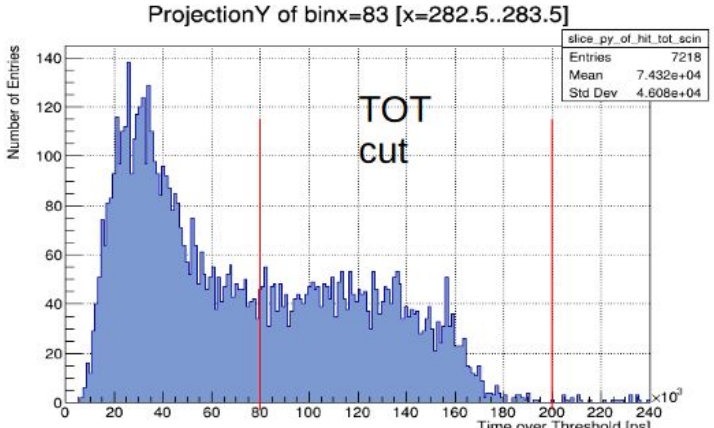
16 Gy deposited

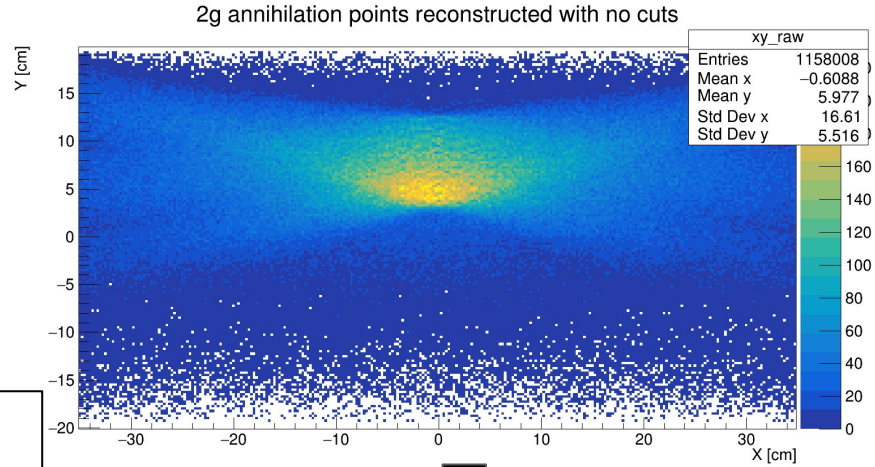
Data selection

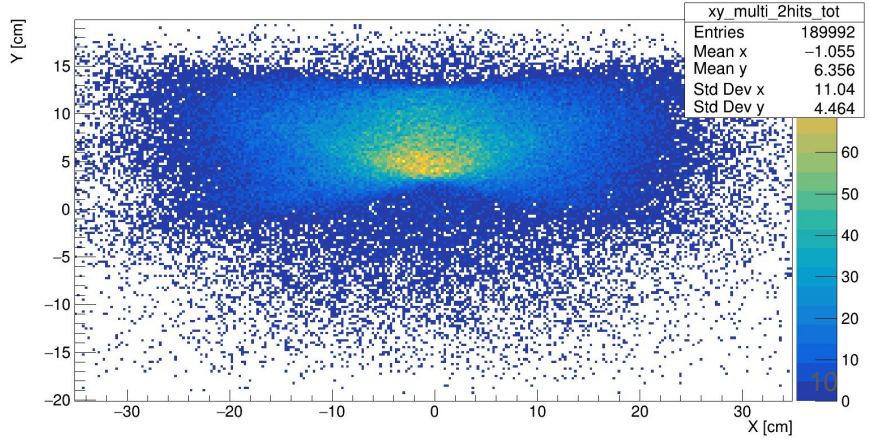
NOTE: pencil beam was used for this phantom

- ~ 200 - 380 keV energy cut;
- only 2 hits in 5 ns coincidence time window;
- all SiPM have to give signal;

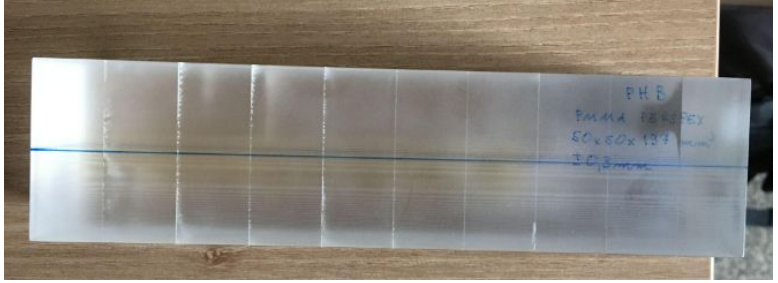
Phantom, @CCB







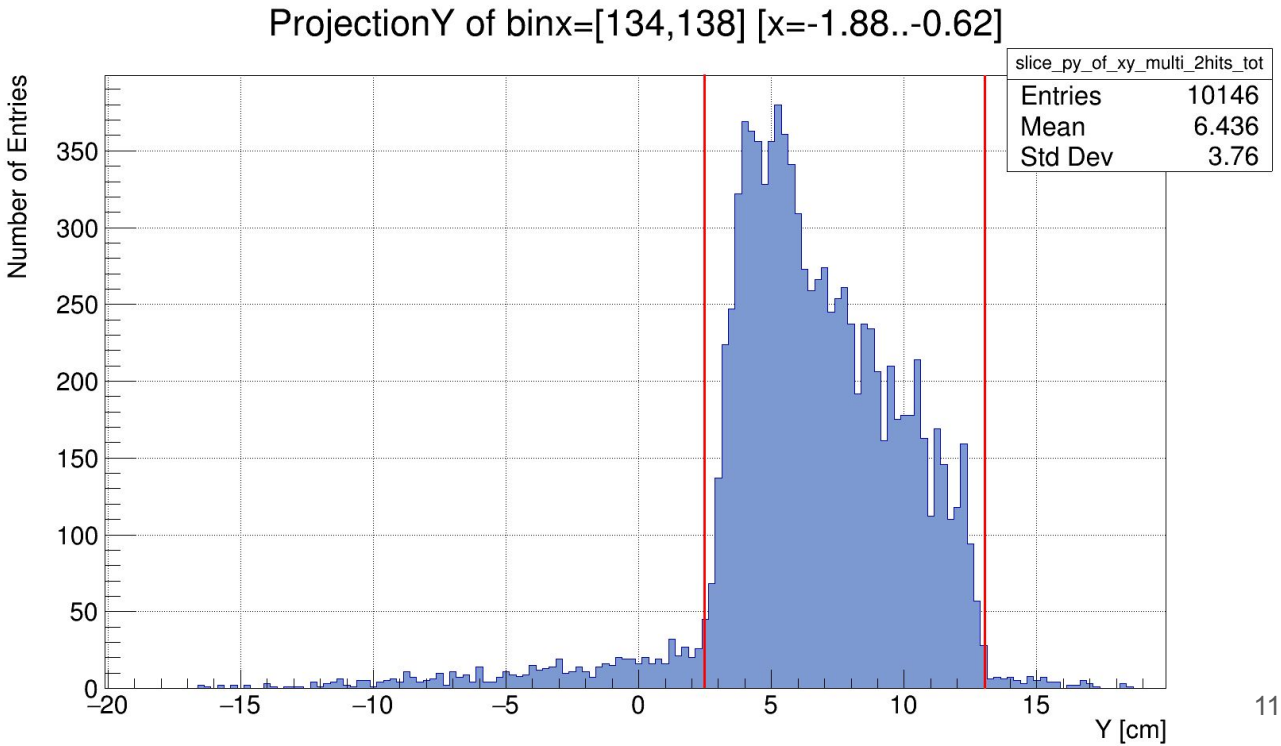
Preliminary raw results



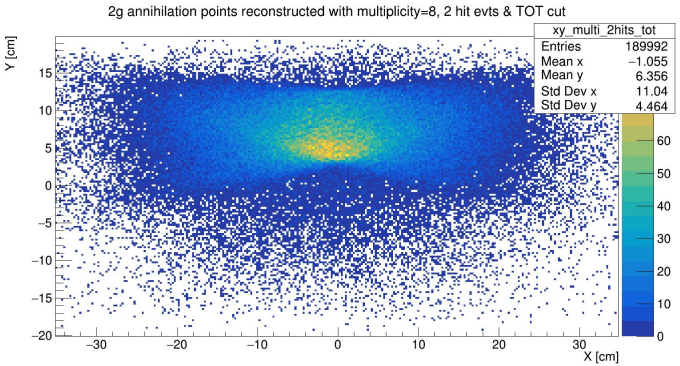
(13.026 - 2.464) =

10.562 cm

Expected: 10 cm



Preliminary results from TOF-FPB



σ(TOF) = 260 ps

25 slices along Z

TOF bin = 1 ns

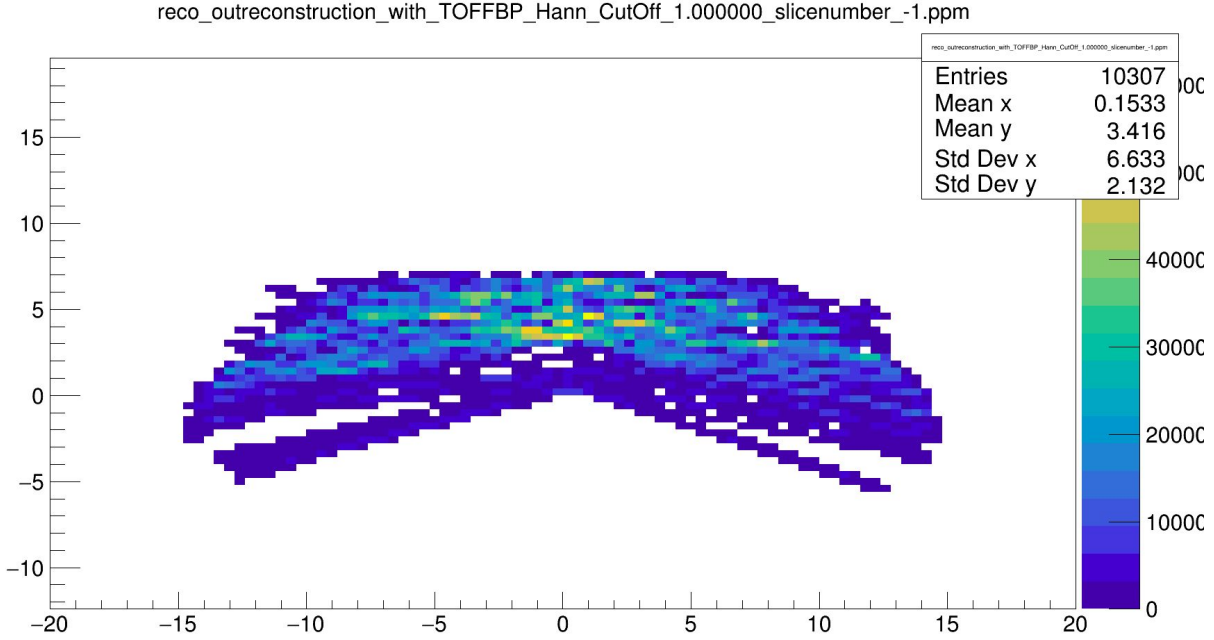
filter - Hann

cutoff 1.0

slice with highest counts

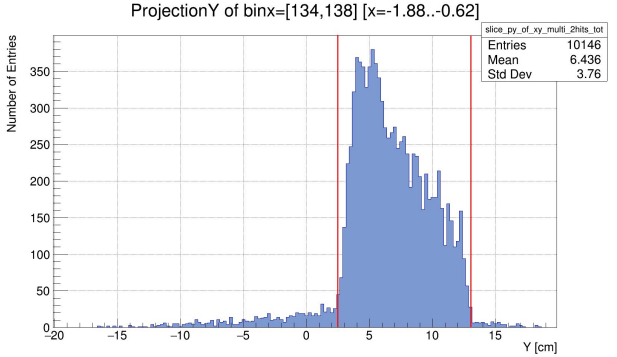
1 bin = 1 mm

but 4 mm per voxel for visualisation



Courtesy of A. Gajos

Preliminary results from TOF-FPB



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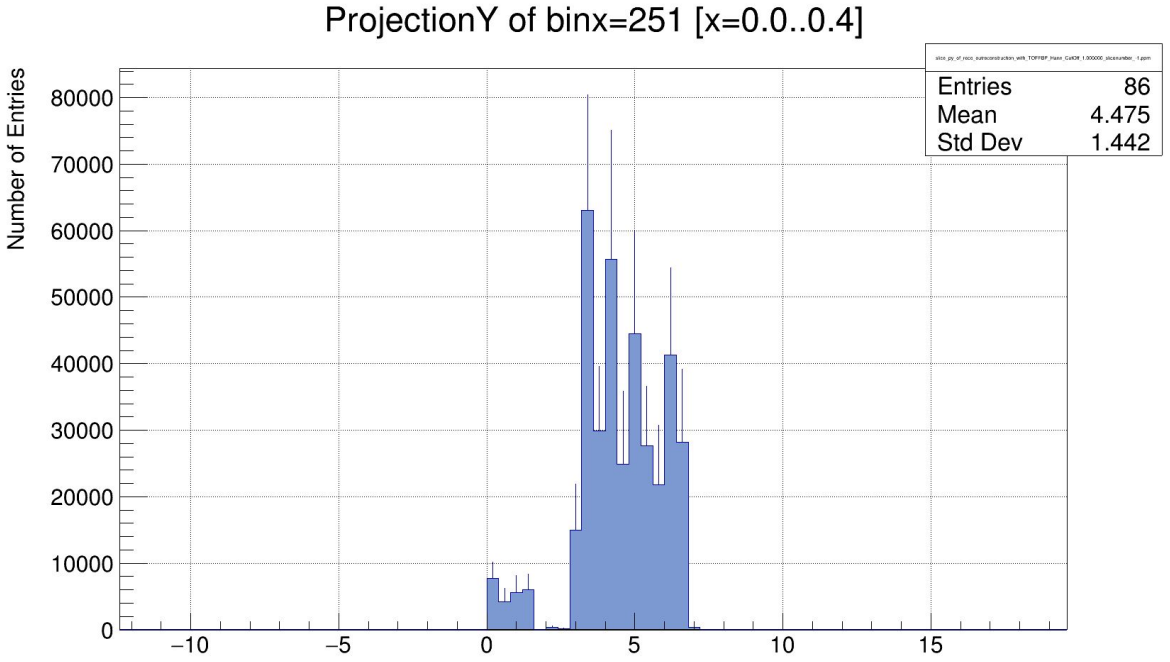


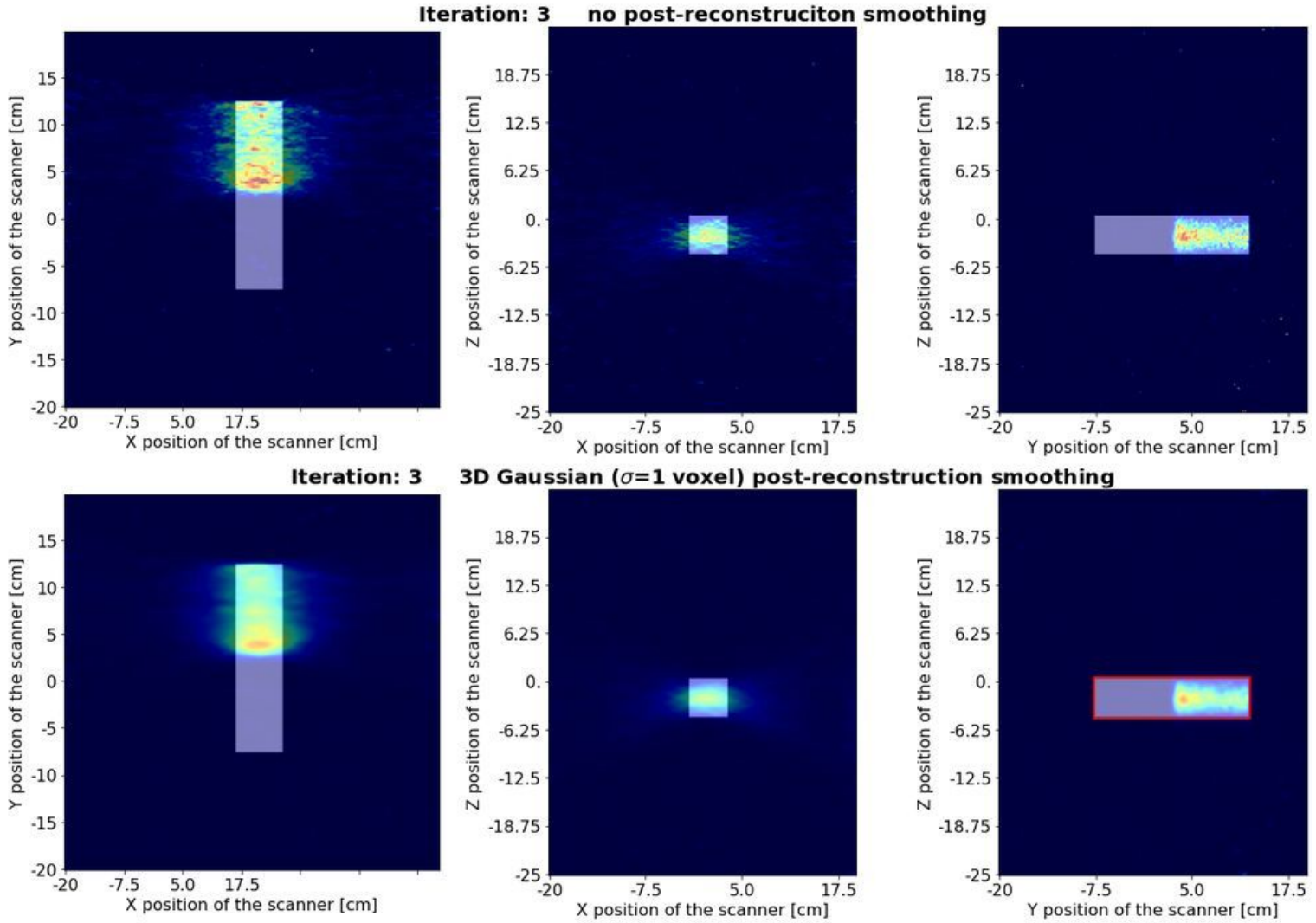
Courtesy of A. Gajos

MLEM

Castor

FWHM(TOF)

= 600 ps



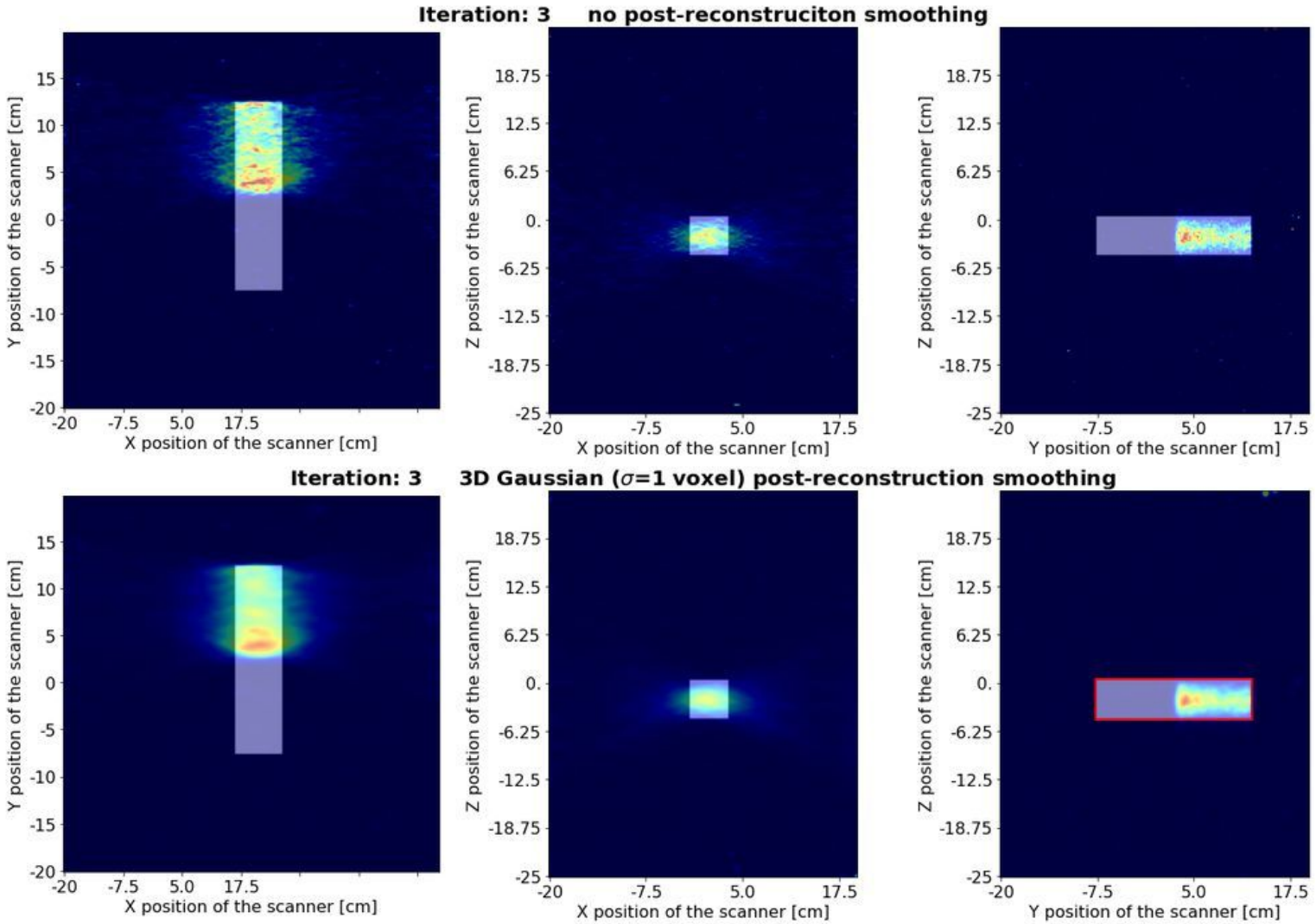
Courtesy of J. Baran

MLEM

Castor

FWHM(TOF)

= 300 ps



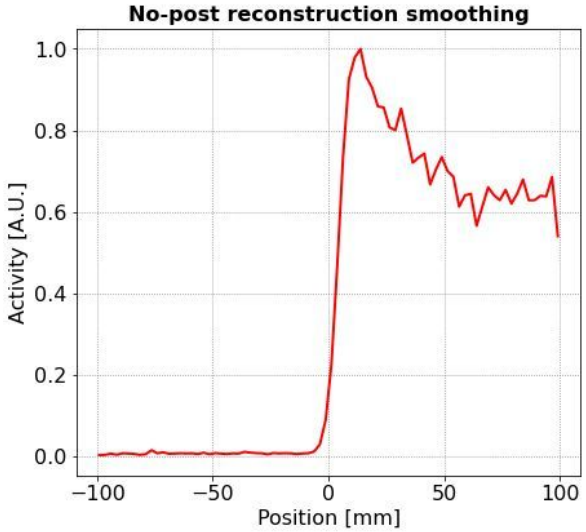
Courtesy of J. Baran

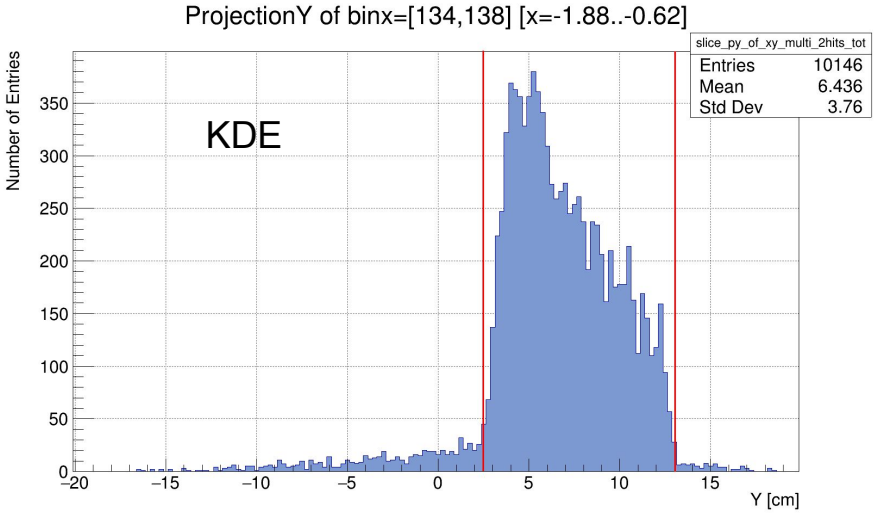
MLEM

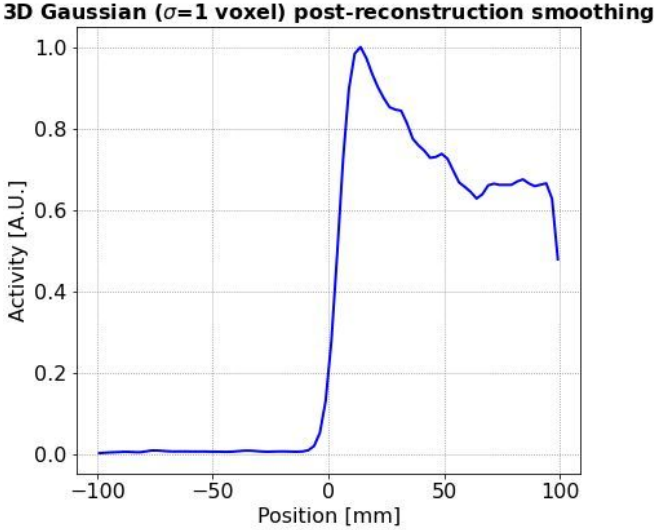
Castor

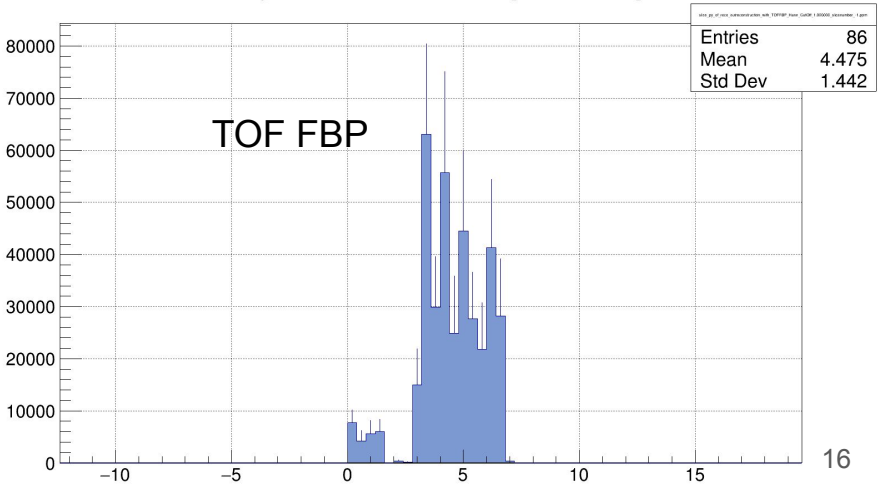
FWHM(TOF)

= 600 ps



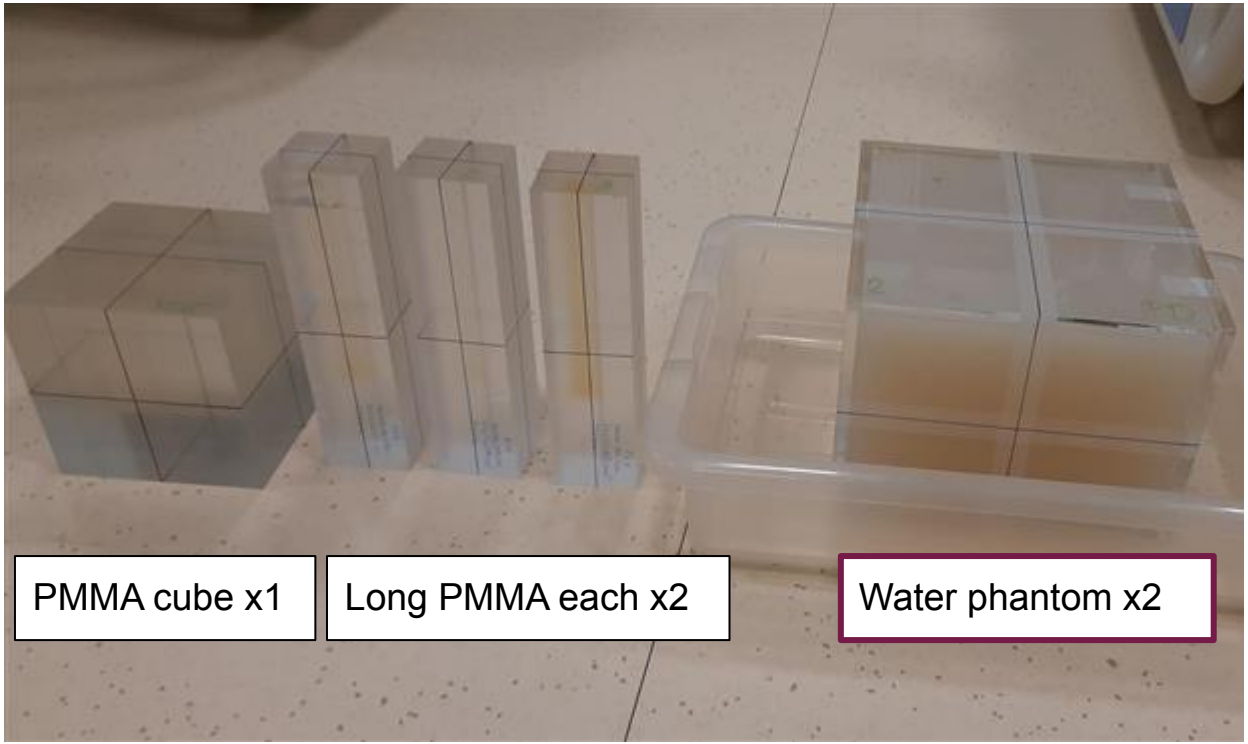






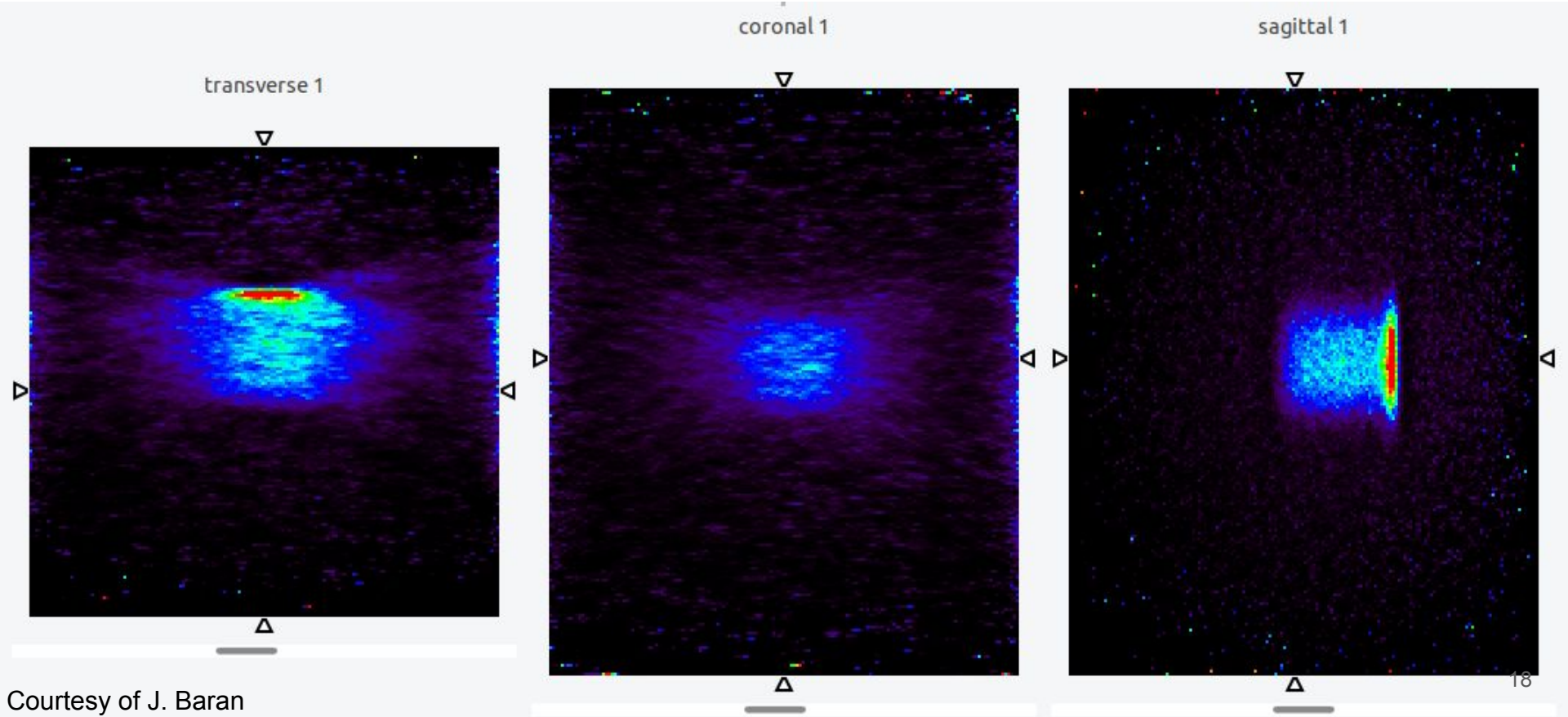
Courtesy of J. Baran

MLEM for 5x5x5 cm^3 field irradiation



MLEM for 5x5x5 cm^3 field irradiation

8 Gy deposited



Courtesy of J. Baran

Discussion

TO DO:

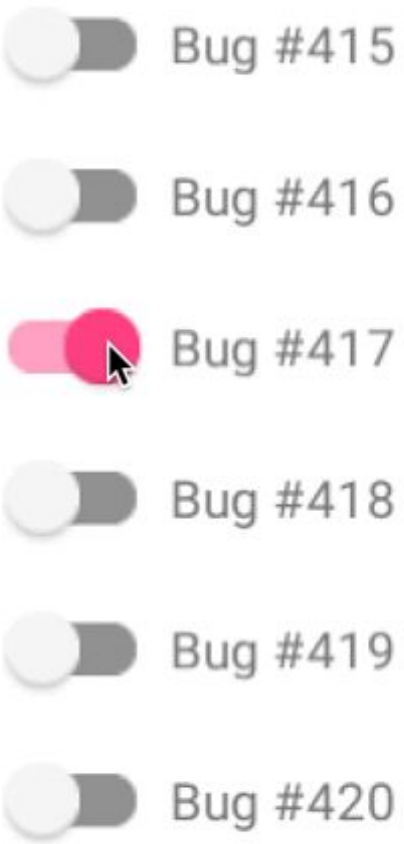
A). Automatic range estimation with every procedure

B). Add sensitivity and attenuation maps to FBP

C). More FBP validation and tuning:

- Check of coordinate system
- Cutoff and filter selection
- Smaller reconstruction radius
- Different TOF sigma and binning

D). reconstruct with MLEM more data



Let’s thank whole team for huge effort!