

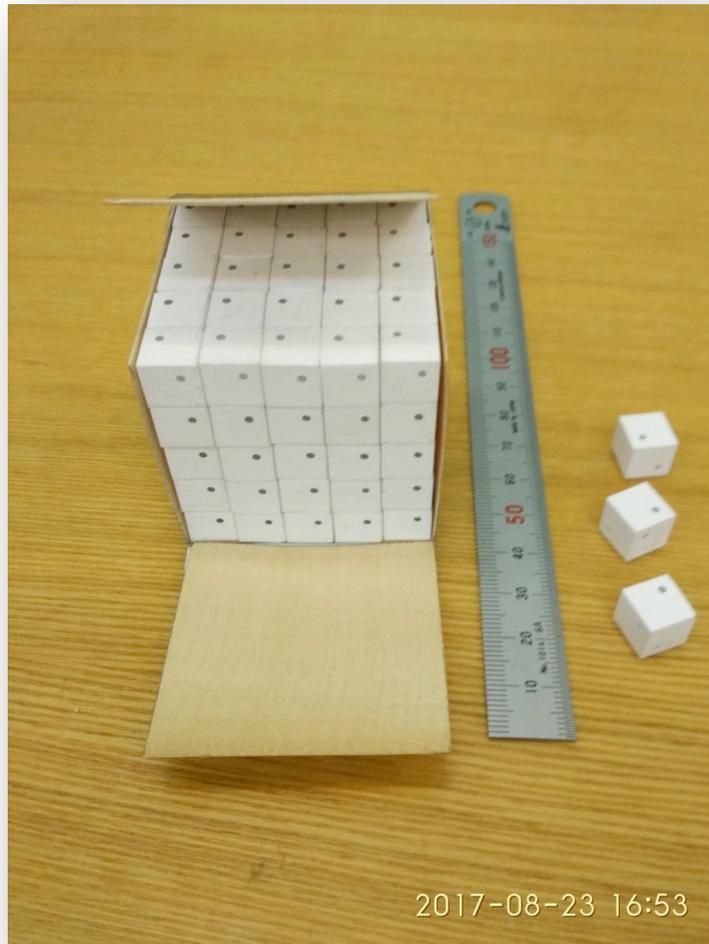
Preliminary test results of the 3D neutrino detector prototype with CITIROC readout chips

A. Mefodev

INR RAS

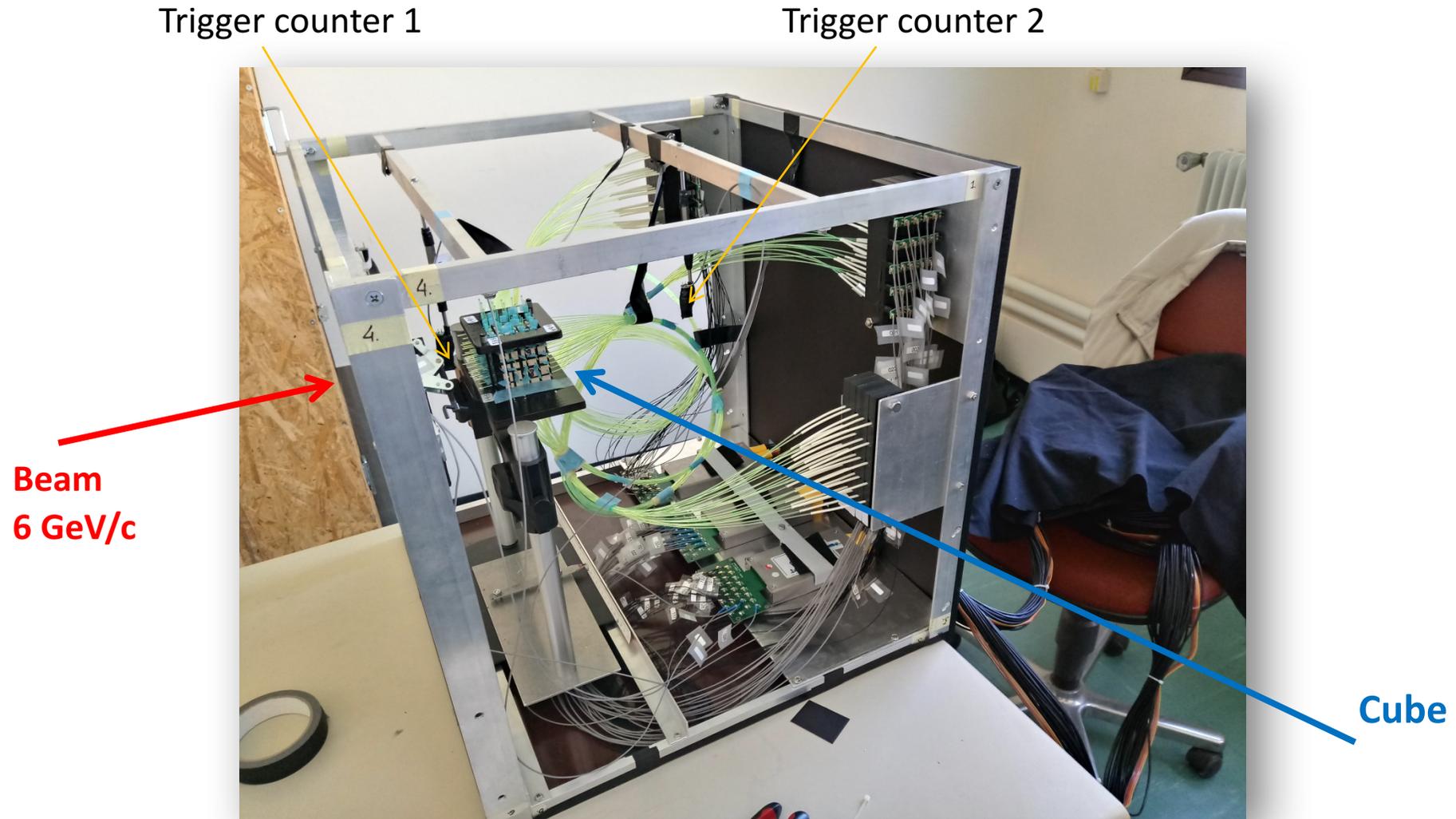
December 25, 2017

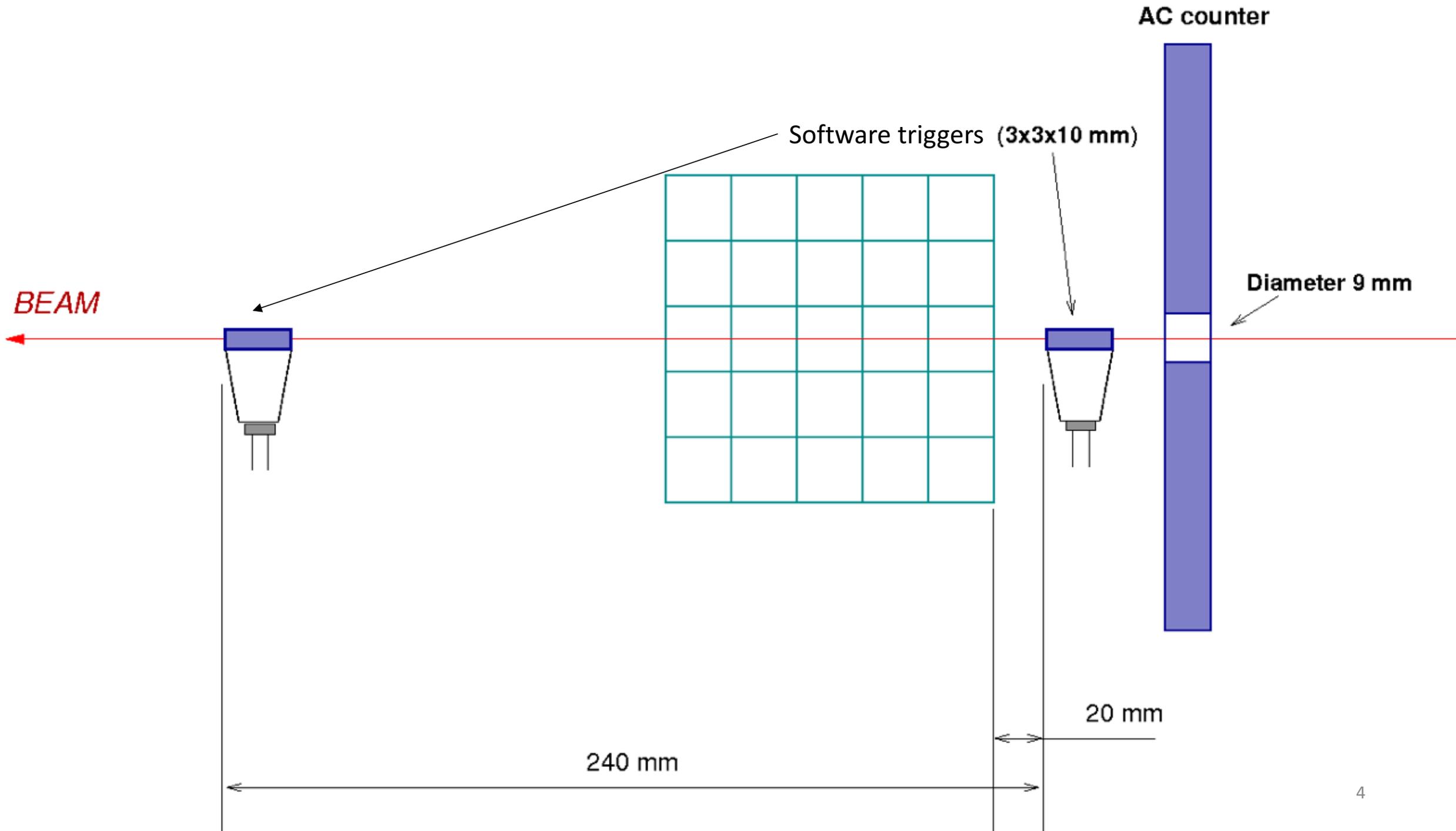
5x5 cube from the cubes



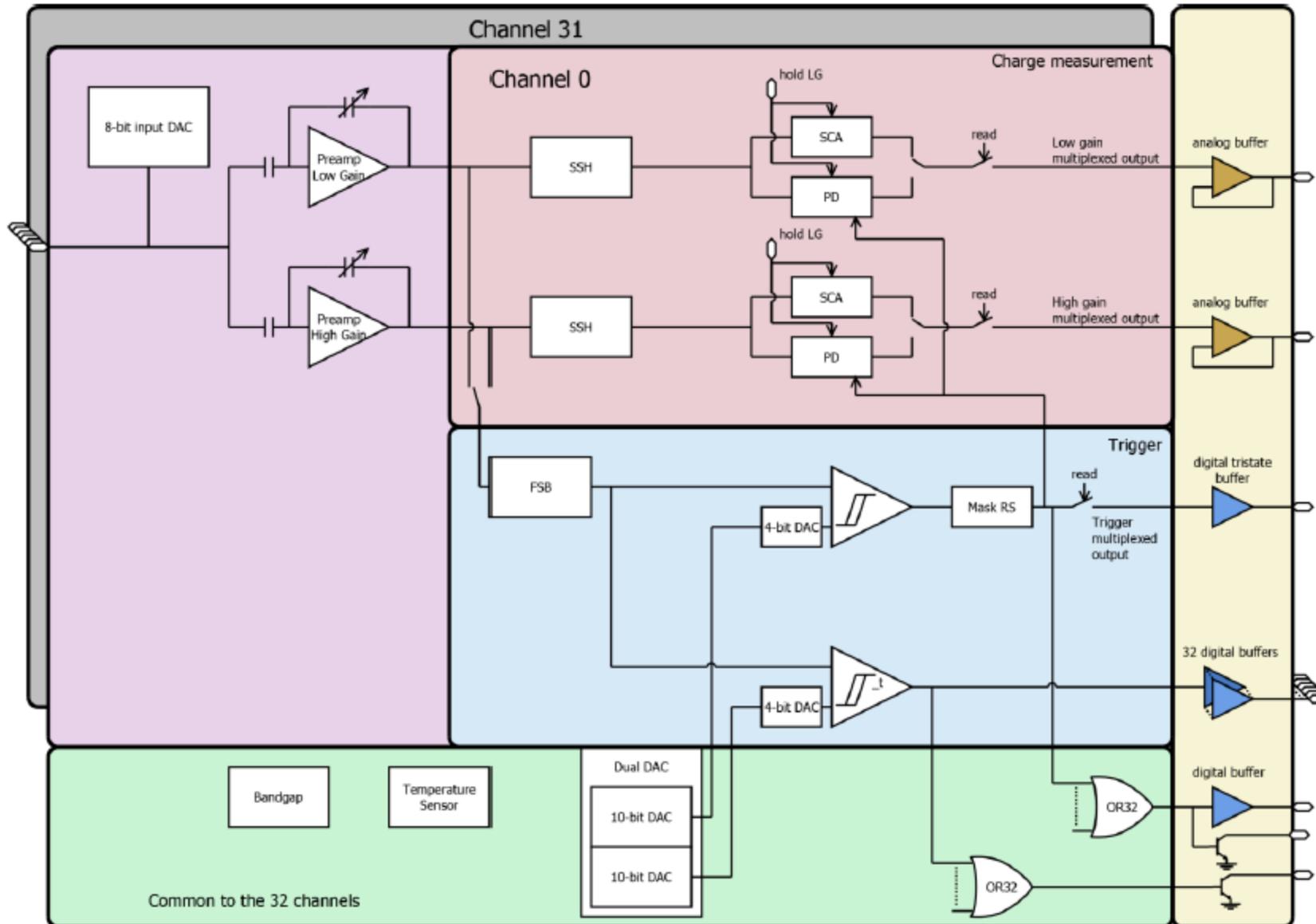
- Manufactured in Vladimir (Uniplast Co.)
- Cube size: $10 \times 10 \times 10 \text{ mm}^3$
- Material: extruded polystyrene doped with 1.5% of paraterphenyl (PTP) and 0.01% of POPOP
- White chemical reflector: thickness is about $50 \text{ }\mu\text{m}$
- Holes for WLS fibers: three of 1.5 mm diameter

The cube inside support frame at CERN

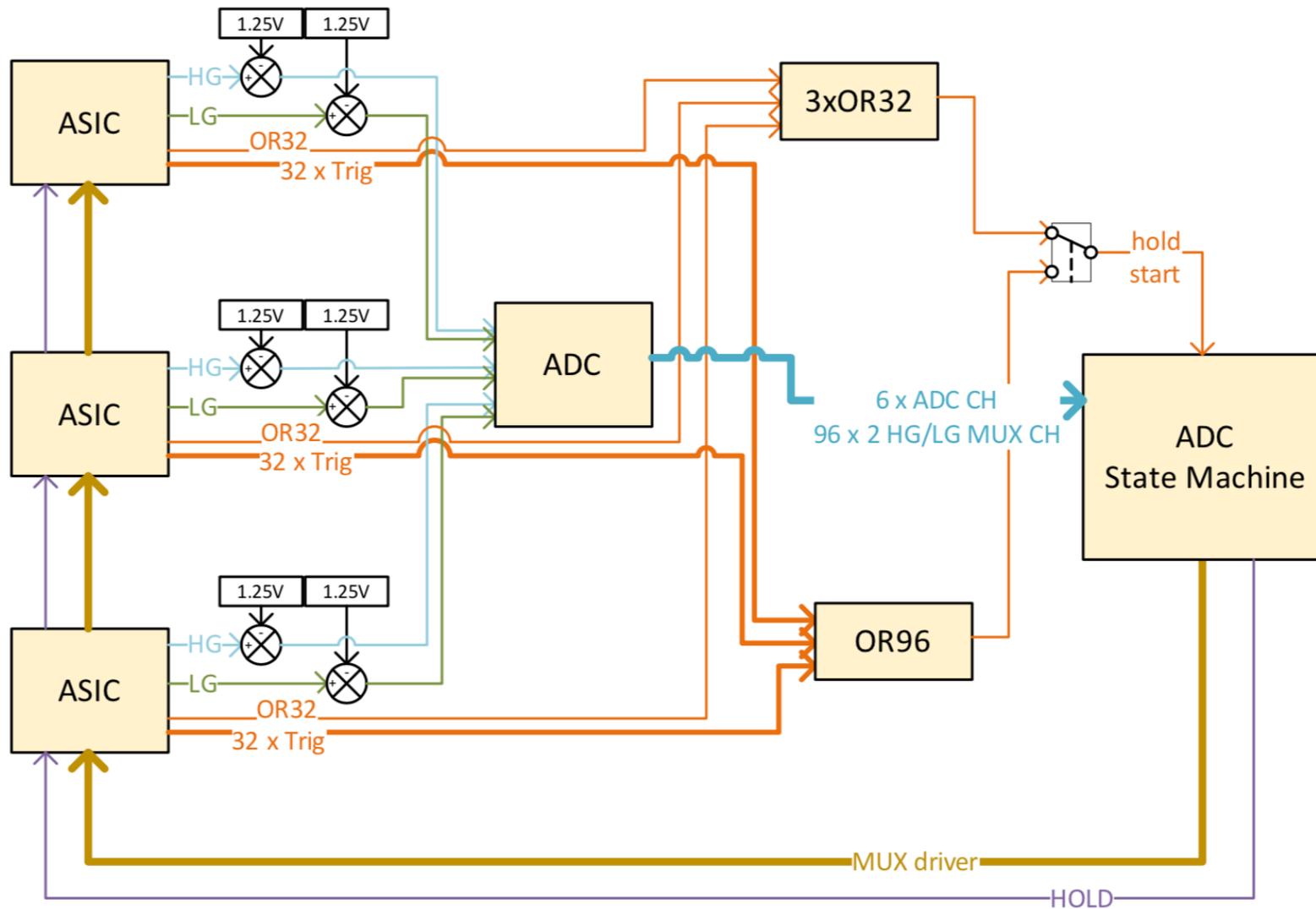




CITIROC BLOC DIAGRAM

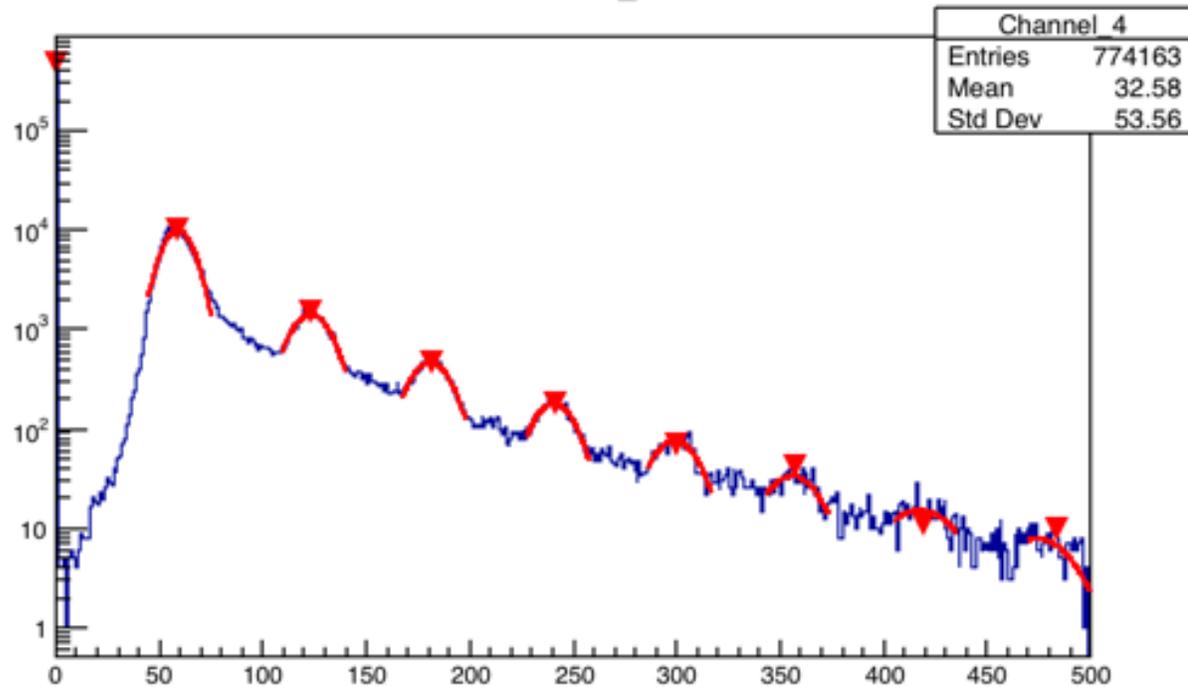


FEB v2 details: ADC Signal chain



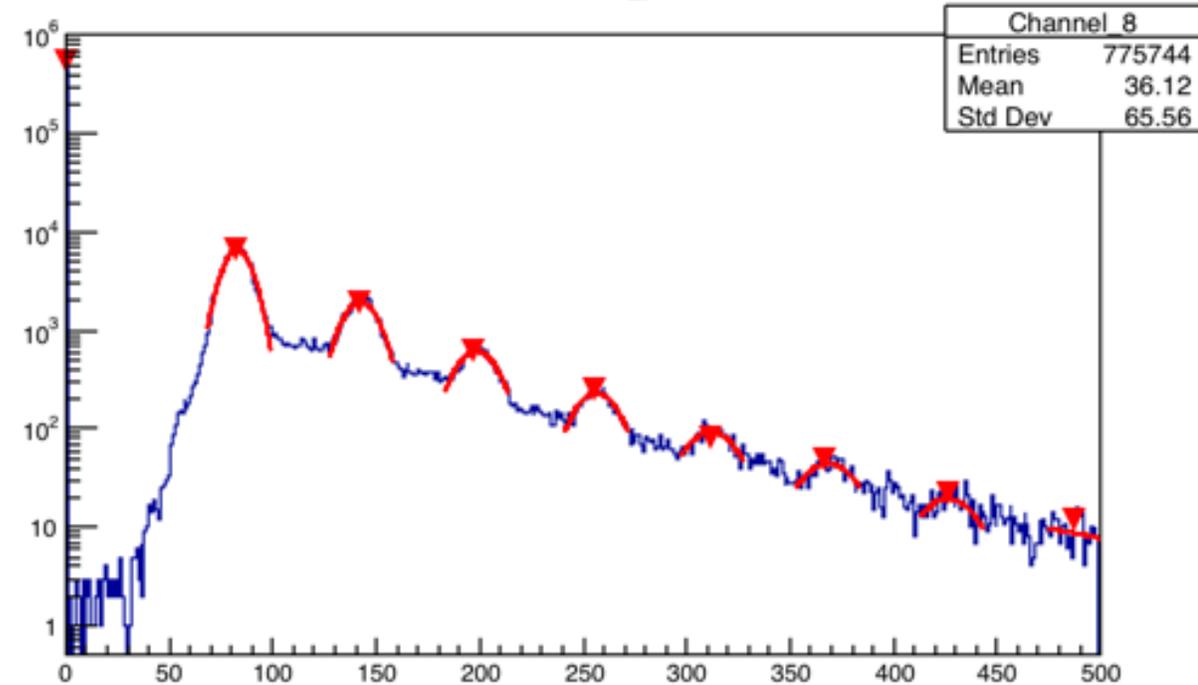
HG vs p.e. Calibration

Channel_4



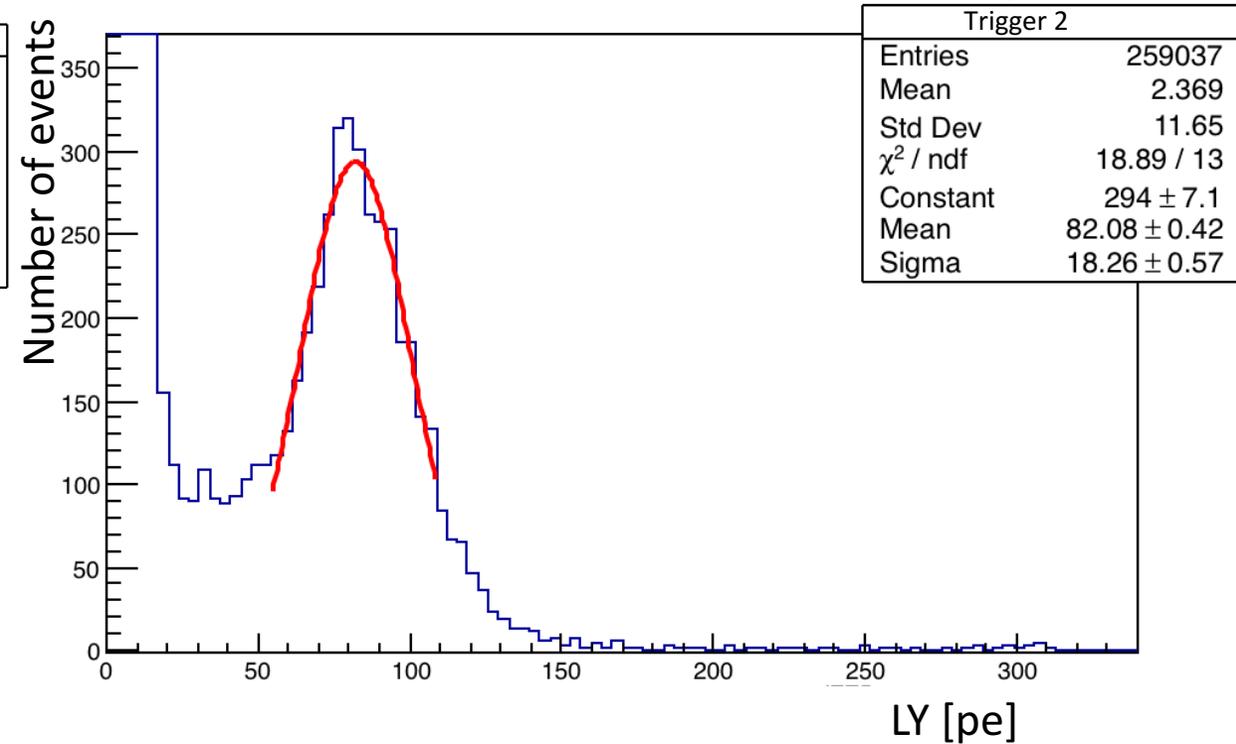
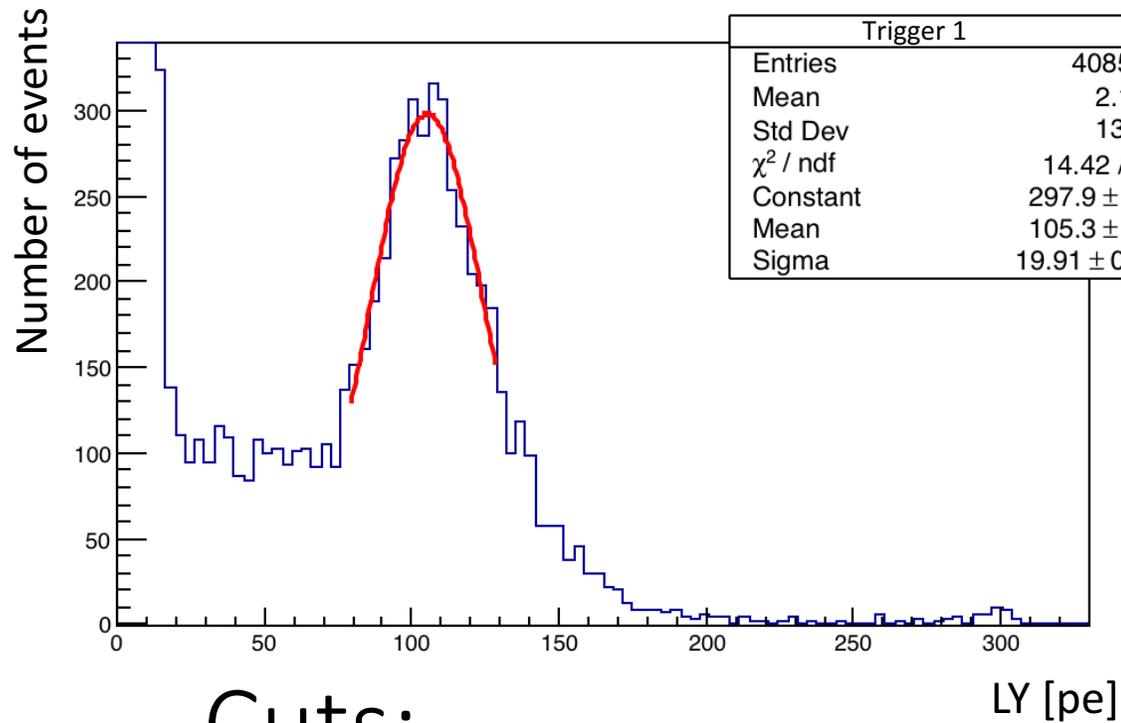
ch4: gain — 59.3235; pedestal — -0.4051;
Peak position:
1pe — 58.9184; 2pe — 123.151; 3pe — 180.87;
4pe — 240.565; 5pe — 299.056.

Channel_8



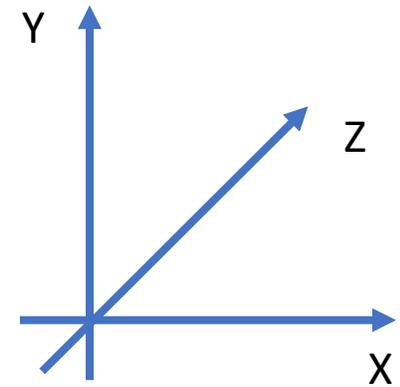
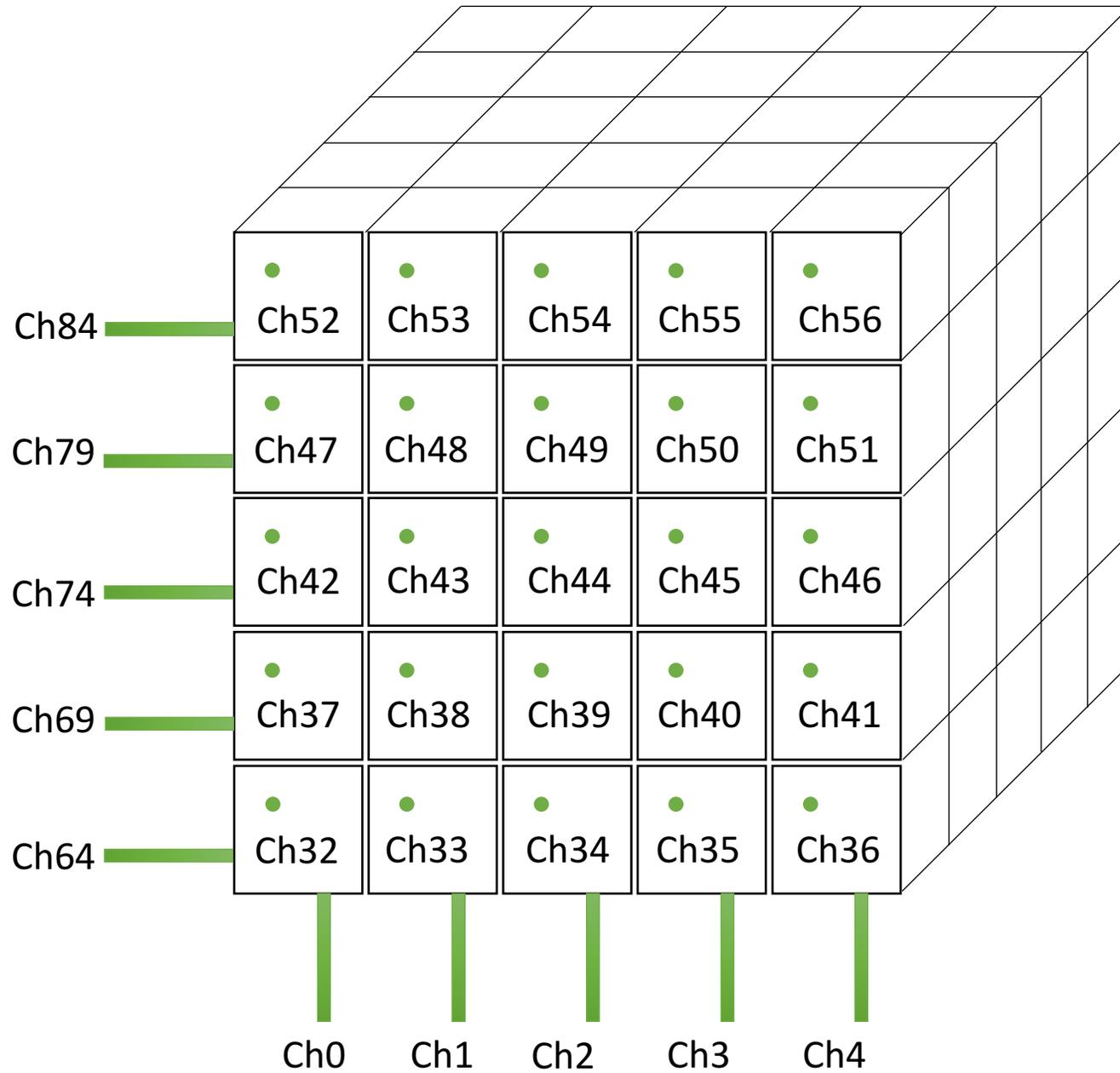
ch8: gain — 57,226; pedestal — 25,6138;
Peak position:
1pe — 82.8398; 2pe — 142.372; 3pe — 198.355;
4pe — 256.374; 5pe — 311.696.

Event selection



Cuts:

- $L.Y_{tr2} > 45 \text{ p.e.}$
- Window $|LY_{tr1} - LY_{tr2}| < 100 \text{ ns}$
- Window $|LY_{tr1} - LY_{channel}| < 100 \text{ ns}$
- Anti-coincidence counter:
 - $!L.Y_{AC1} \ || \ !L.Y_{AC2}$
 - $|LY_{tr1} - LY_{AC2}| > 100 \text{ ns}$

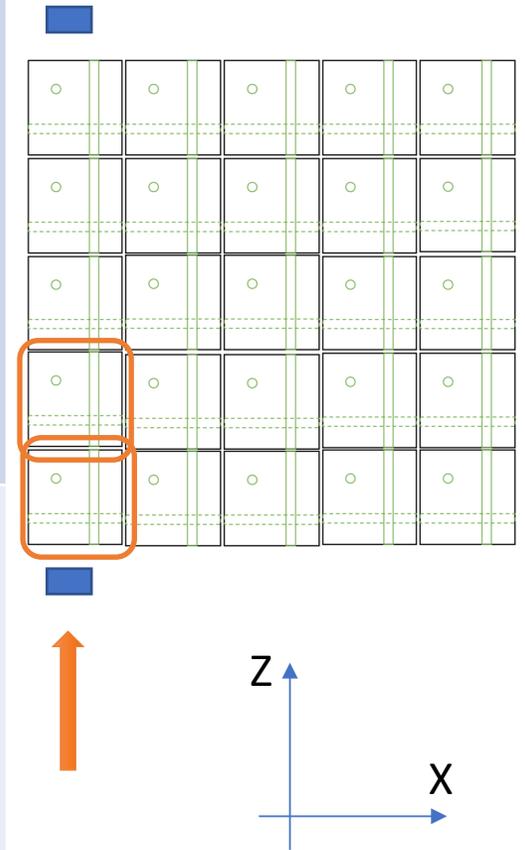
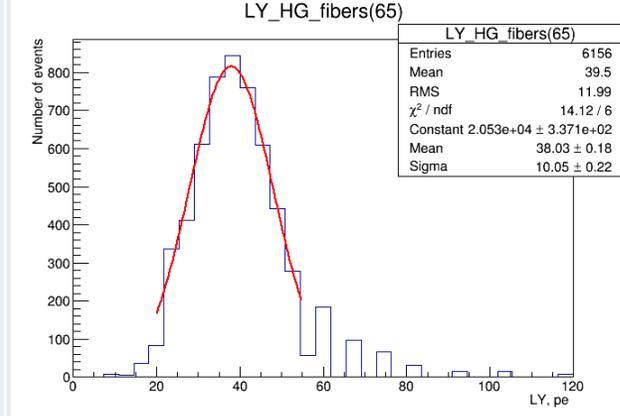
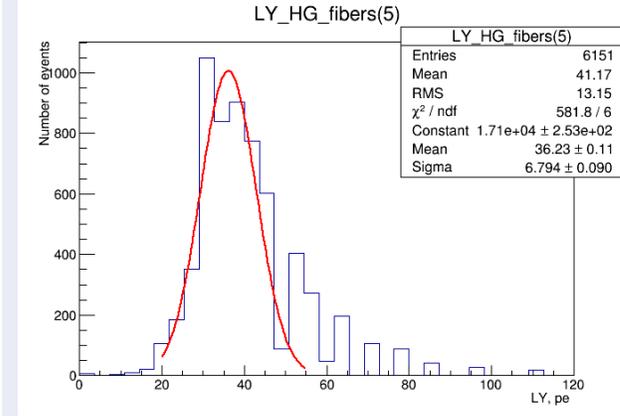
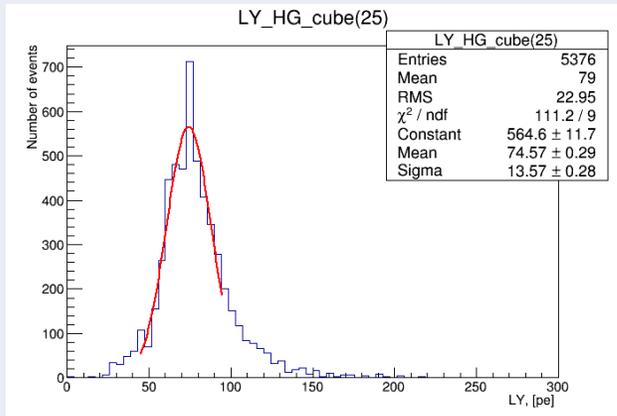
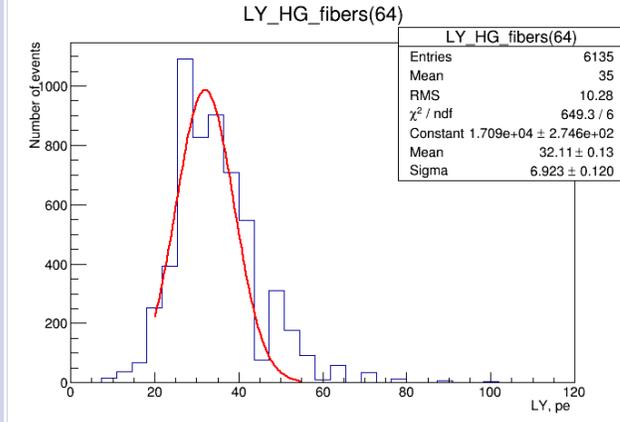
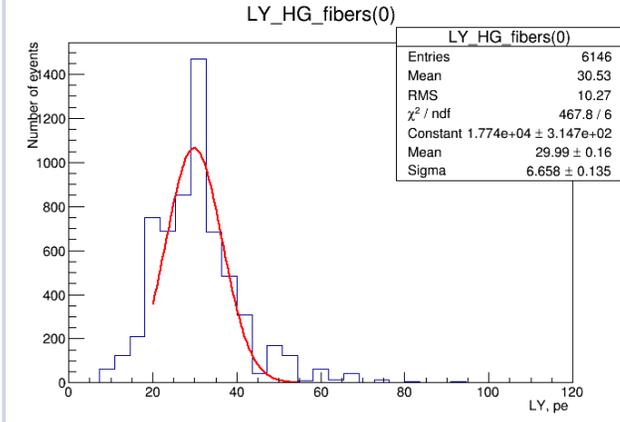
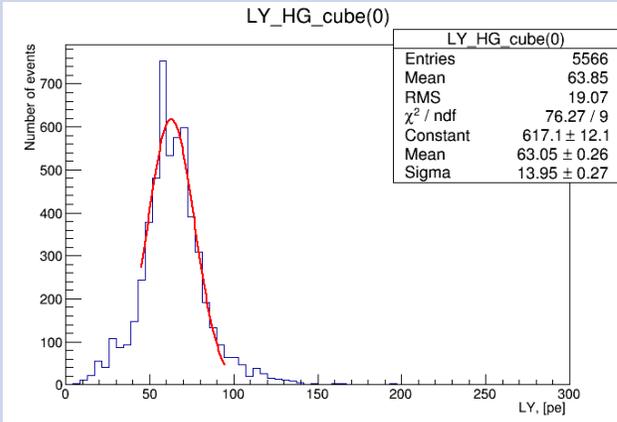


Cube

Fiber X

Fiber Y

First Layer

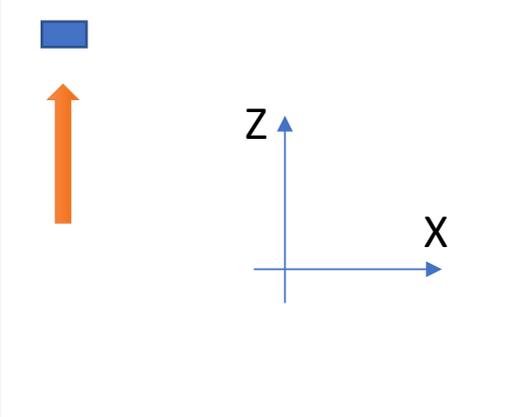
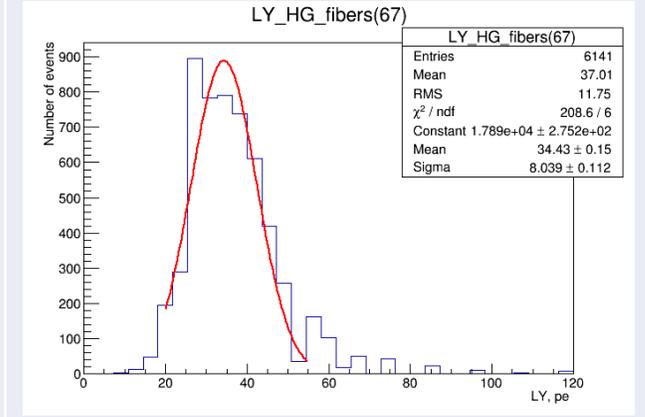
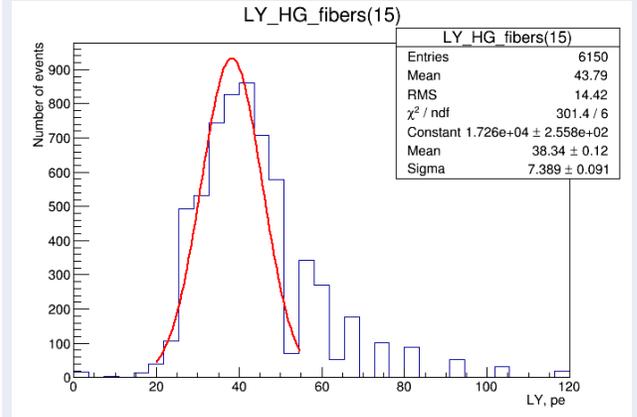
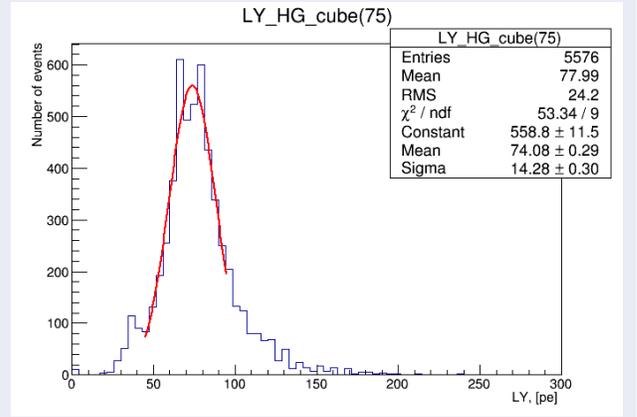
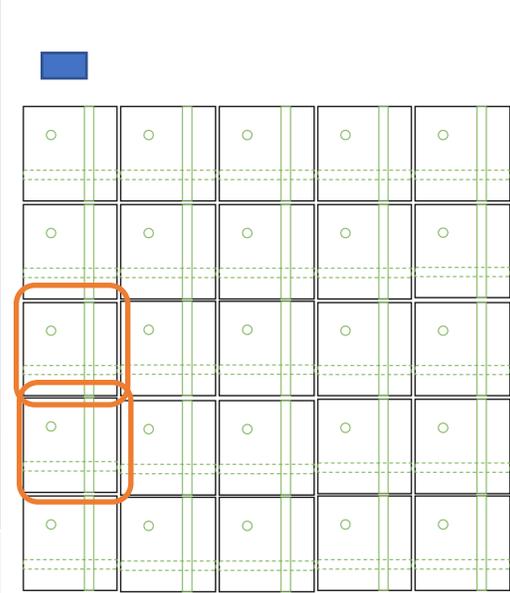
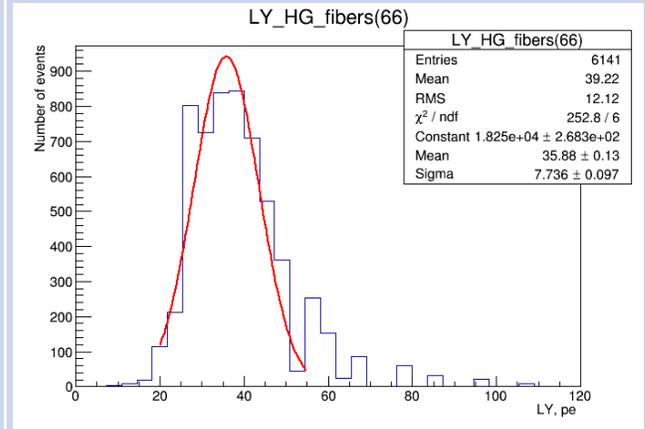
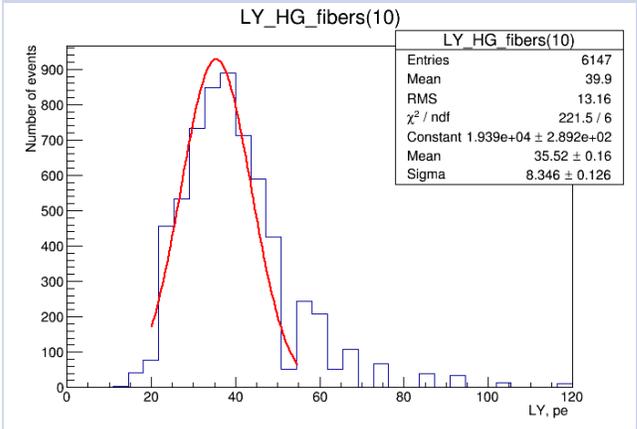
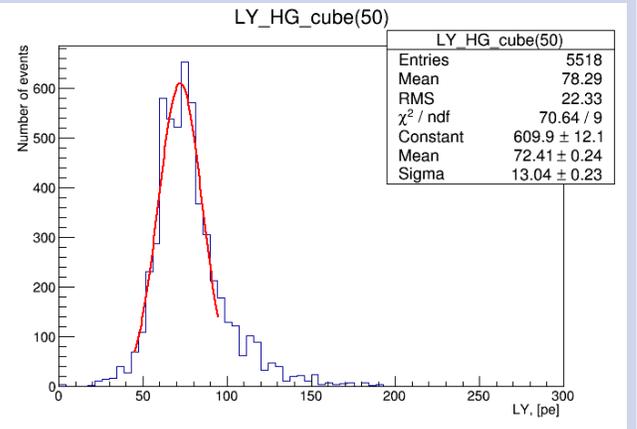


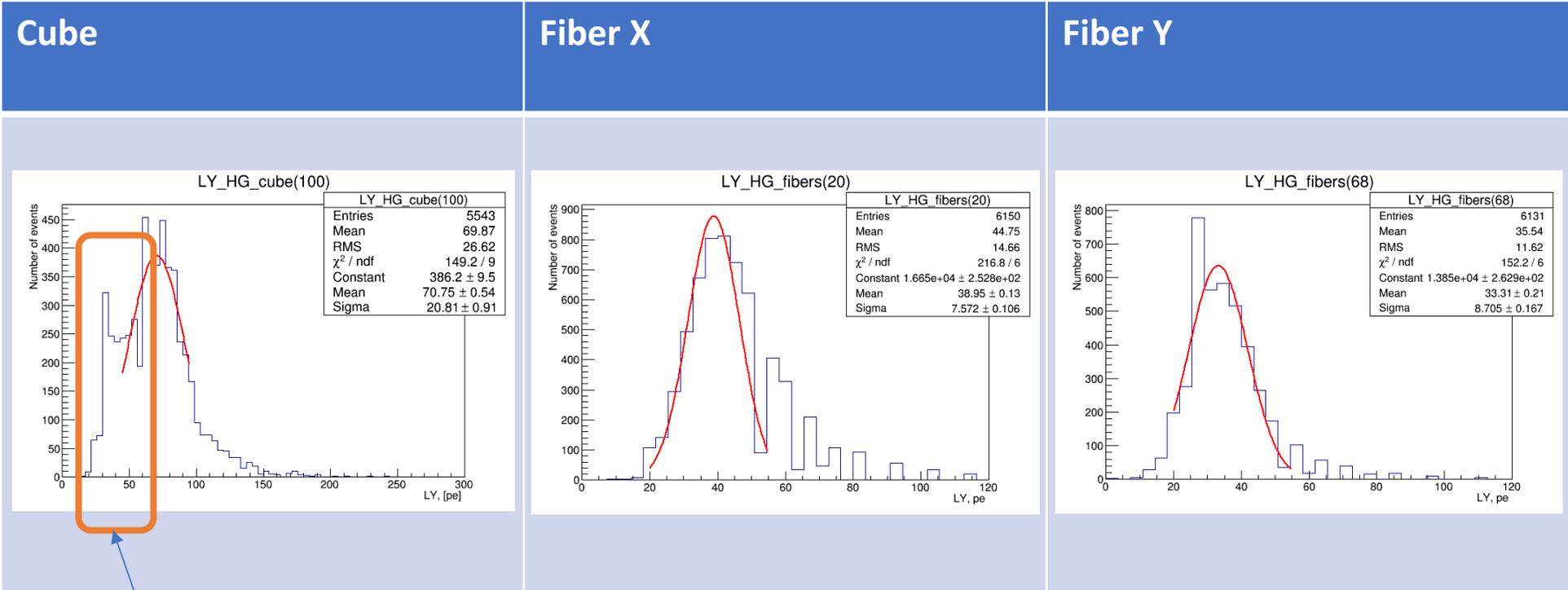
Cube

Fiber X

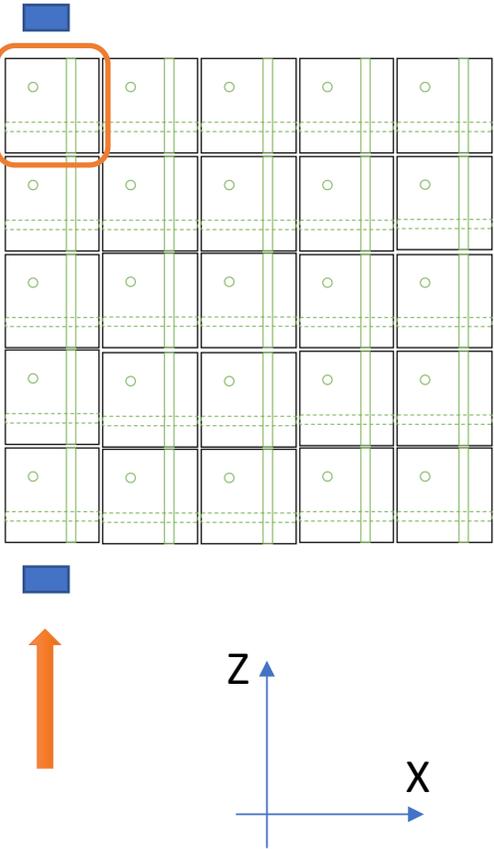
Fiber Y

First Layer





First Layer



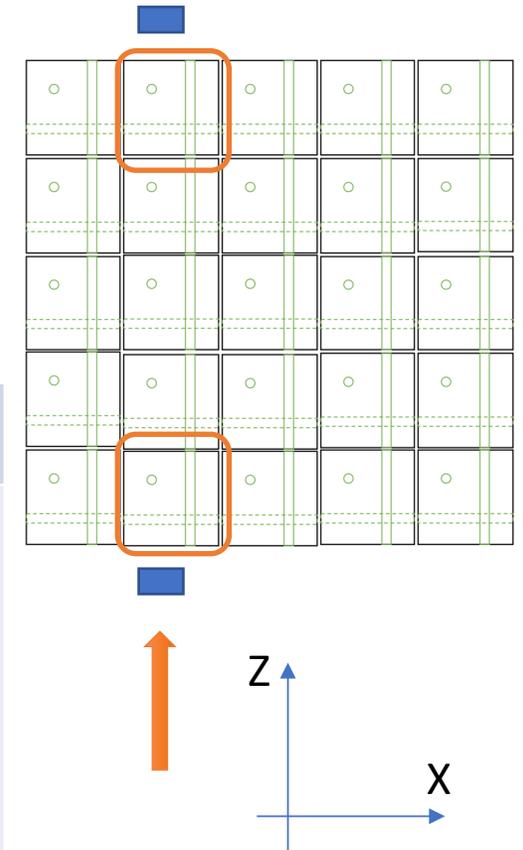
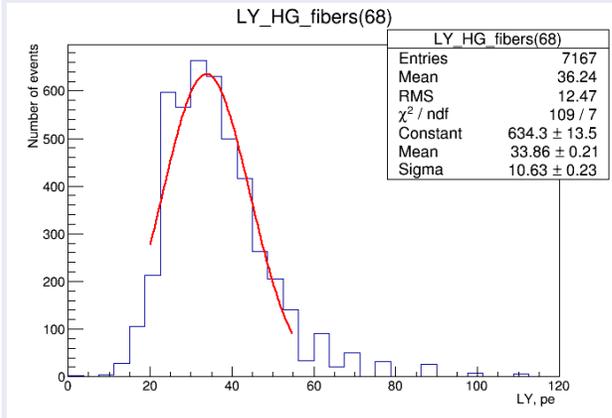
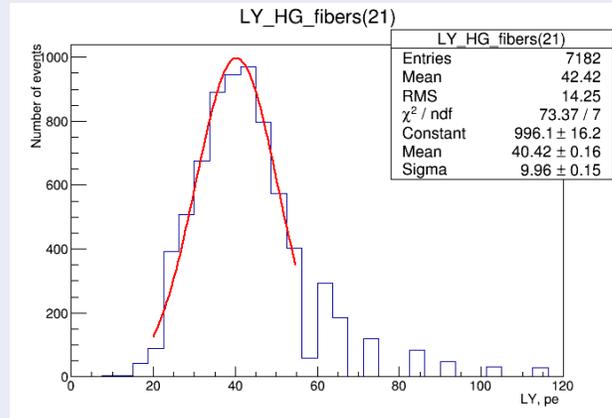
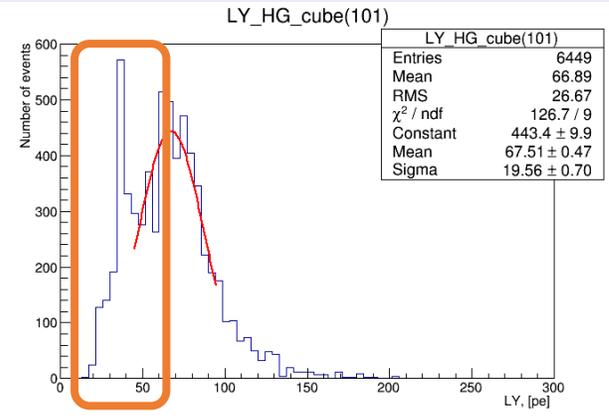
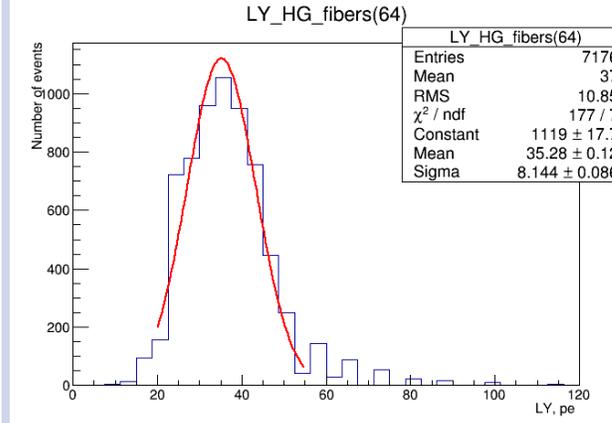
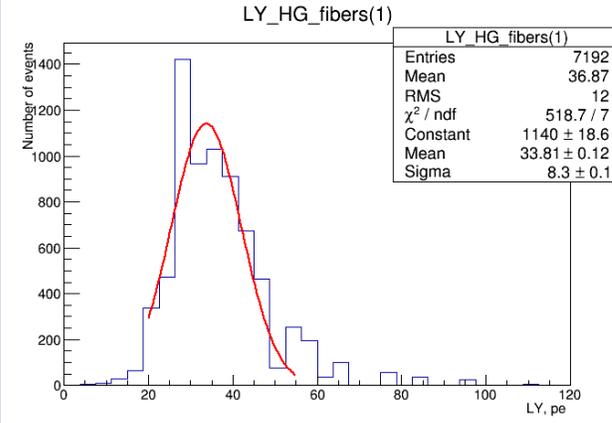
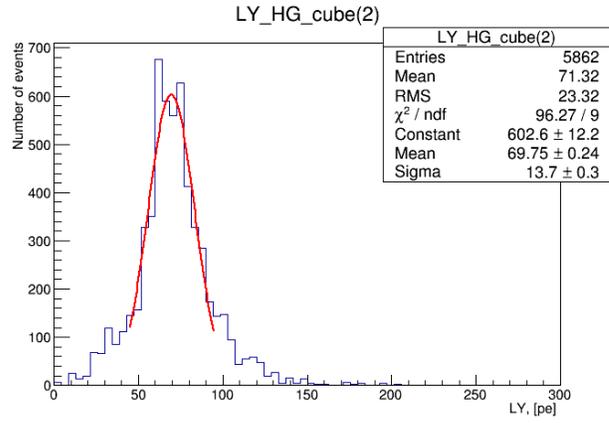
Why we have events with lower LY on the last cube in row?

Cube

Fiber X

Fiber Y

First Layer

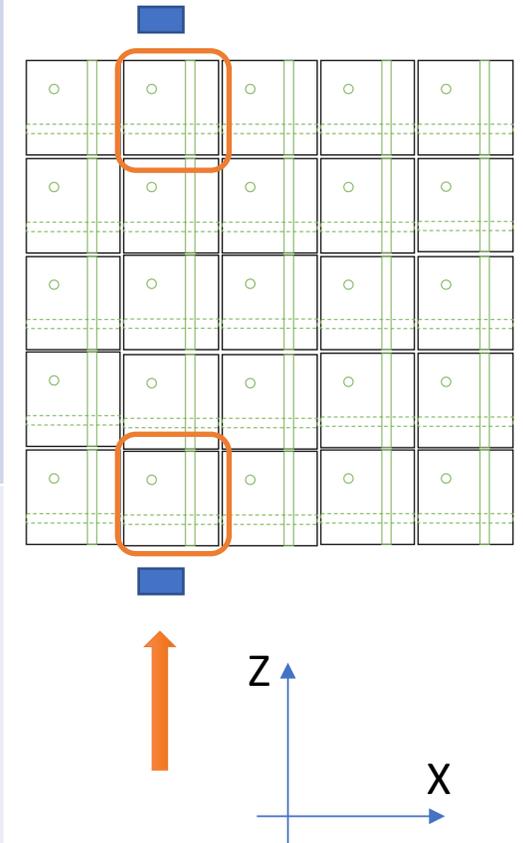
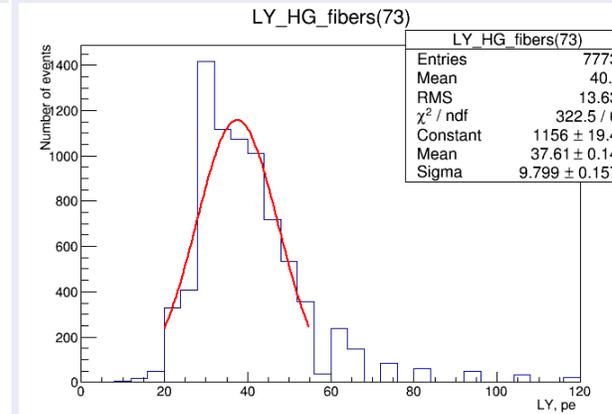
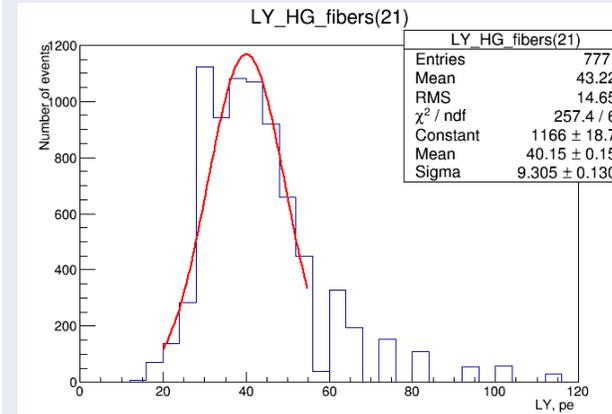
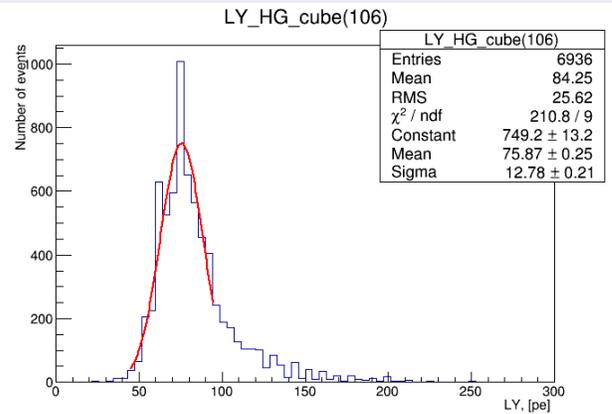
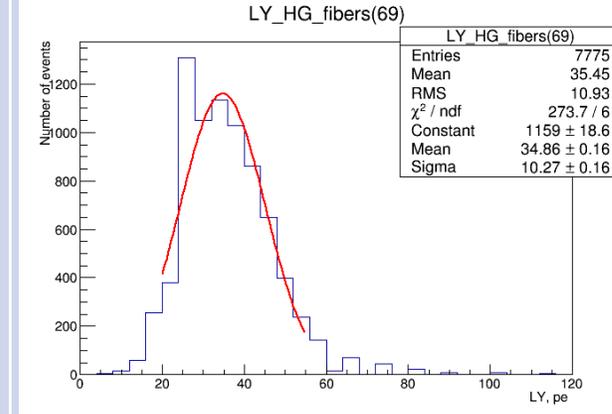
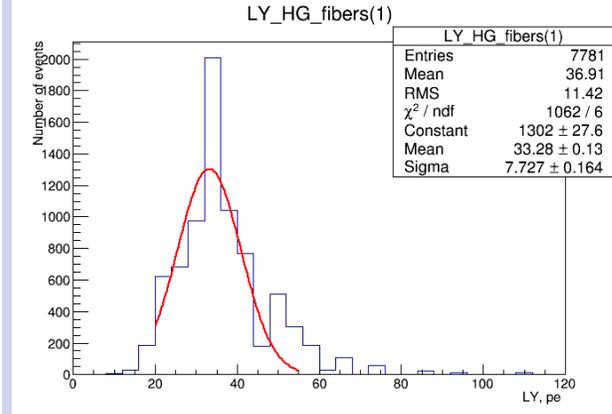
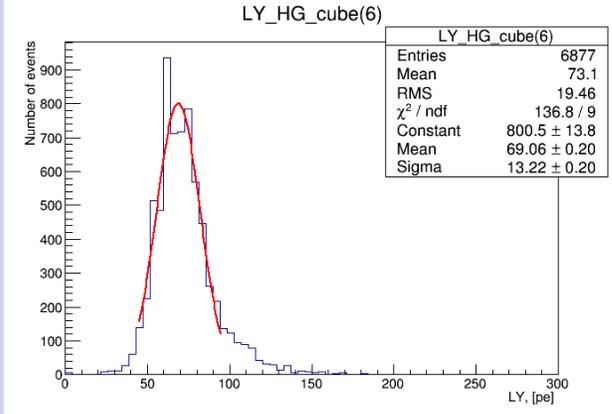


Cube

Fiber X

Fiber Y

Second Layer



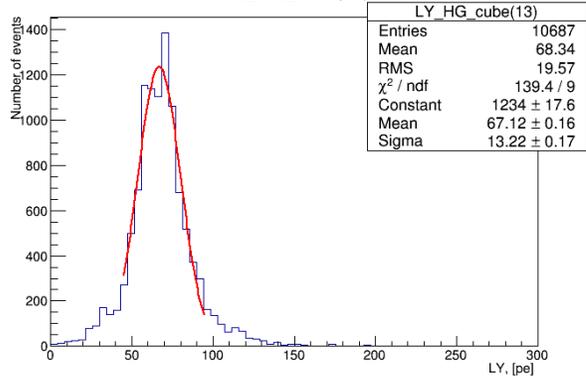
Cube

Fiber X

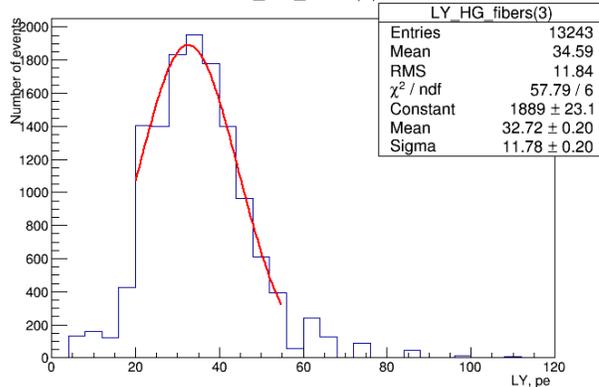
Fiber Y

Third Layer

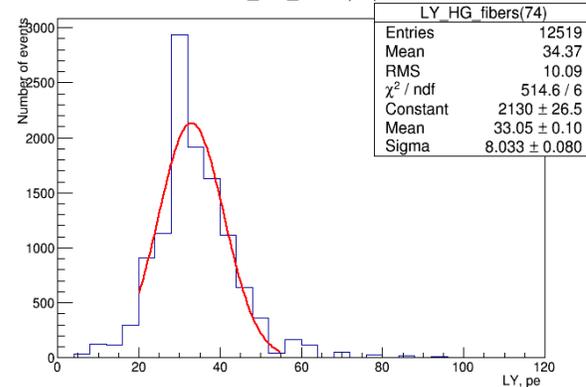
LY_HG_cube(13)



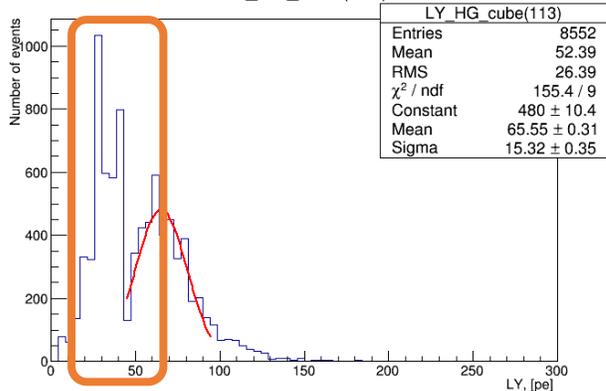
LY_HG_fibers(3)



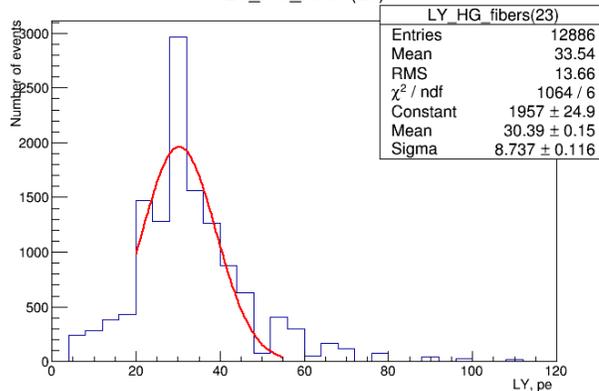
LY_HG_fibers(74)



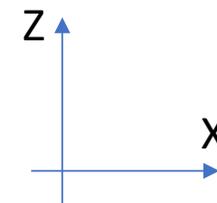
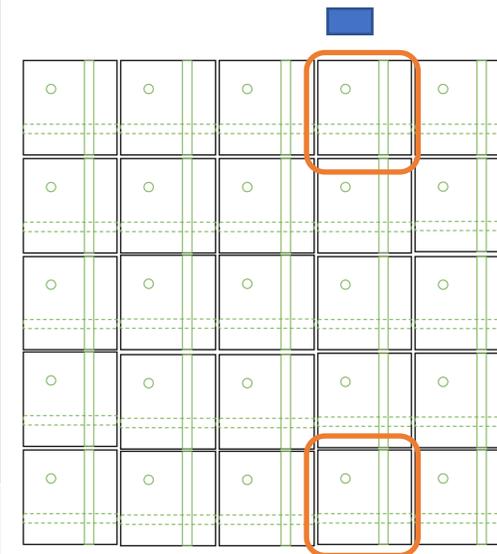
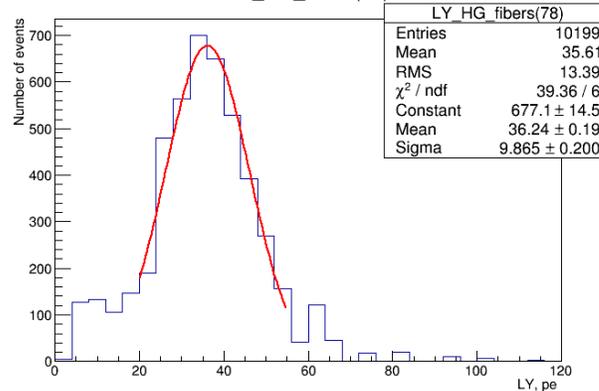
LY_HG_cube(113)

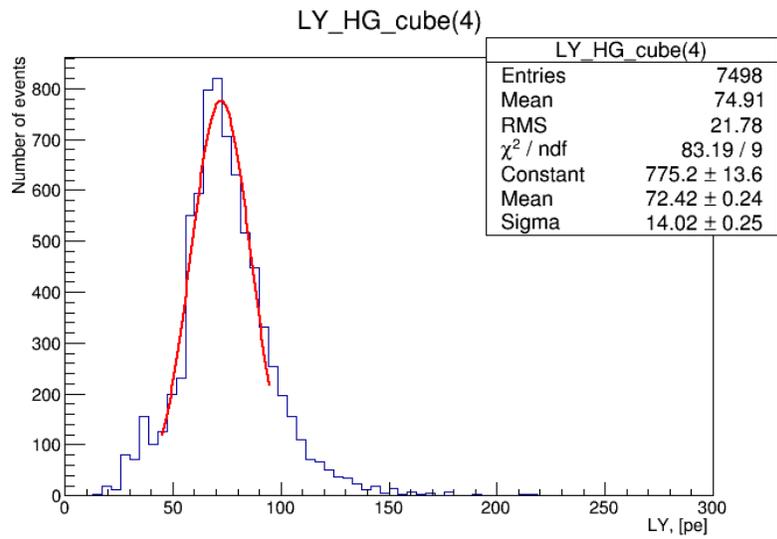
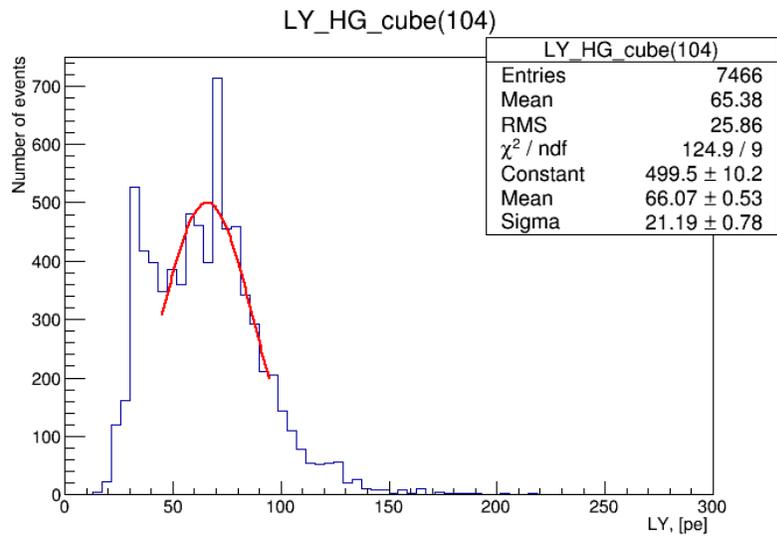


LY_HG_fibers(23)

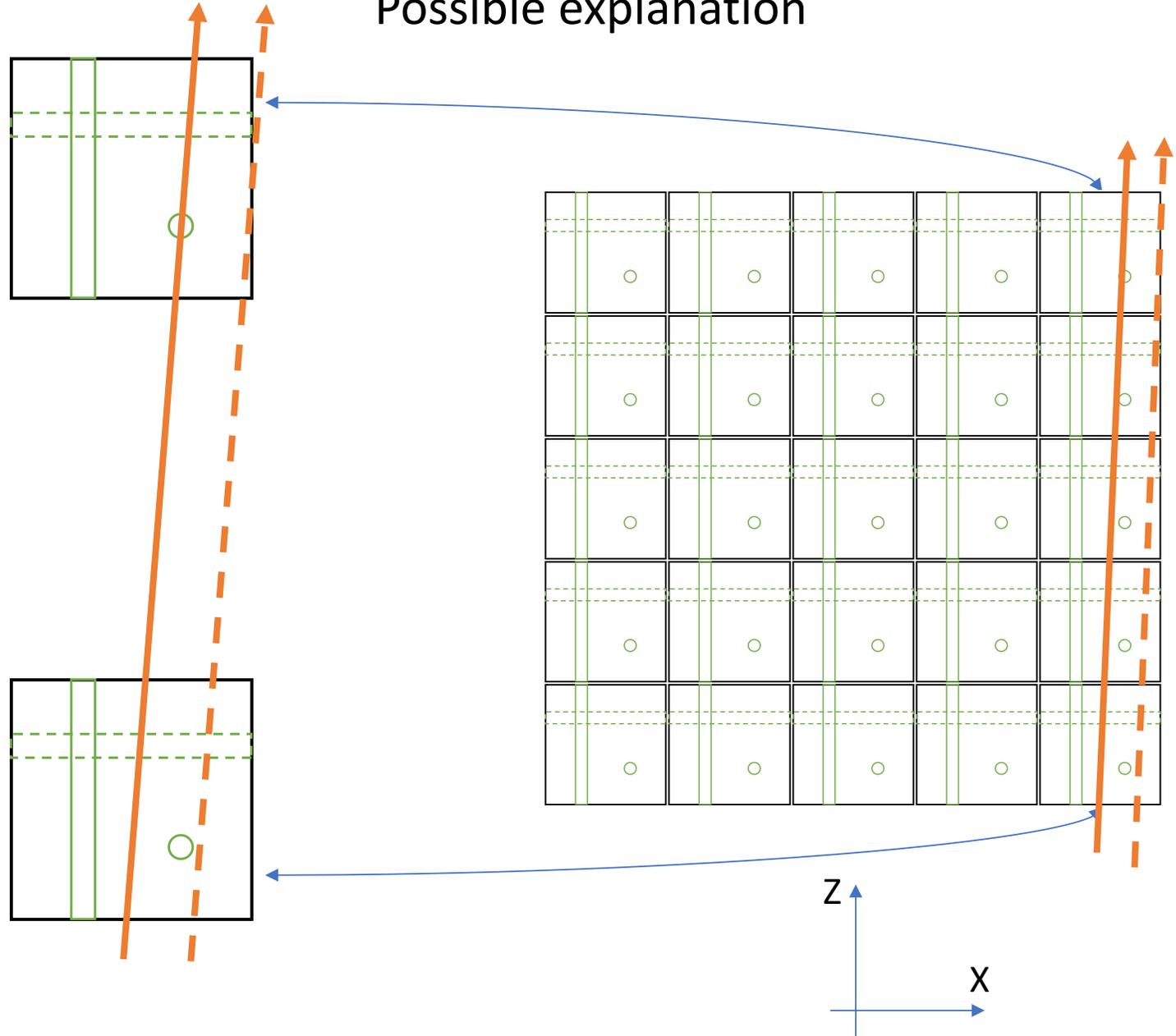


LY_HG_fibers(78)

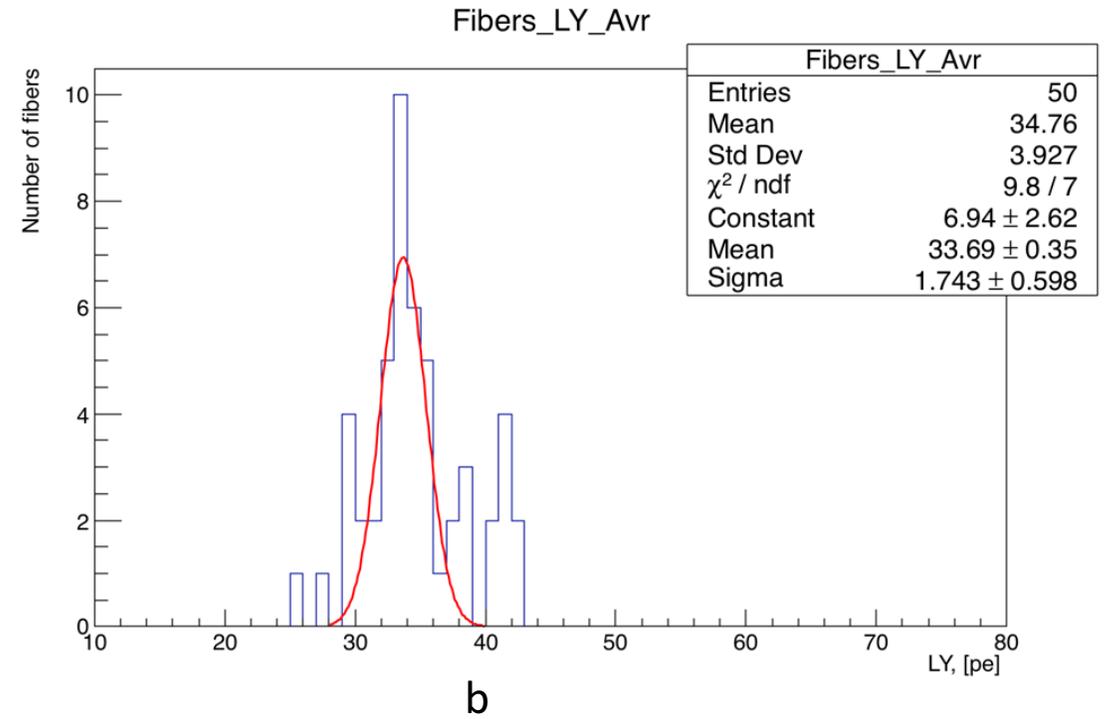
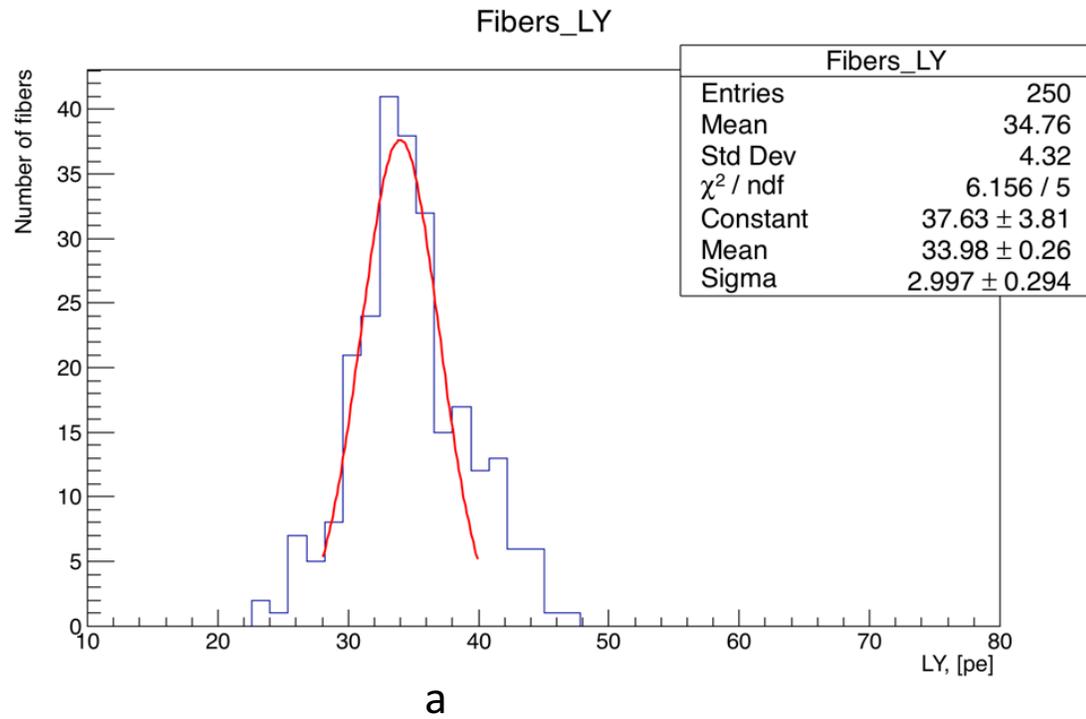




Possible explanation



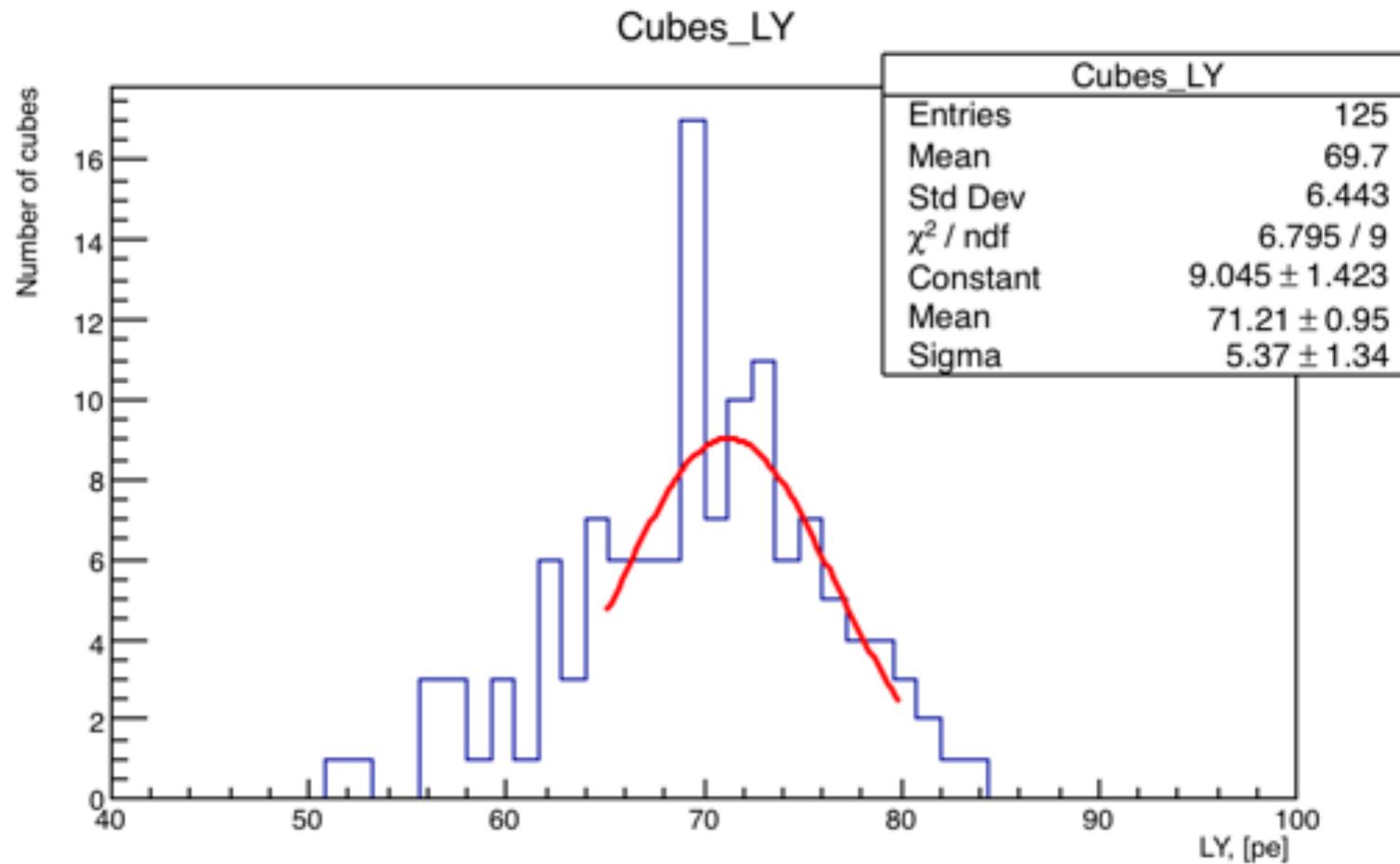
Light Yield of fibers



Each fiber was tested 5 times

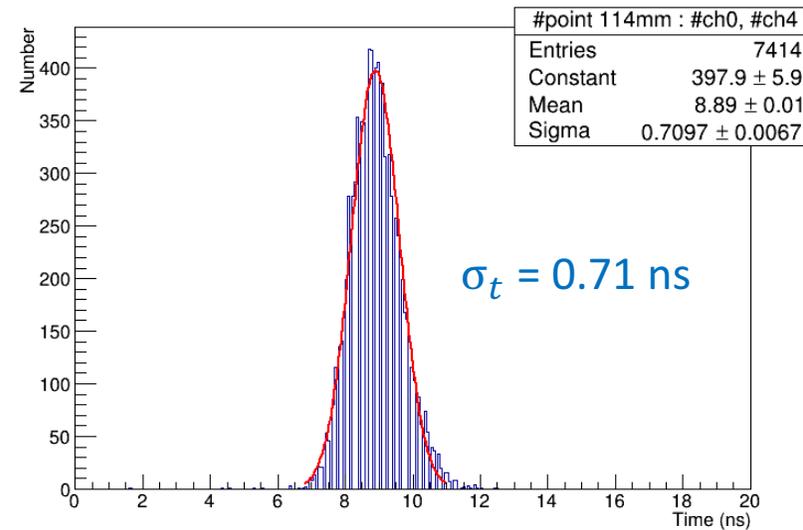
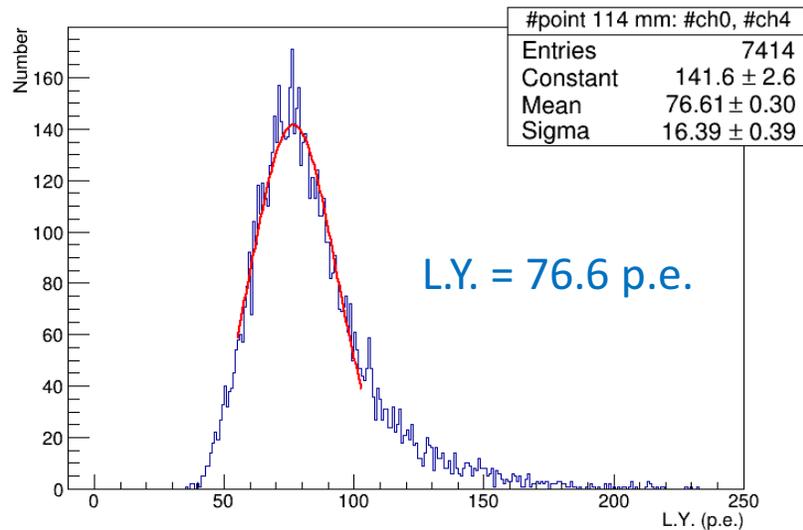
- a) All measurement in one plot;
- b) Calculating LY in average for all channels.

Light Yield of cubes



L.Y. and time resolution for cube#121, point 114 mm, ch0 and ch4 combined

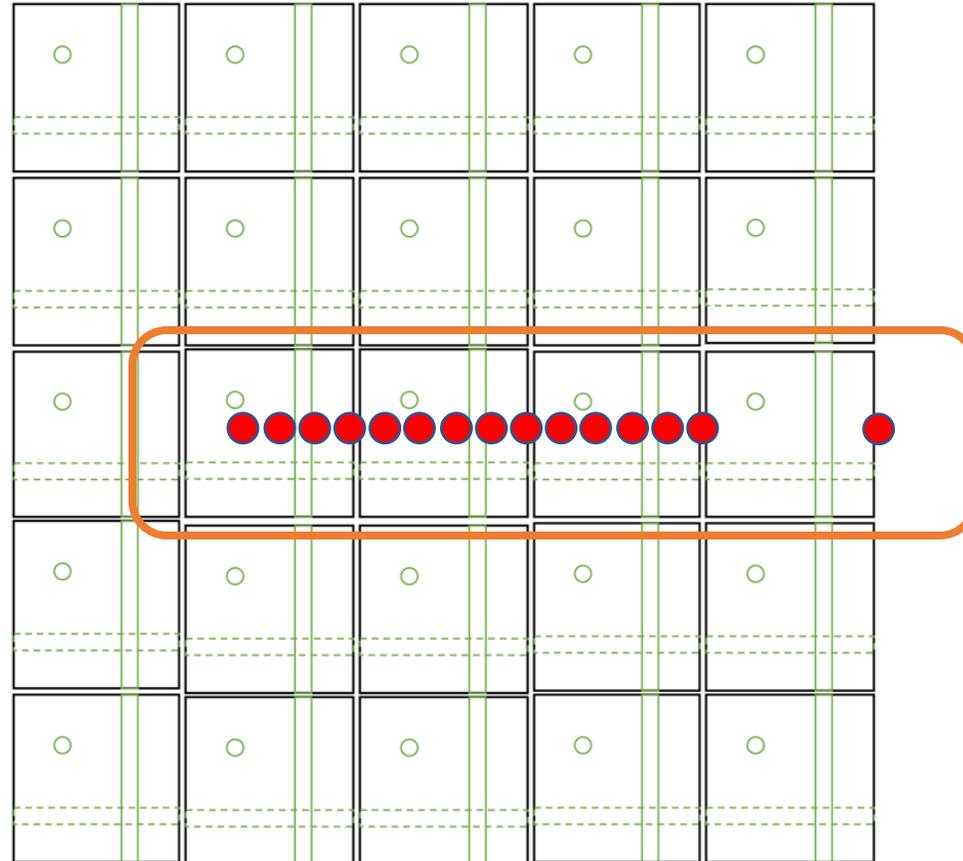
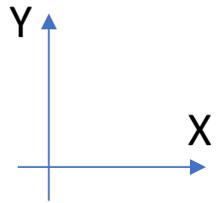
CAEN results



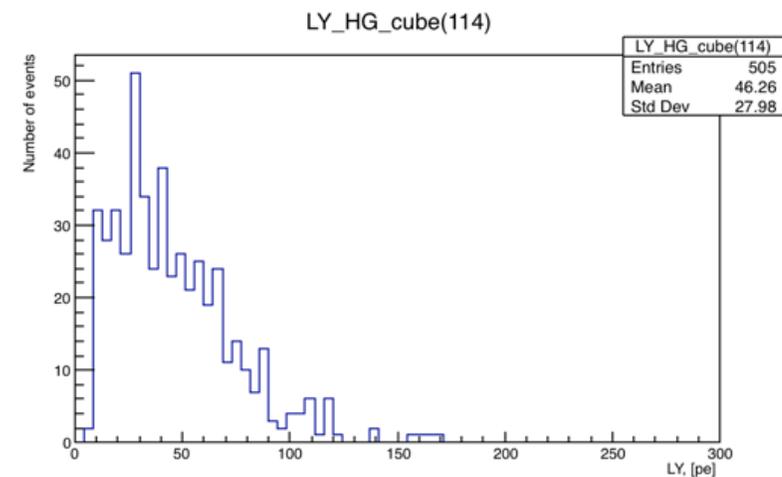
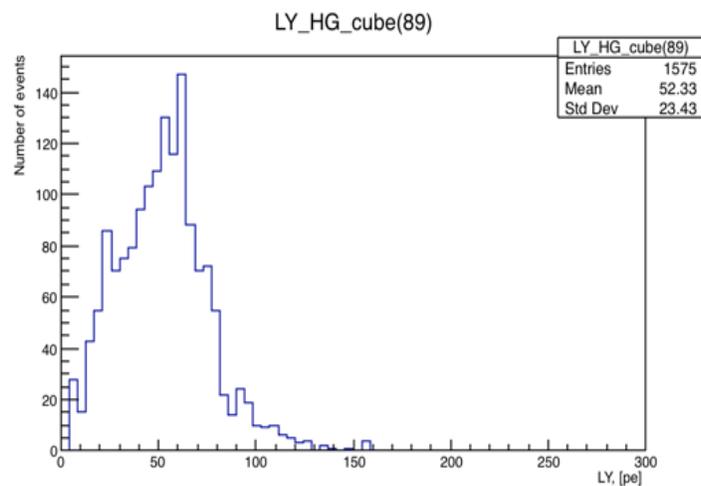
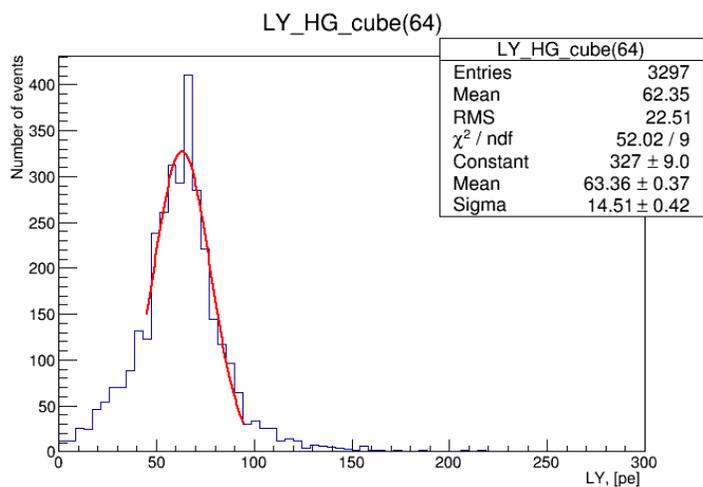
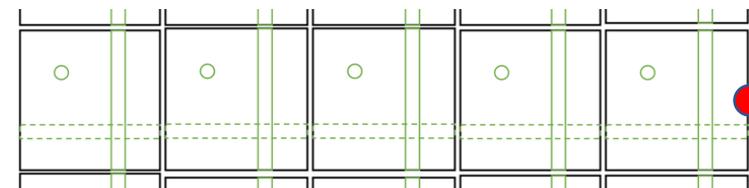
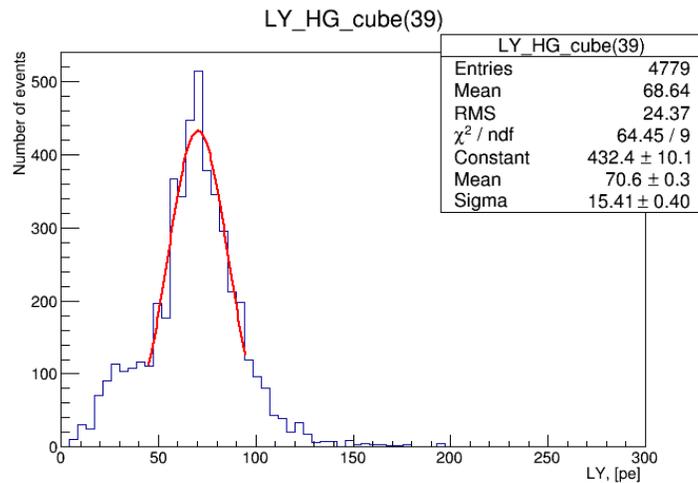
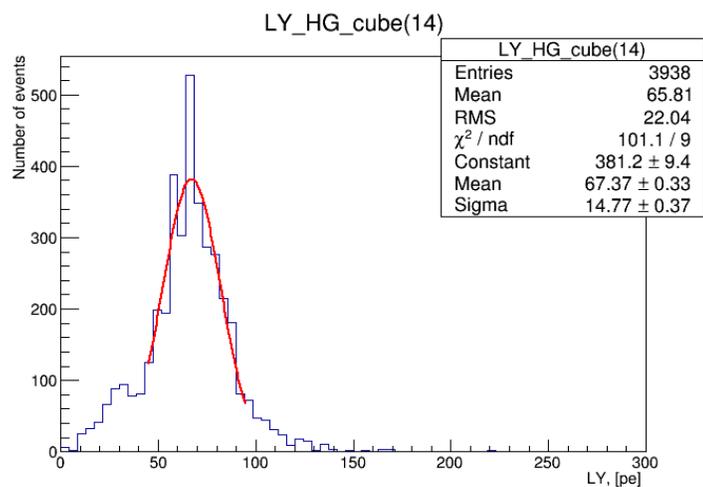
$$L.Y._{cube} = L.Y._{ch0} + L.Y._{ch4}$$

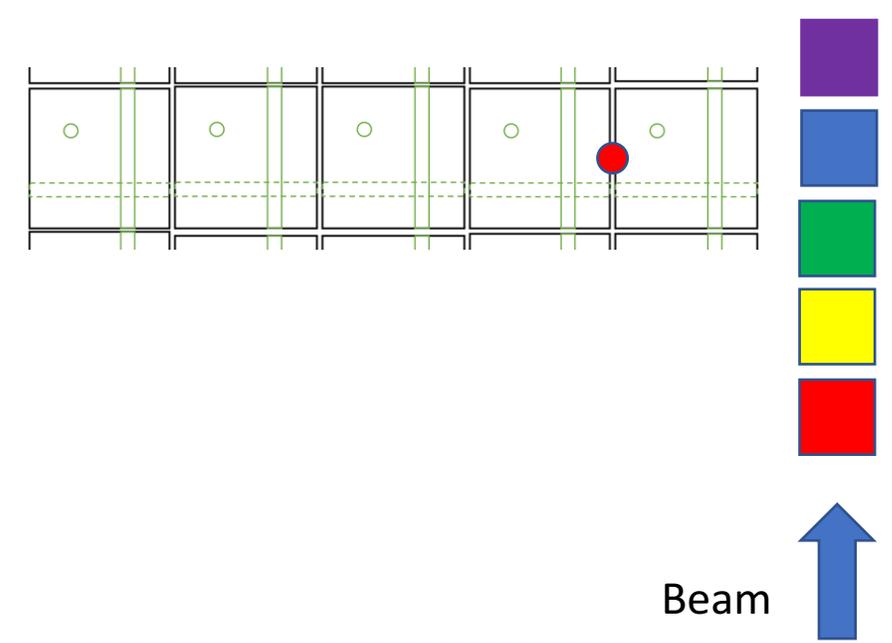
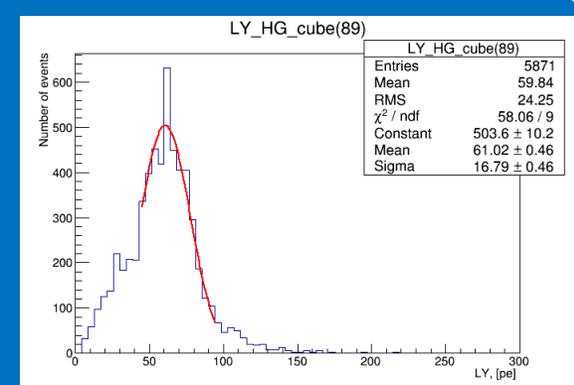
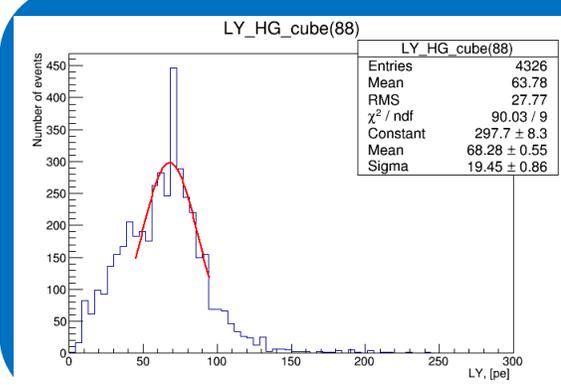
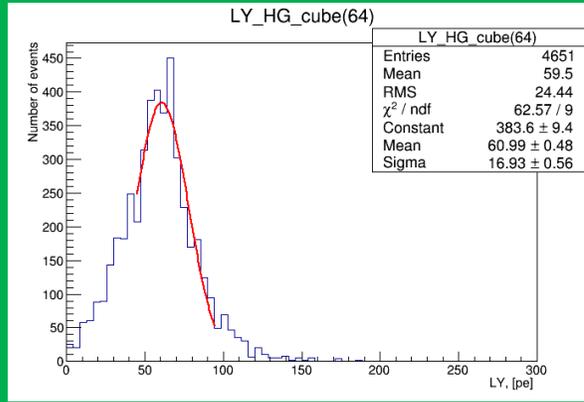
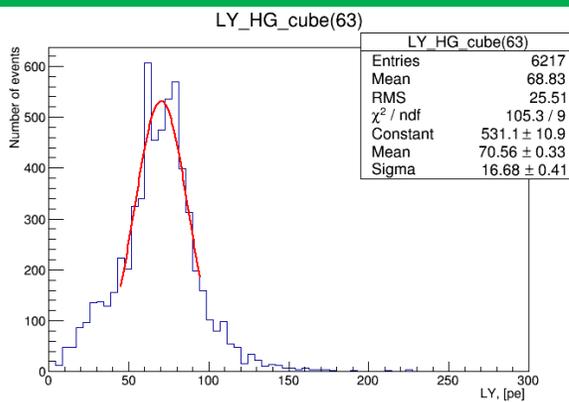
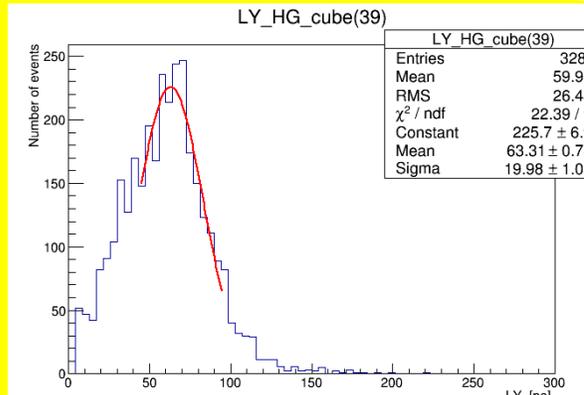
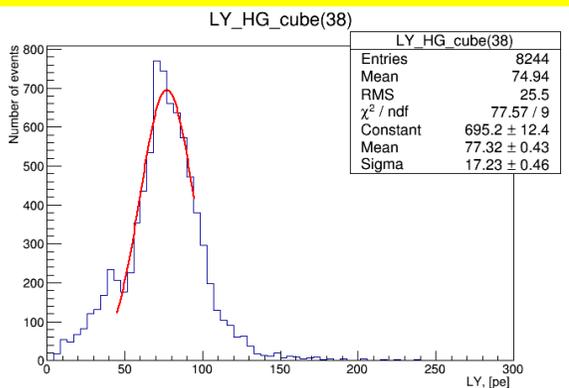
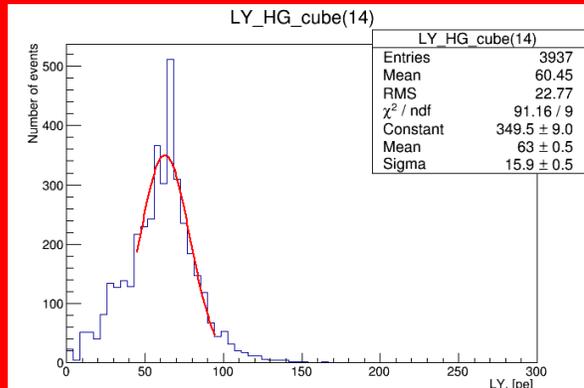
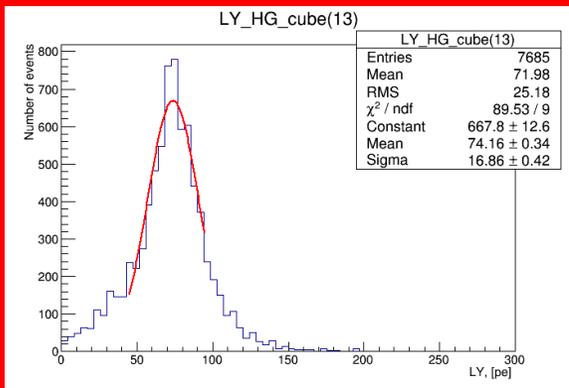
$$T_{cube} = ((T_{ch0} - T_{tr2}) + (T_{ch4} - T_{tr2}))/2$$

2mm scan



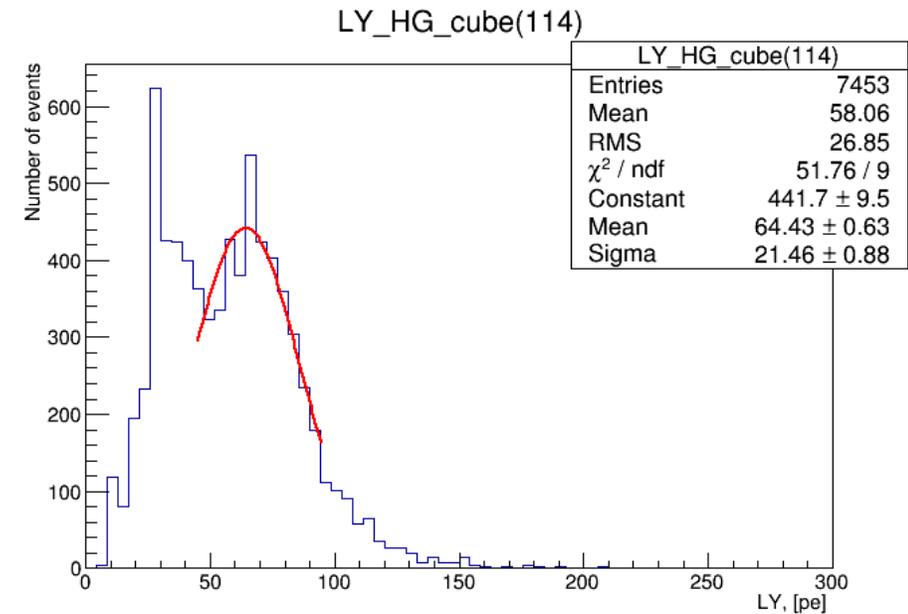
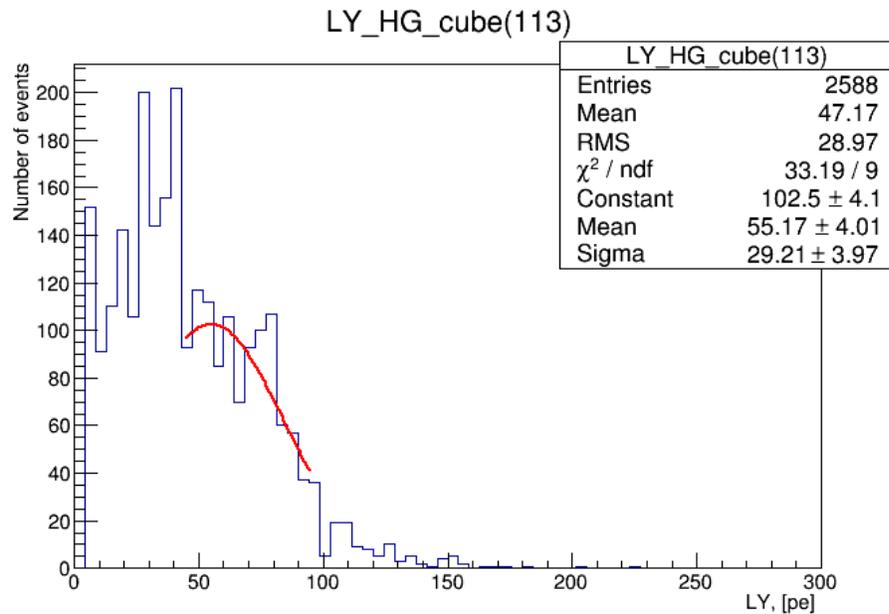
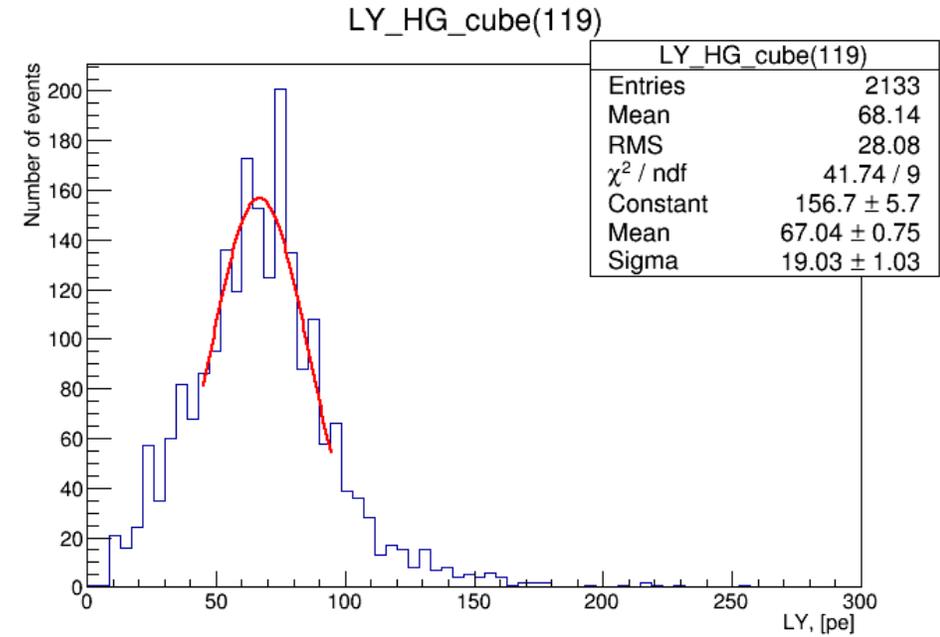
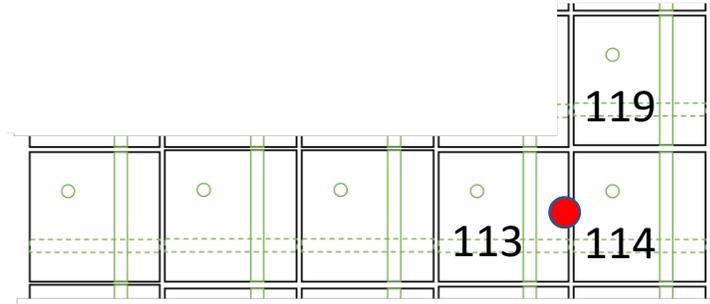
Side point

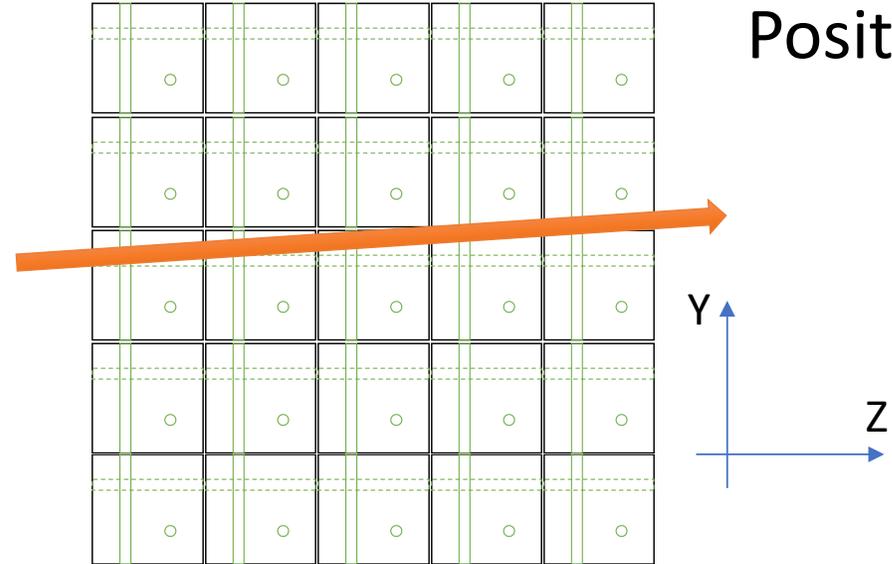
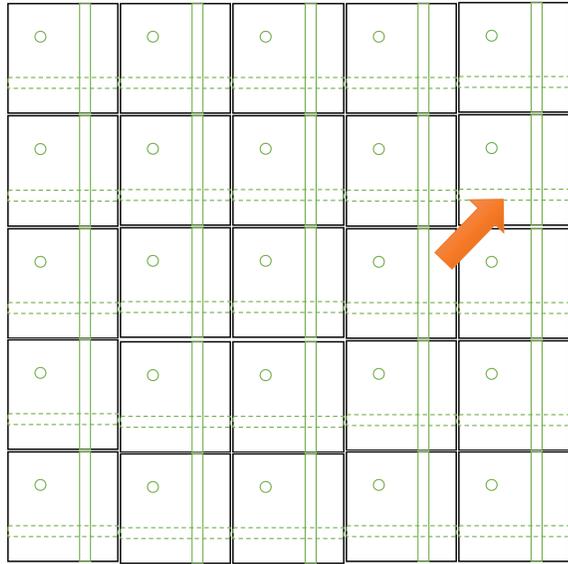
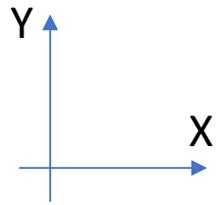




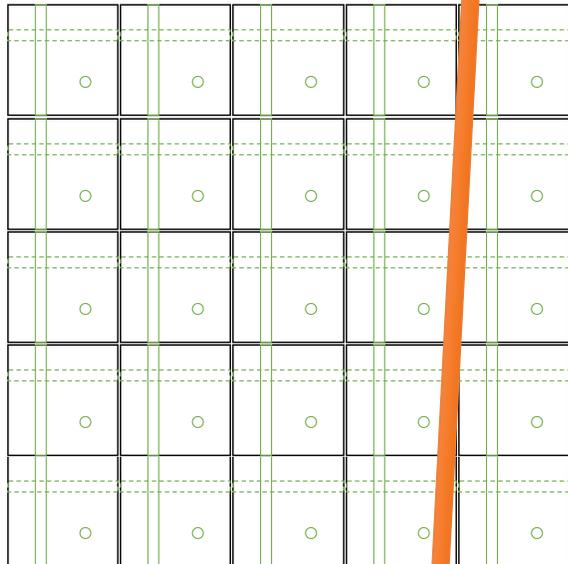
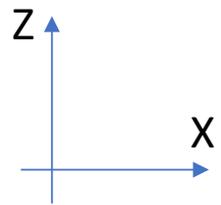
SURPRISE!!!

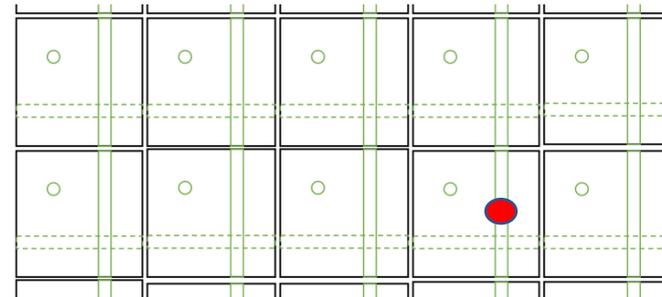
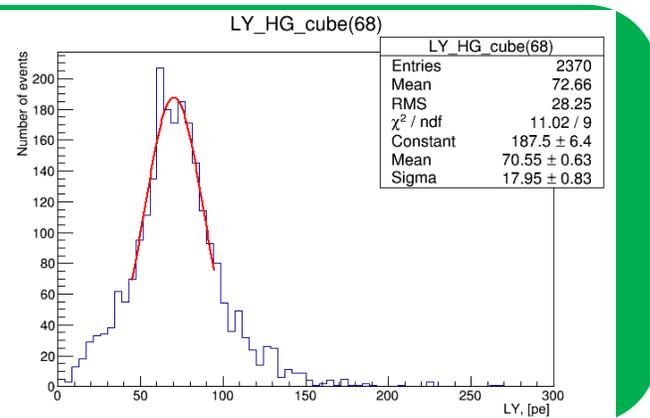
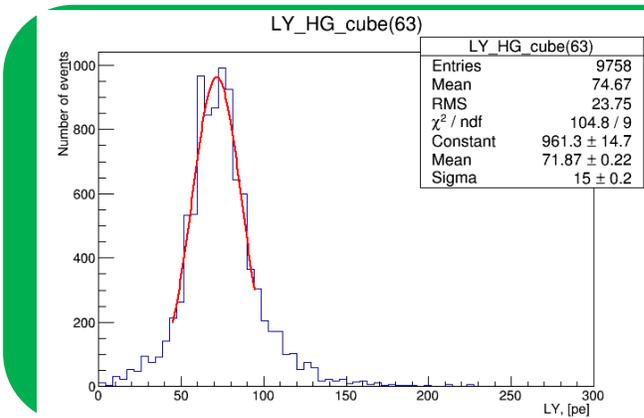
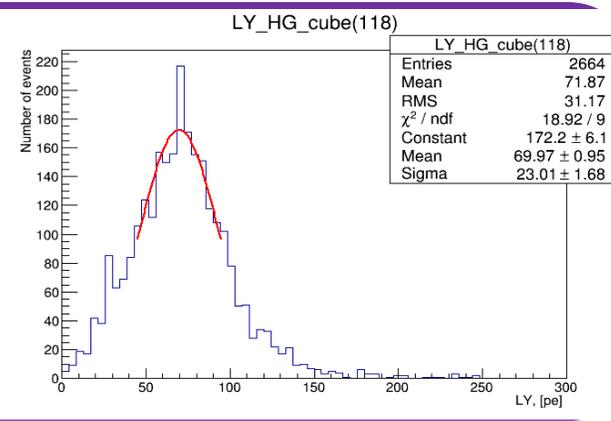
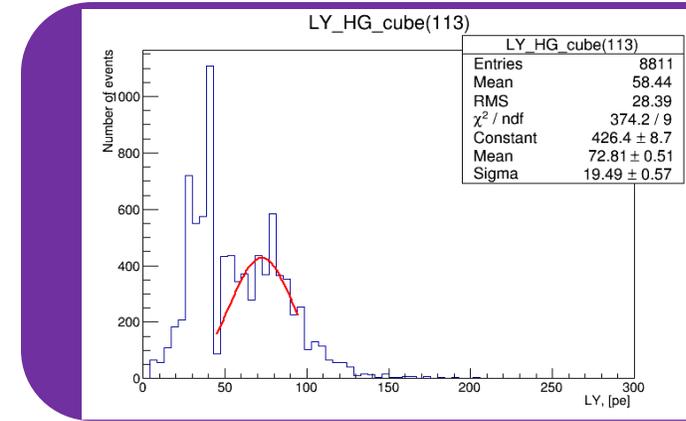
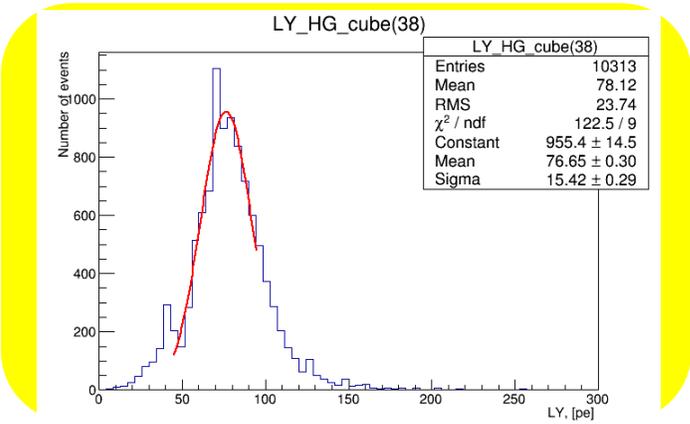
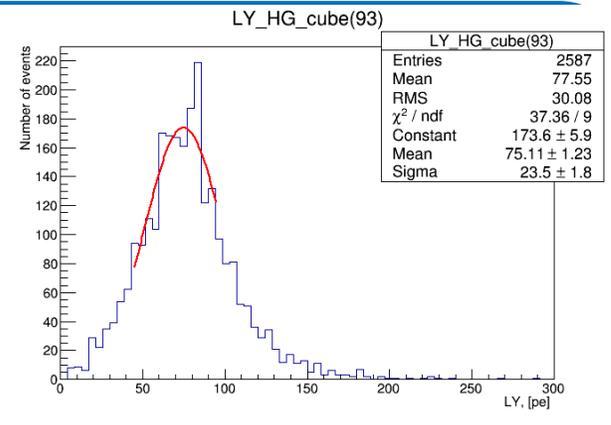
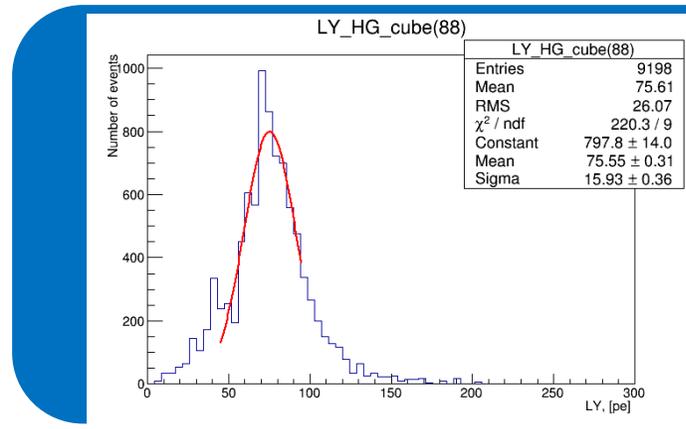
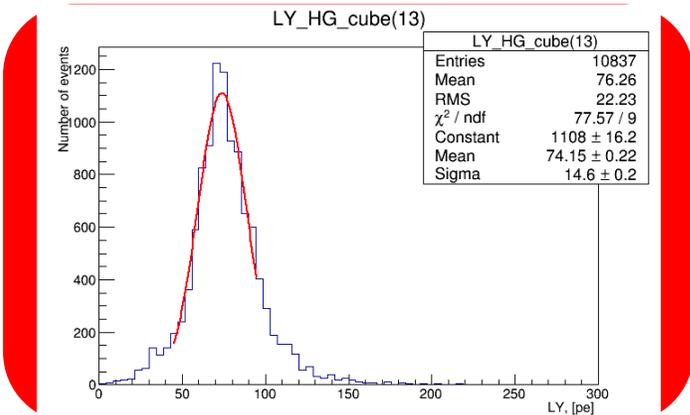
Surprise



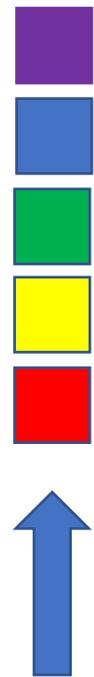
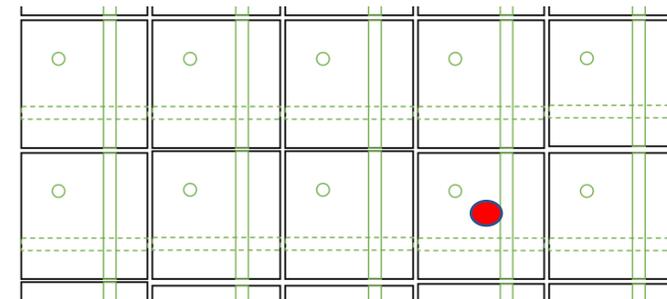
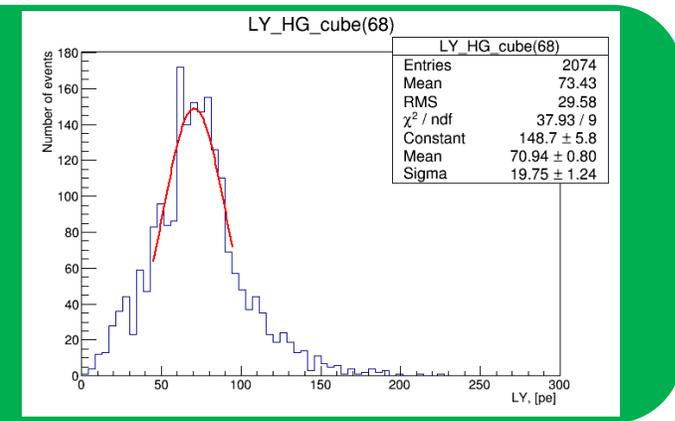
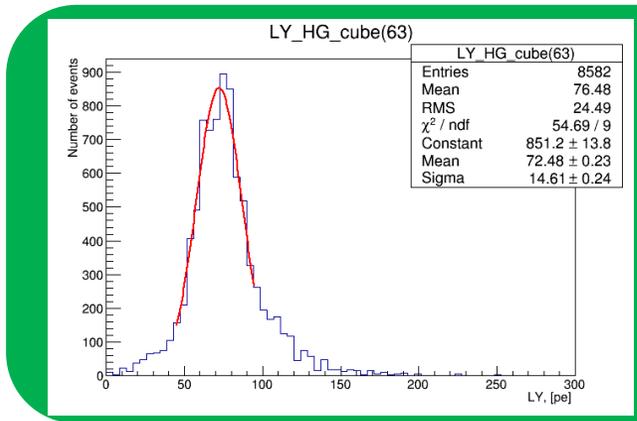
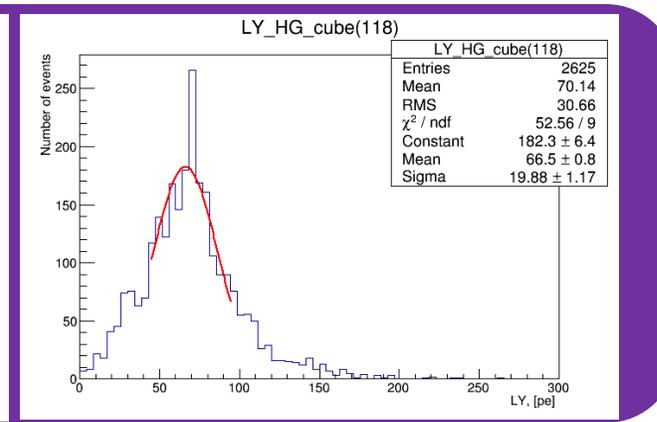
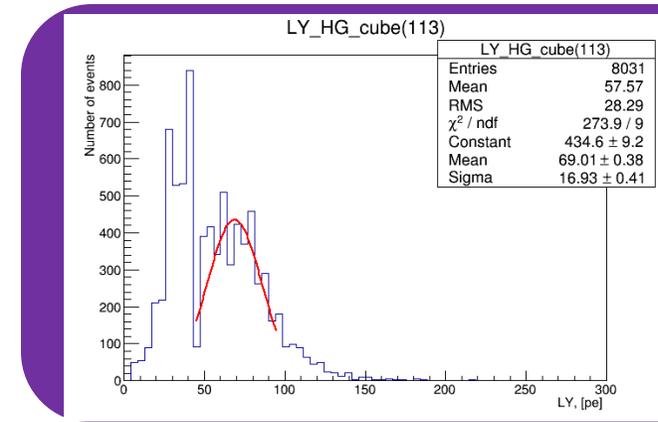
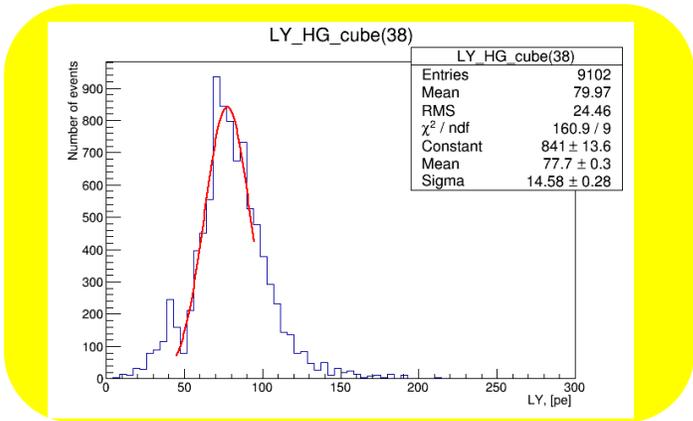
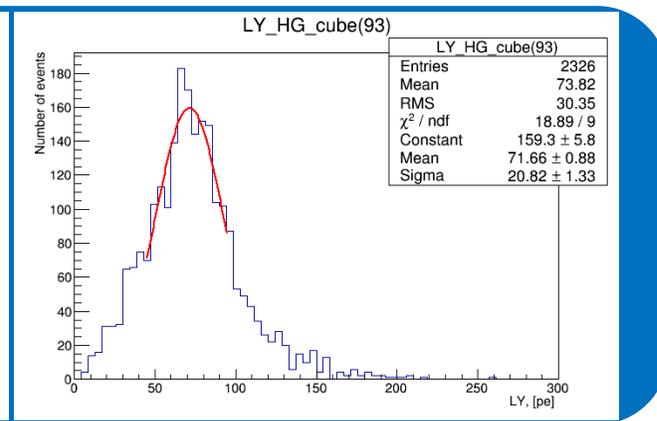
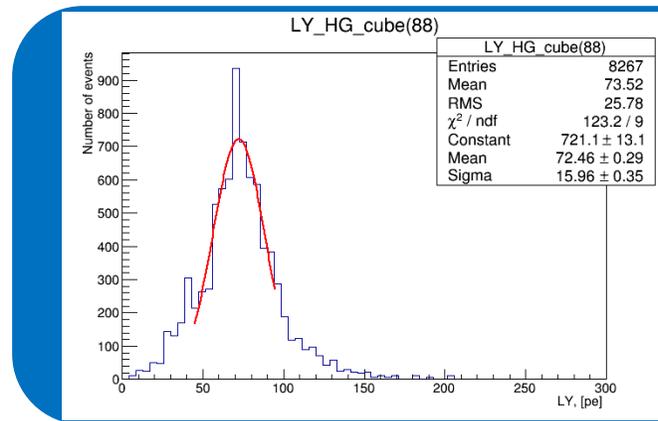
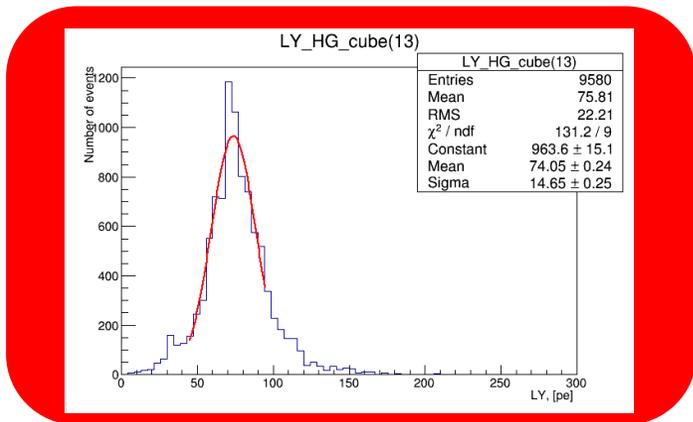


Position to beam

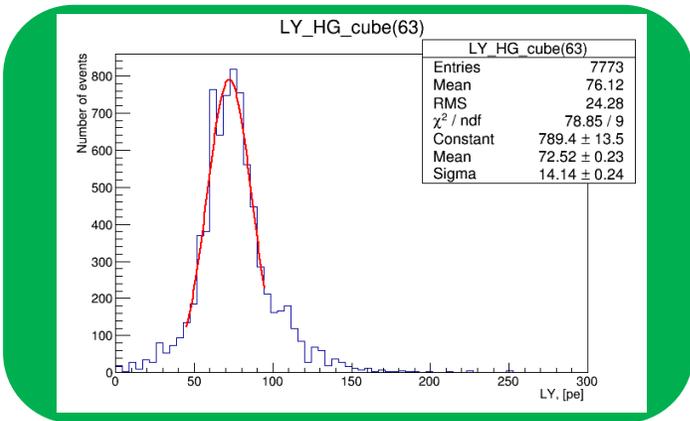
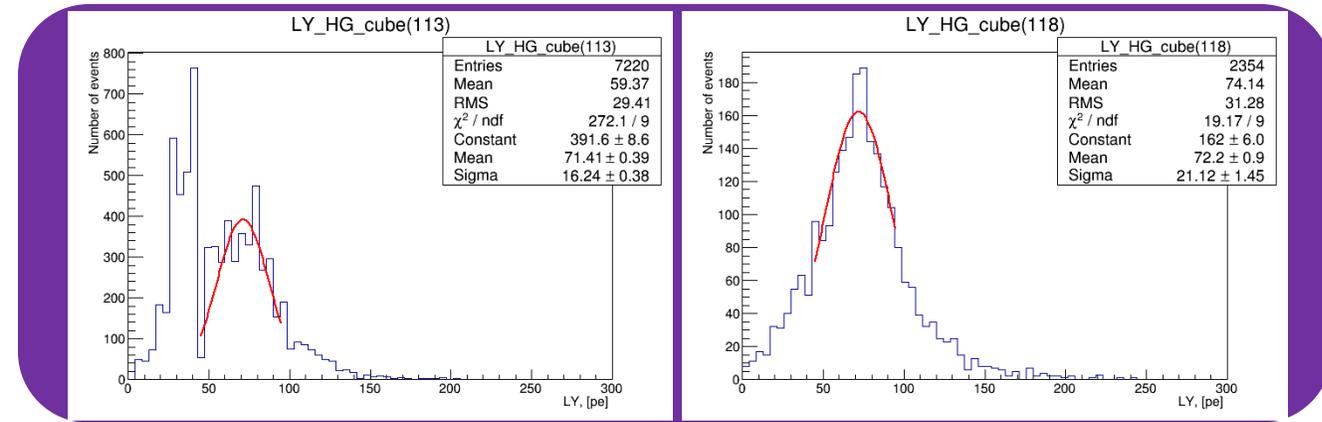
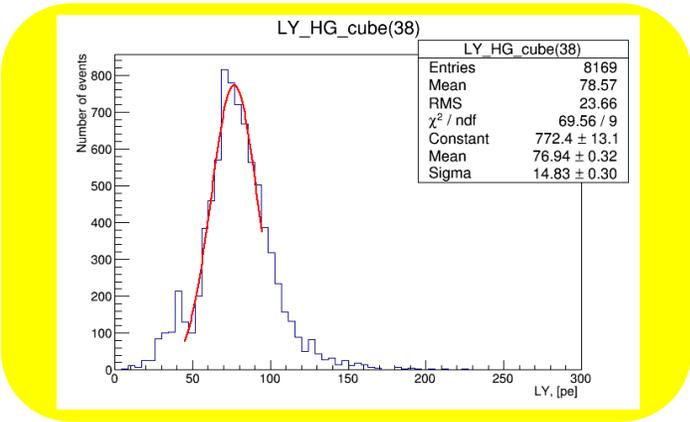
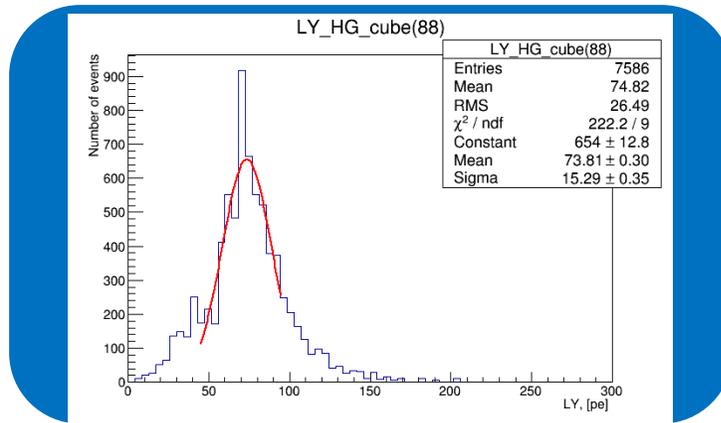
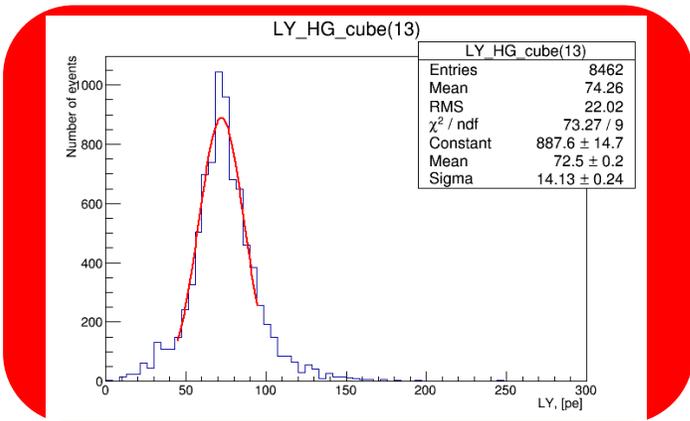




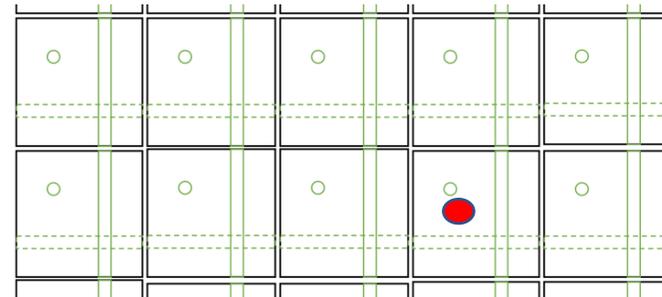
Beam



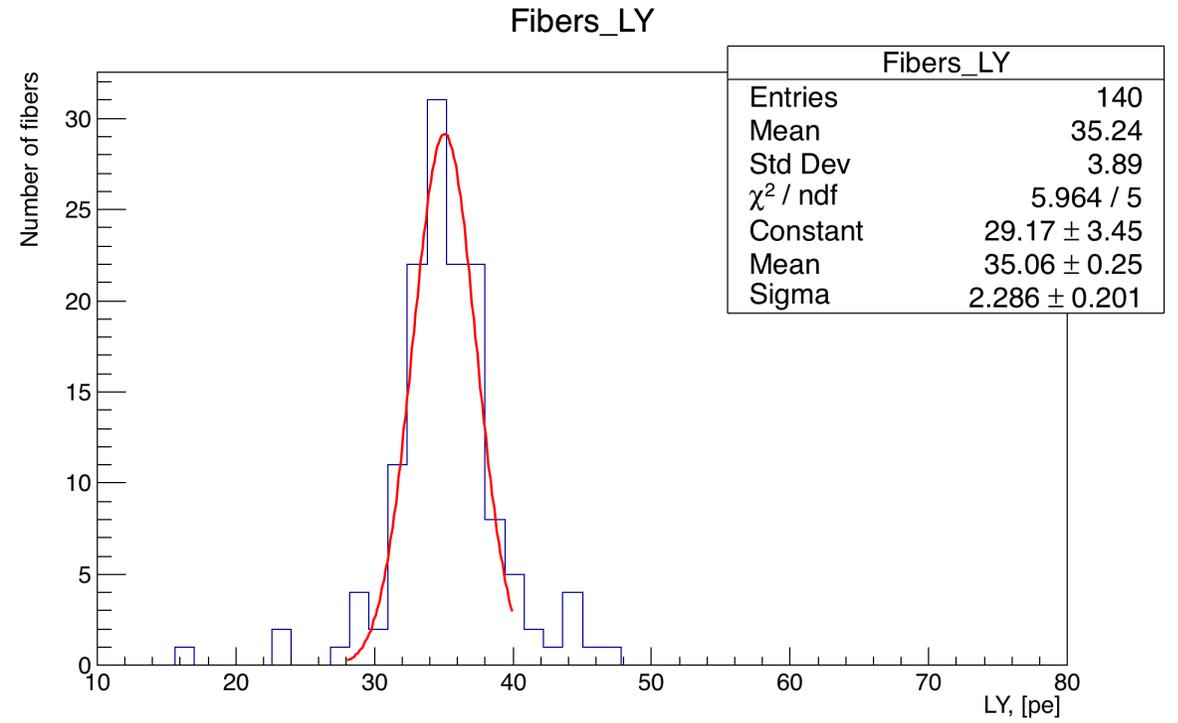
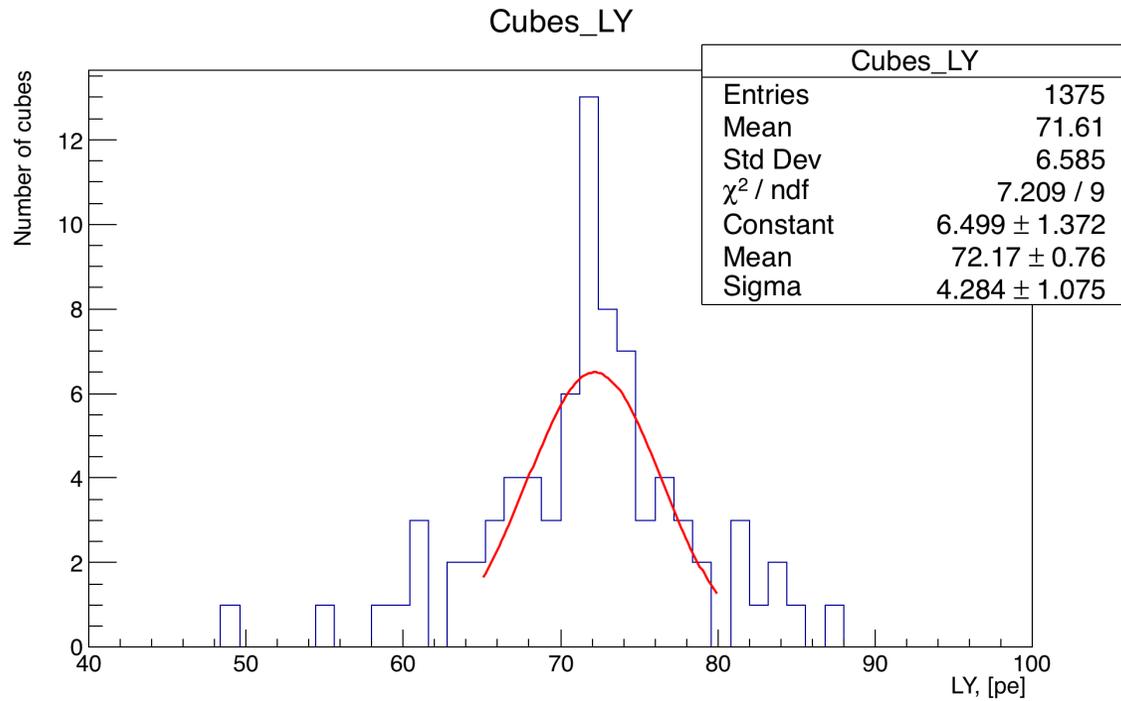
Beam



Beam



Scan results in average

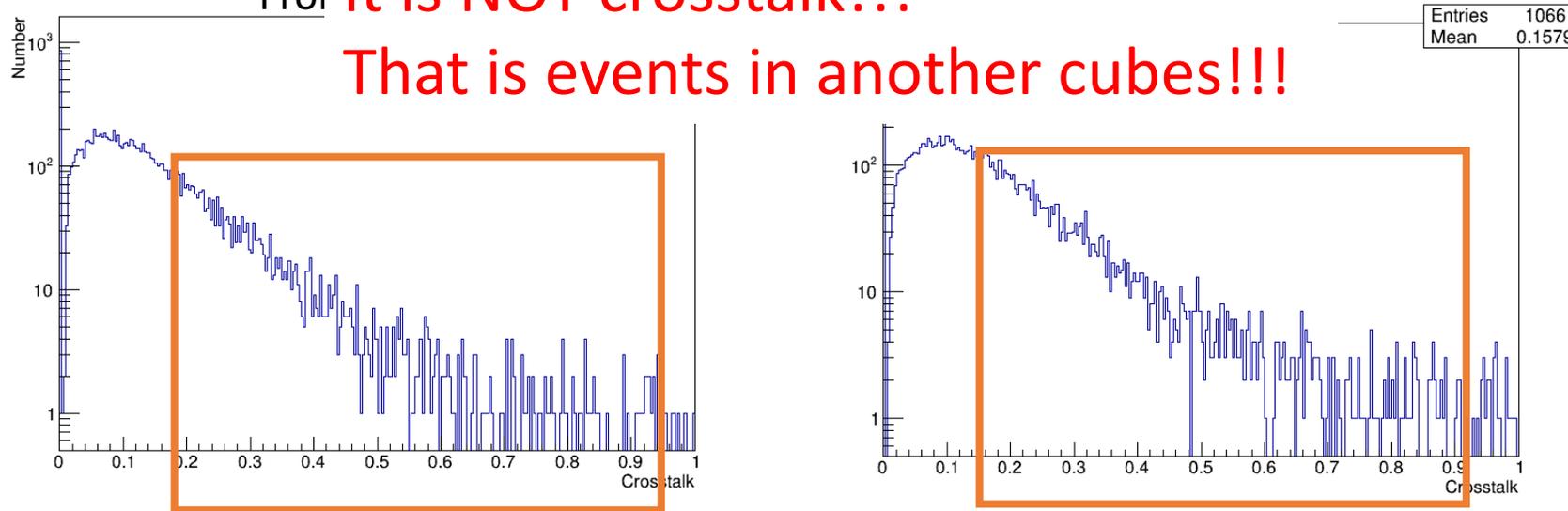


Crosstalk leaked to four sides

CAEN results

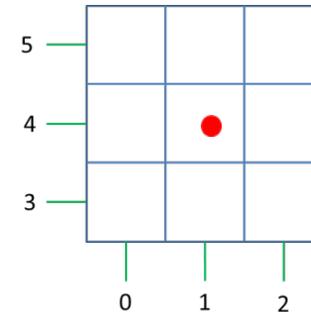
From **It is NOT crosstalk!!!**

That is events in another cubes!!!

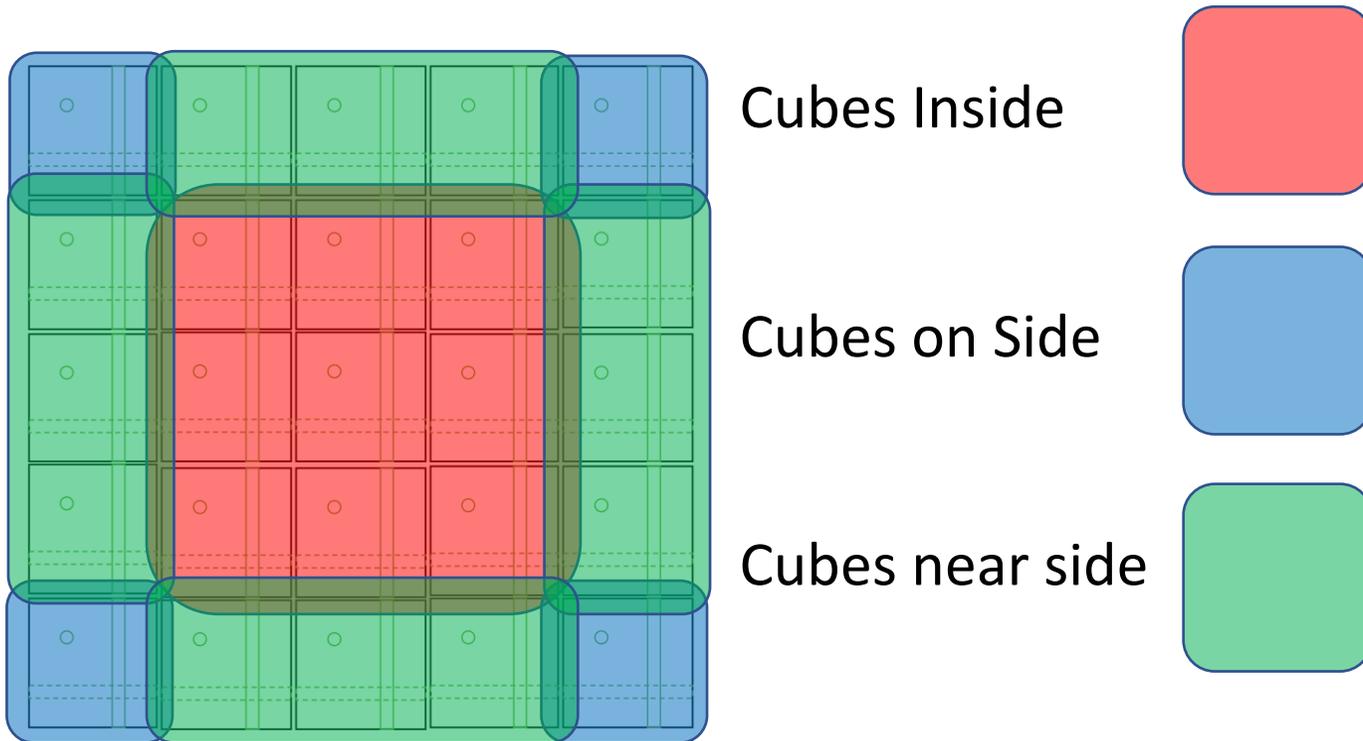


$$C_{front} = \frac{1}{2} \left(\frac{LY_{ch0} + LY_{ch2} + LY_{ch3} + LY_{ch5}}{LY_{ch1} - LY_{ch3} - LY_{ch5}} + \frac{LY_{ch3} + LY_{ch5} + LY_{ch0} + LY_{ch2}}{LY_{ch4} - LY_{ch0} - LY_{ch2}} \right) = \mathbf{13.69\%}$$

$$C_{back} = \frac{1}{2} \left(\frac{LY_{ch6} + LY_{ch8} + LY_{ch9} + LY_{ch11}}{LY_{ch7} - LY_{ch9} - LY_{ch11}} + \frac{LY_{ch6} + LY_{ch8} + LY_{ch9} + LY_{ch11}}{LY_{ch10} - LY_{ch6} - LY_{ch8}} \right) = \mathbf{15.79\%}$$



Reflector effect



$$Re_{\text{blue}} = \left(1 - \frac{\sum LY_{\text{cout}}/NC_{\text{out}}}{\sum LY_{\text{cin}}/NC_{\text{in}}}\right) * 100\% = 9,34 \%$$

$$Re_{\text{green}} = \left(1 - \frac{\sum LY_{\text{cout}}/NC_{\text{out}}}{\sum LY_{\text{cin}}/NC_{\text{in}}}\right) * 100\% = 2,92 \%$$

Summary

Preliminary results with the CITIROC:

- Average L.Y. \approx **33.8 p.e.** per a fiber
- Average L.Y. \approx **71.21 p.e.** per two fibers (a cube)
- Average Reflector effect (crosstalk???) per cube side:
 \approx **3 %**; three sides \approx **9.3%**

Event display & proper crosstalk is ongoing.

