Update IDEA DR calorimeter geometry

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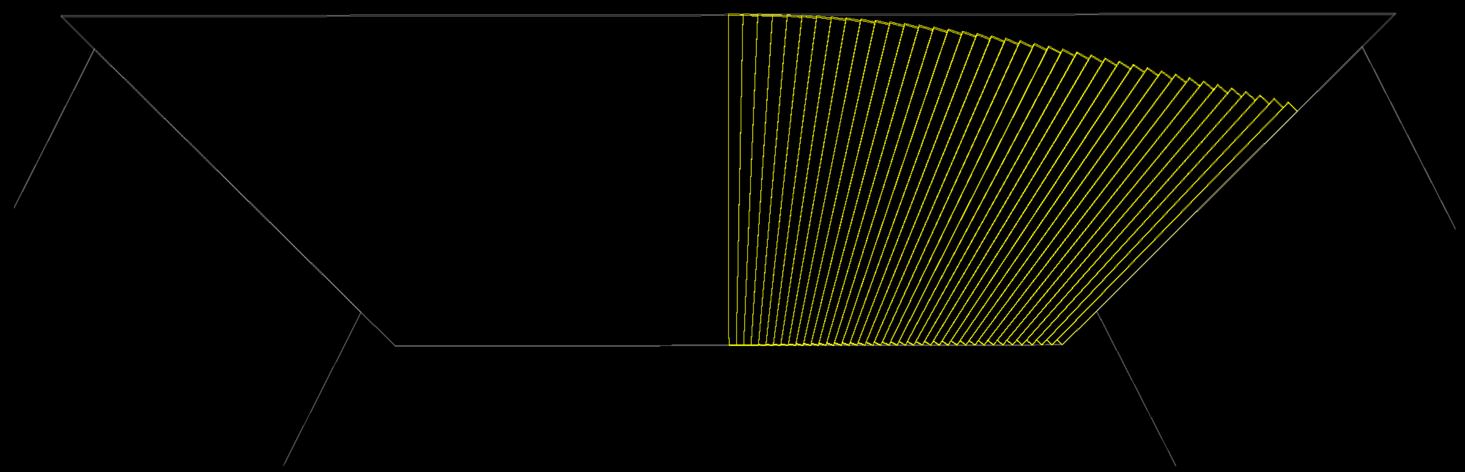
WG11 Detector Design Meeting

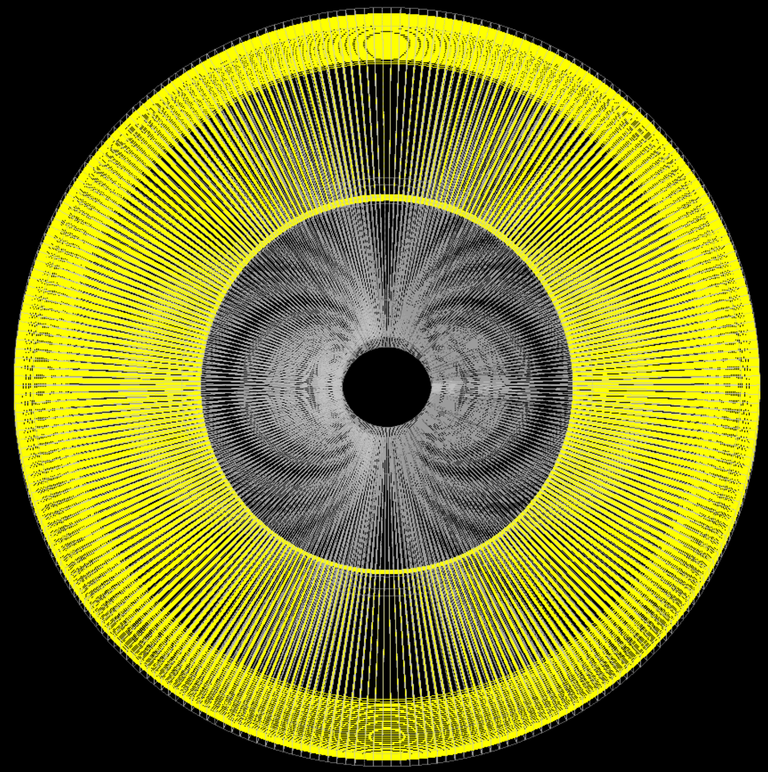
7/3/2019

- **4π projective geometry - Simulation**
- **Staggered calorimeter option - Hardware/Test Beam**

Barrel Geometry

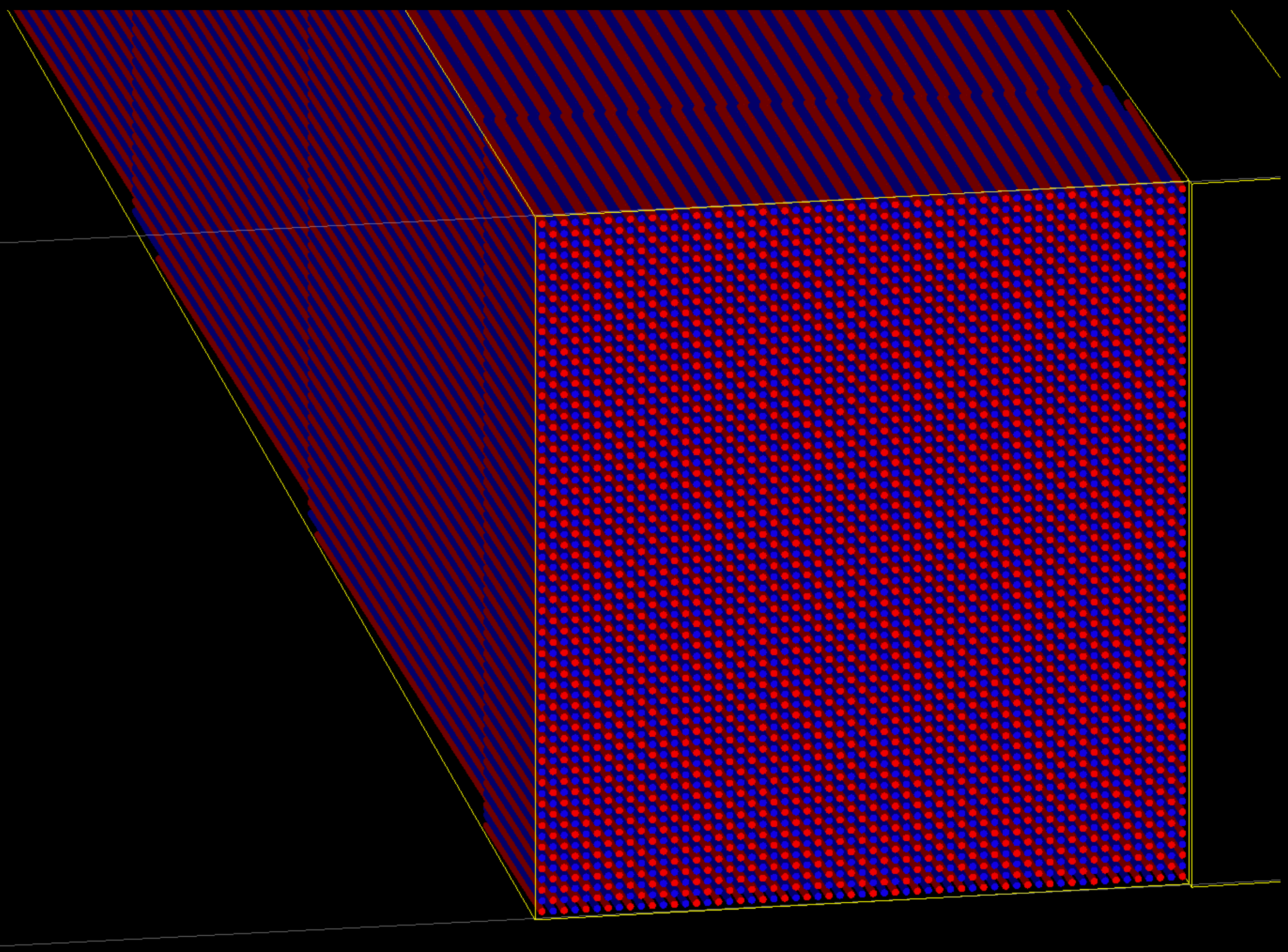


40 towers in barrel right.
Barrel inner length 5 m.
Inner radius 2.5 m.
Tower height 2 m.



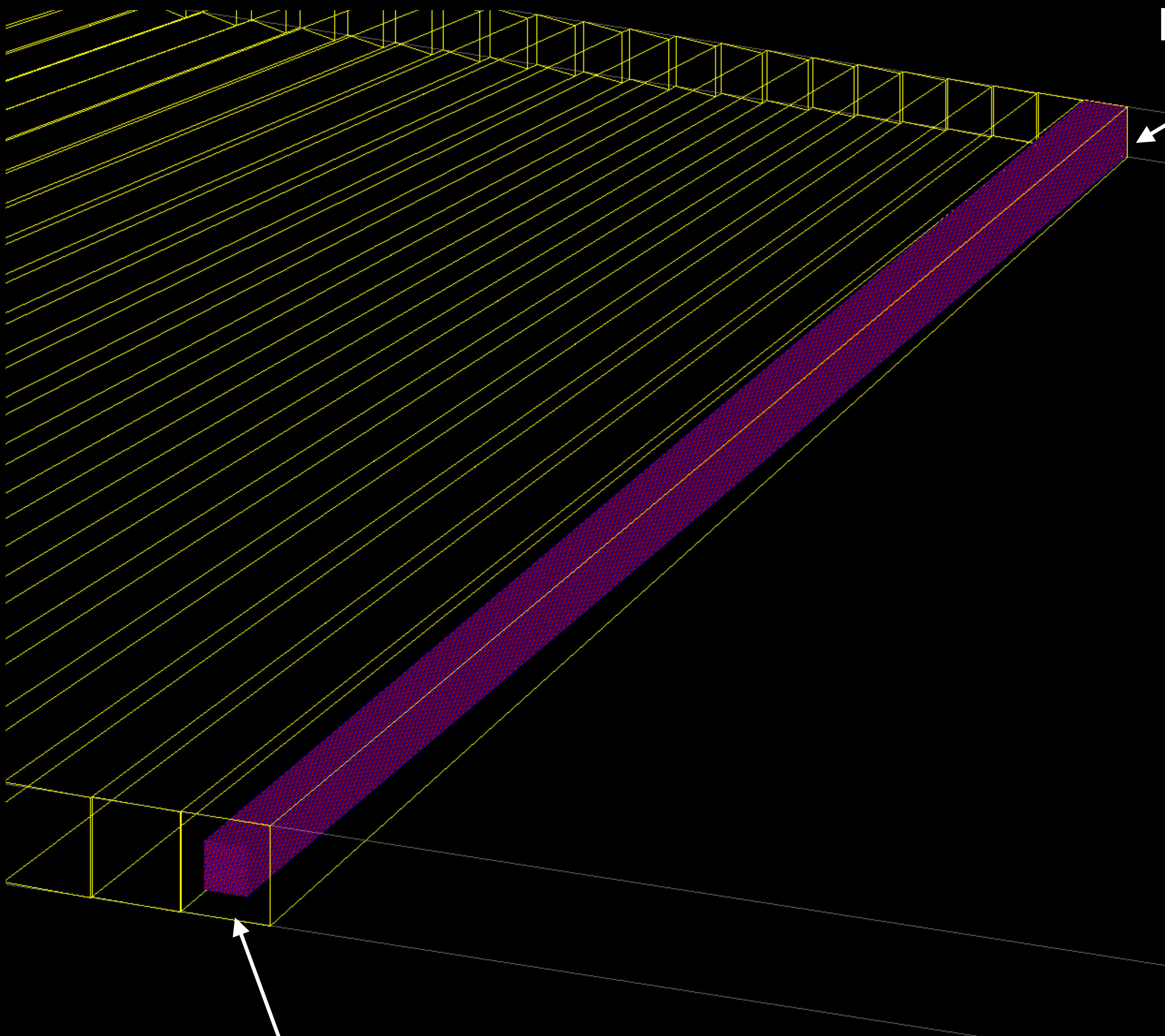
256 towers around beam axis,
number close to 4th concept geometry.

Placing fibers



Each tower in the barrel is filled with 1 mm diameter fibers with 0.5 mm of absorber between them. How to achieve that?

Placing fibers



Inner face.

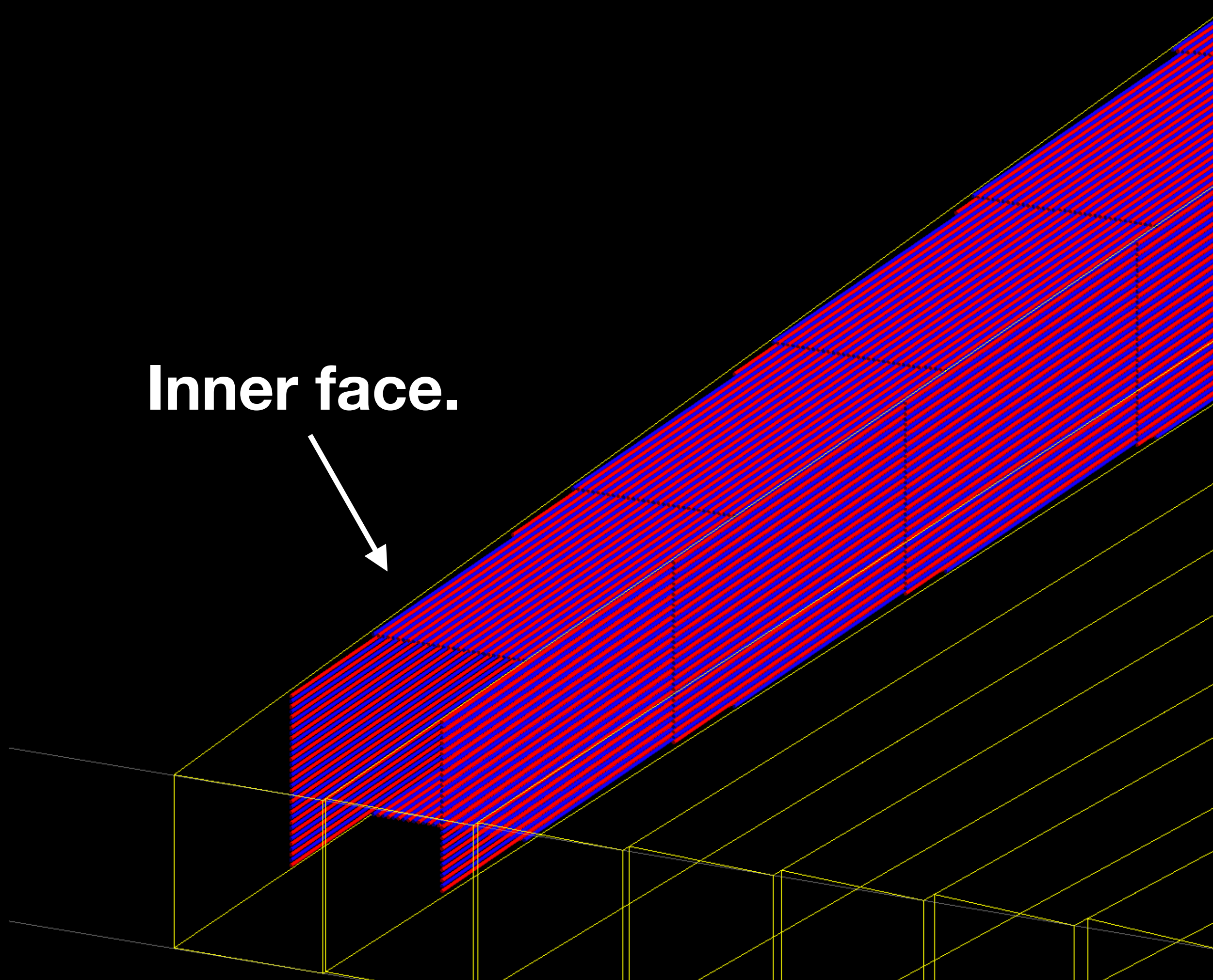
A single barrel slice.

“Regular” fibers fill the inner face of each tower.

Empty space at the end of outer tower face.

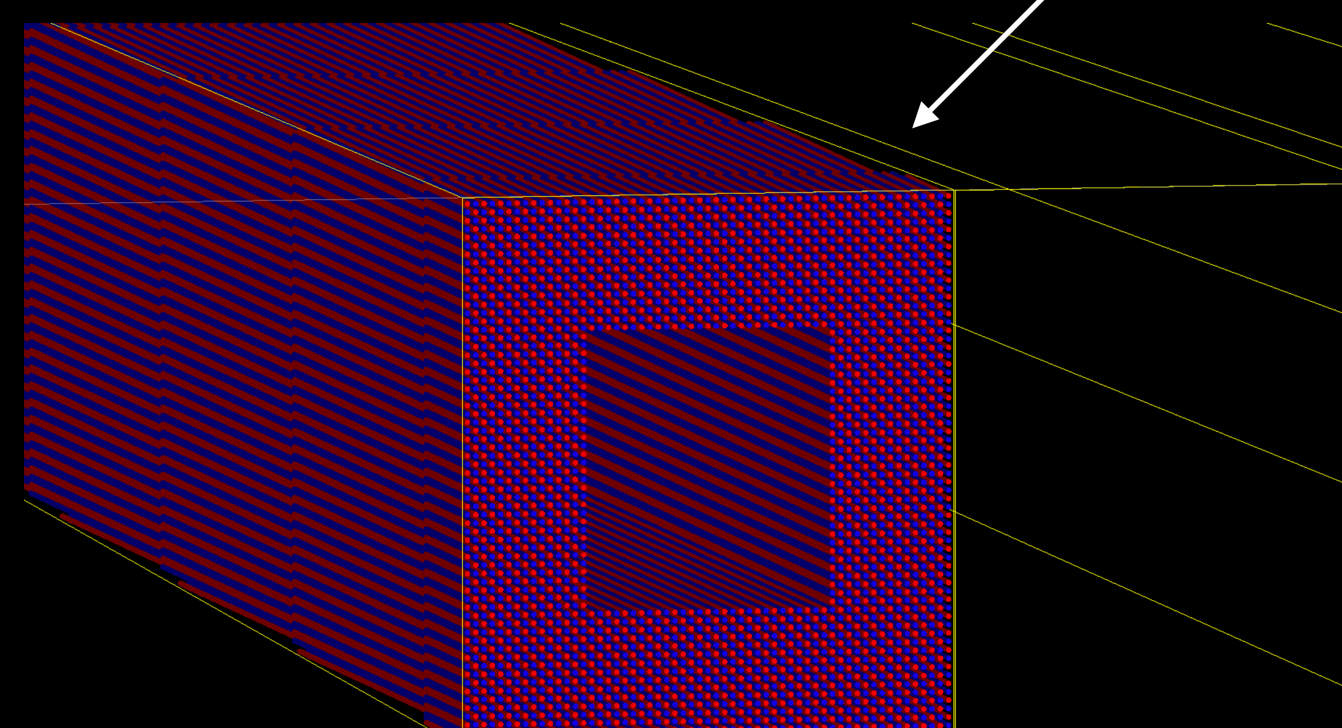
Placing fibers

Inner face.



Added “displaced” fibers at different lengths to keep sampling fraction constant.

Outer face.



Outer face of a tower with only displaced fibers inside.
Regular fibers fill the gap perfectly.

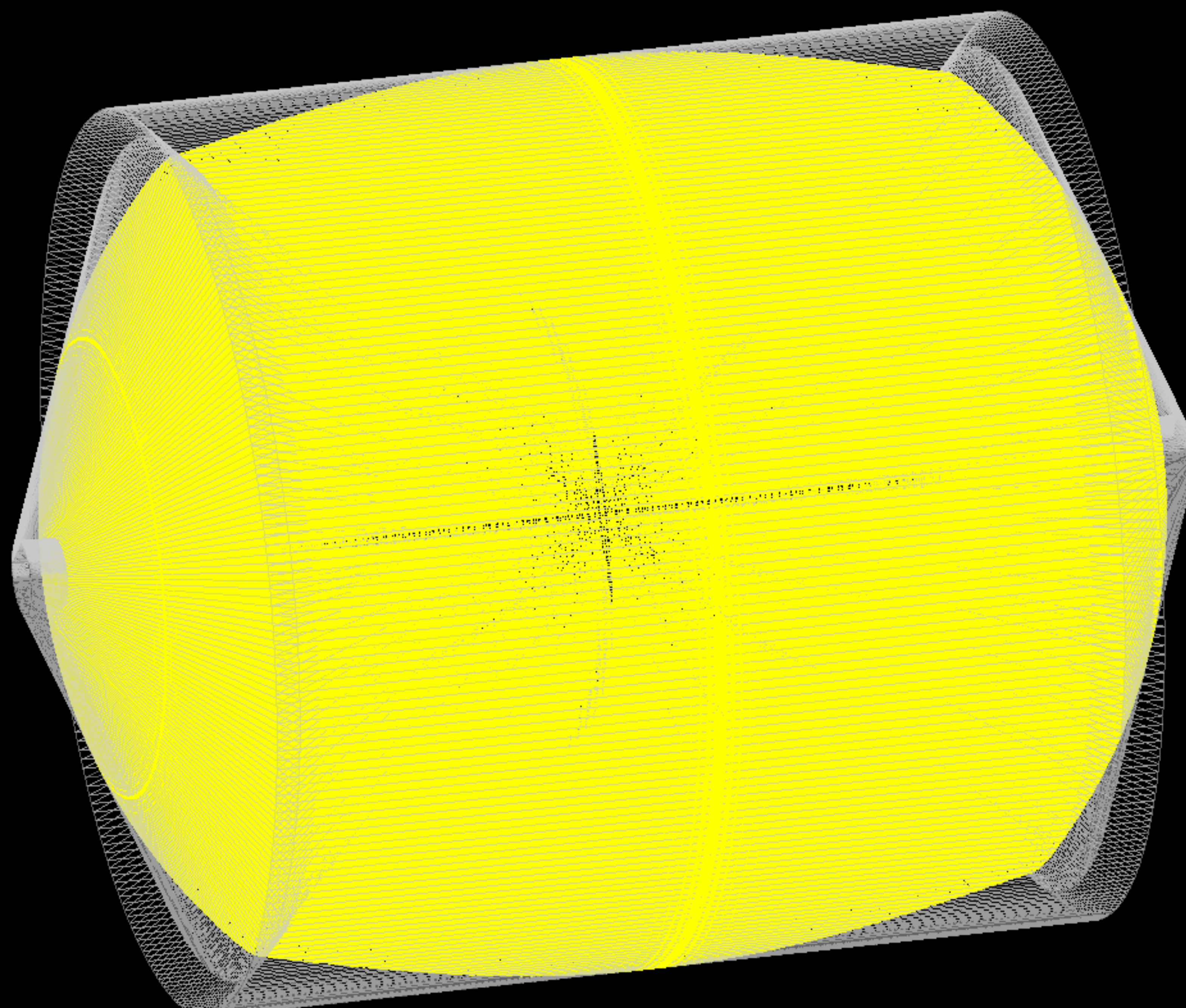
fibers - preliminary

Tower	Regular fibers	Displaced fibers	Total
0	957	2878	3835
1	957	2878	3835
2	957	2878	3835
3	957	2878	3835
4	957	2878	3835
5	957	2878	3835
6	957	2878	3835
7	957	2878	3835
8	957	2878	3835
9	960	2752	3712
10	960	2752	3712
11	960	2752	3712
12	960	2752	3712
13	960	2752	3712
14	960	2752	3712
15	957	2634	3591
16	957	2634	3591
17	957	2634	3591
18	957	2634	3591
19	964	2508	3472

Tower	Regular fibers	Displaced fibers	Total
20	968	2504	3472
21	970	2502	3472
22	990	2426	3416
23	957	2398	3355
24	957	2398	3355
25	957	2398	3355
26	978	2262	3240
27	978	2262	3240
28	980	2260	3240
29	990	2196	3186
30	957	2170	3127
31	950	2124	3074
32	950	2124	3074
33	984	2032	3016
34	990	1974	2964
35	990	1974	2964
36	957	1950	2907
37	954	1902	2856
38	954	1902	2856
39	988	1812	2800
SUM	38564	99028	137592

Total number of fibers in the barrel: 137592*256*2 = 70447104

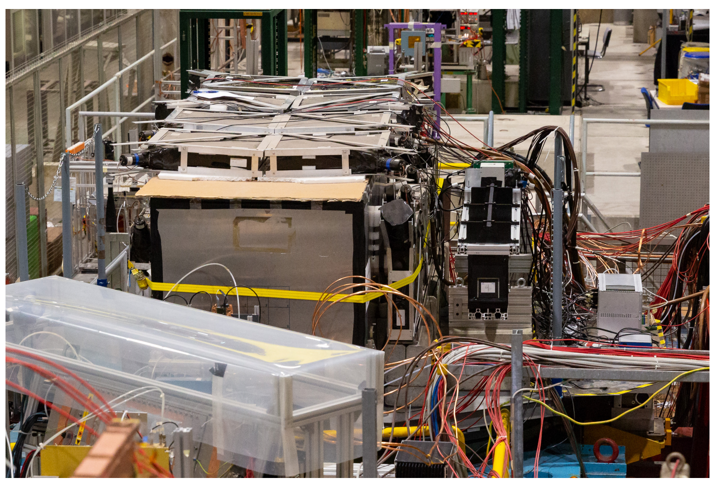
Fully projective geometry



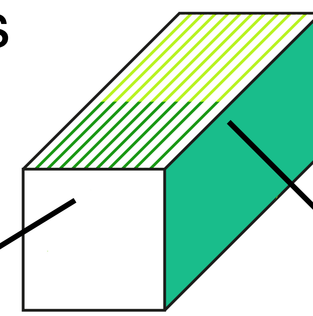
The IDEA 2019 Test Beam

To deal with particle identification with multi particle environment, a longitudinal segmentation given by an electromagnetic and a hadronic section might be needed.

A possible solution is investigated with a 9x9x250 cm^3 lead module with half fibers staggered of 25 cm from the front face.

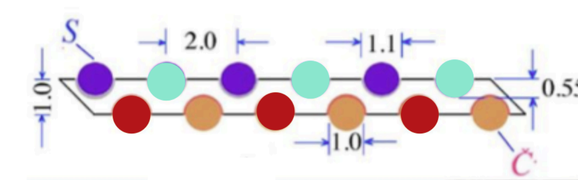


Long fibers section

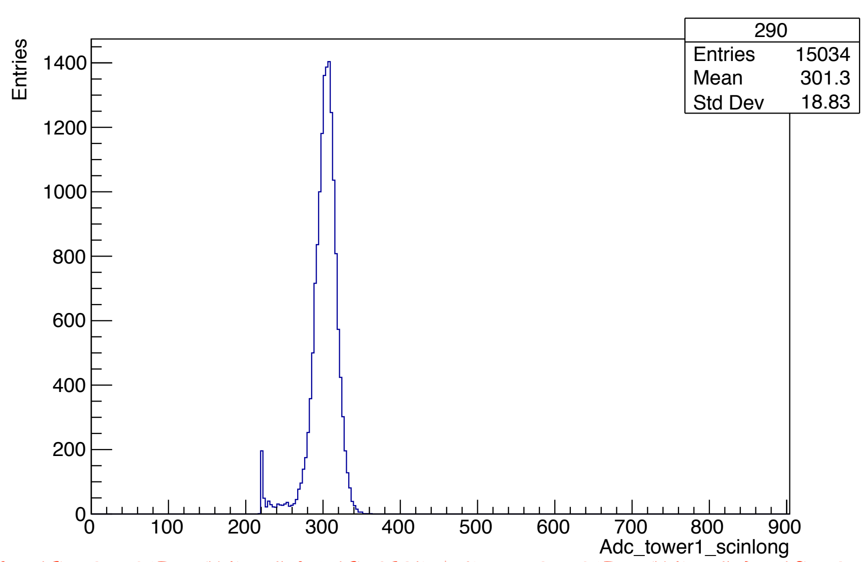


Short fibers section

"*Staggered*" module: 4 kind of fibres
S-short S-long C-short C-long



20 GeV e^- in long fibers



20 GeV e^- in short fibers

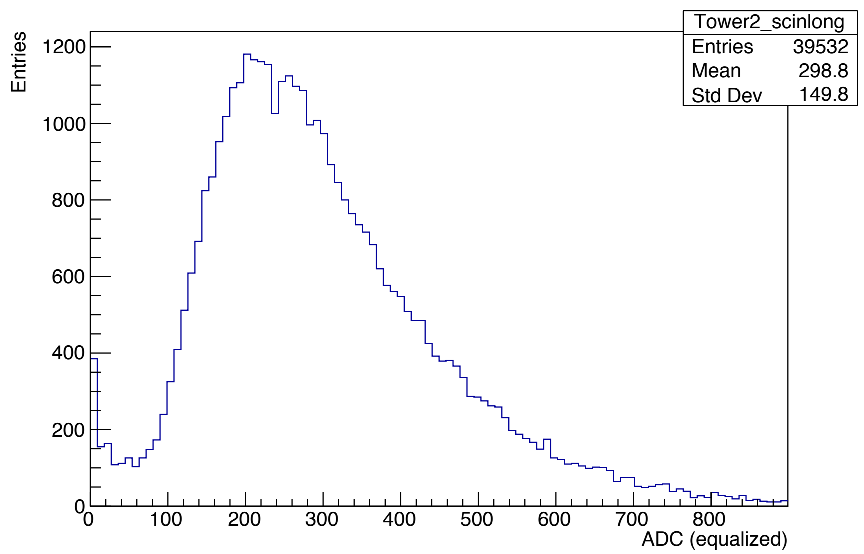
Signal
Compatible with pedestal

Staggered module results

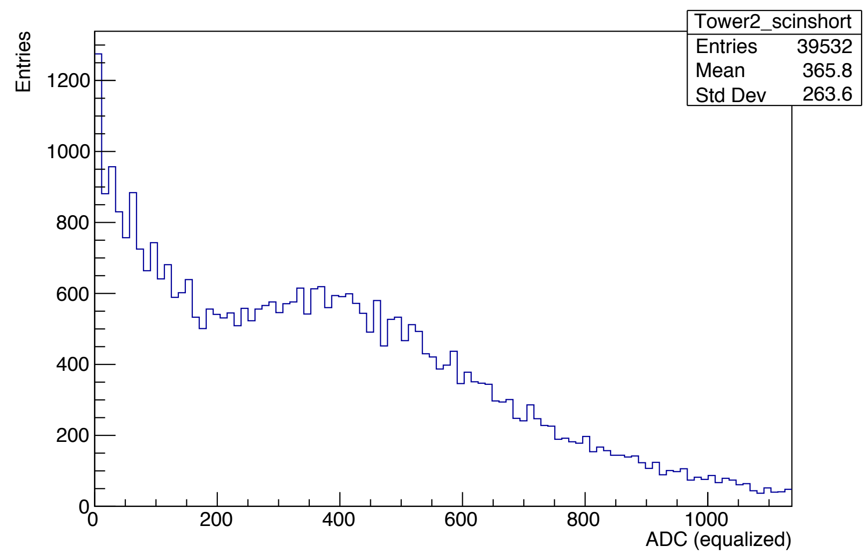
But… how is it possible to calibrate the short fibers with electrons if electrons do not reach short fibers?

Scintillating fibers

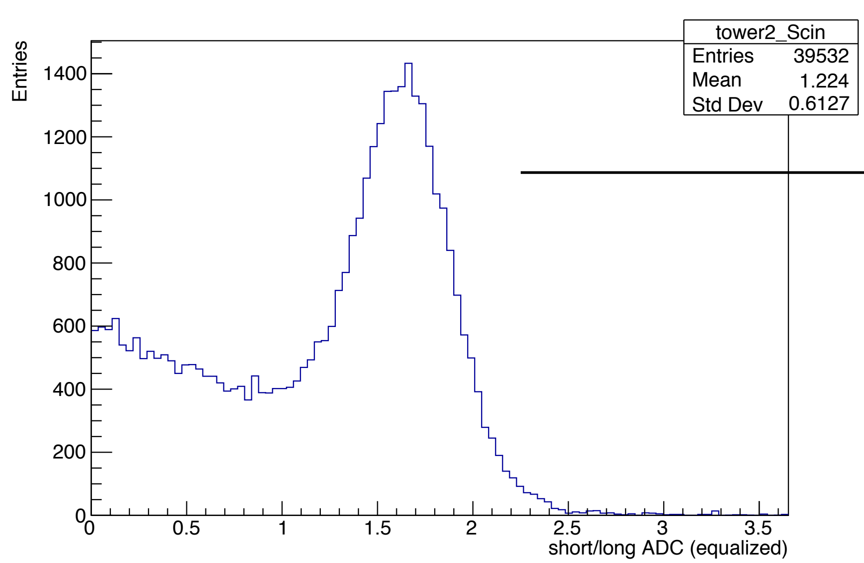
60 GeV π⁻ long fibers



60 GeV π⁻ short fibers



60 GeV π⁻ short/long fibers



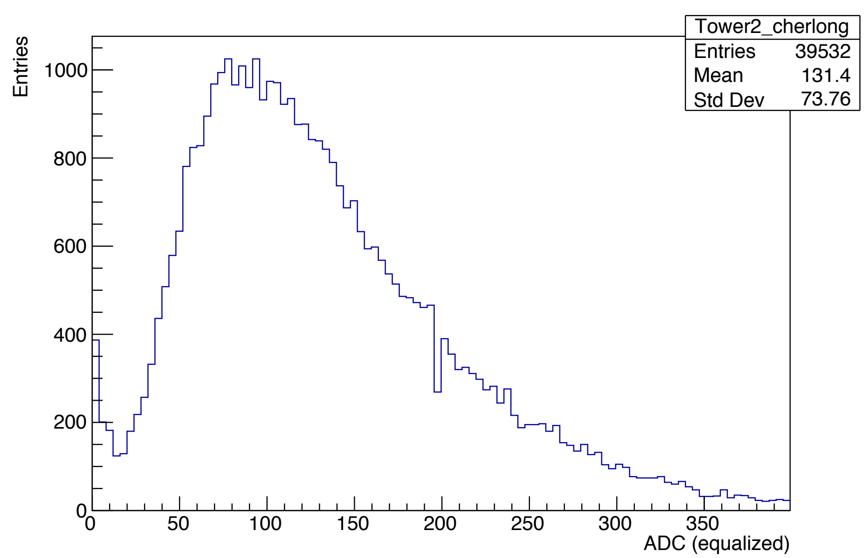
Peak induced by hadrons that start showering late in the short section:
<u>mean value can be used to scale calibration constants of long fibers to obtain the short fiber ones.</u>

Staggered module results

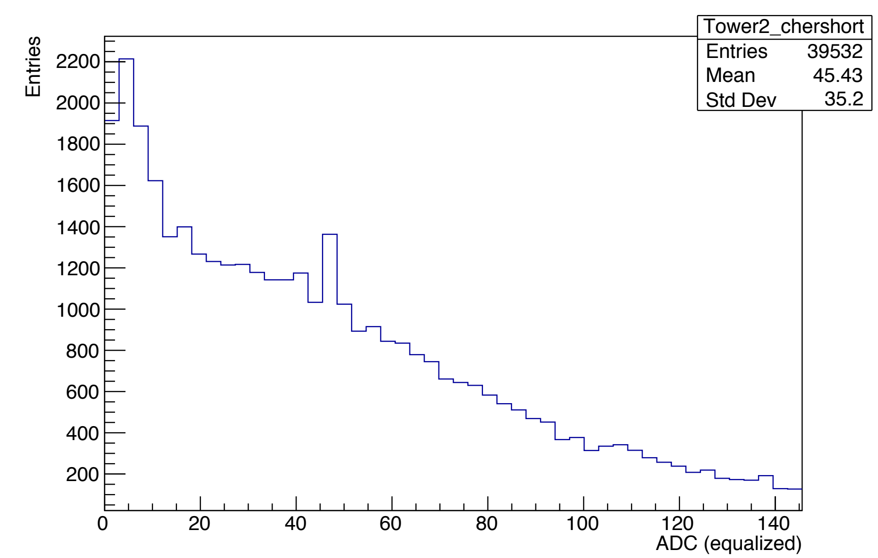
And for the Cherenkov signal?

Cherenkov fibers

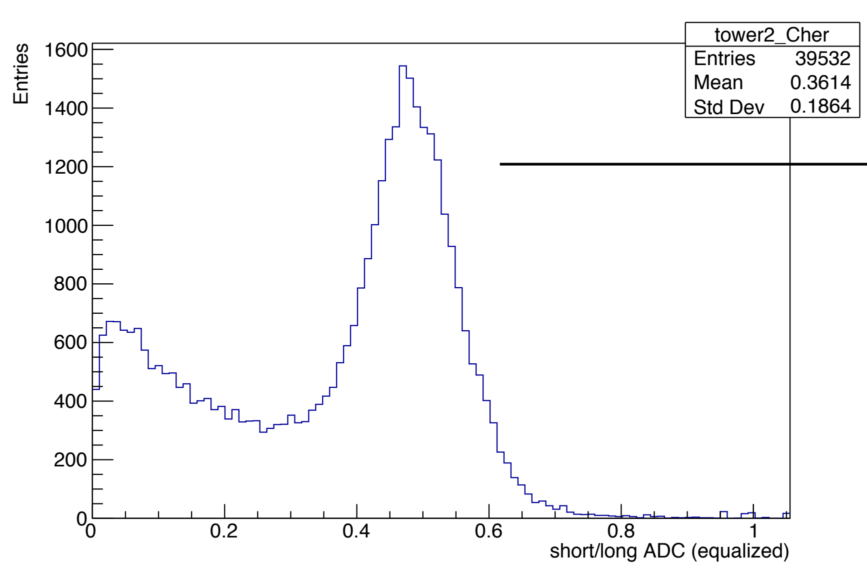
60 GeV π^- long fibers



60 GeV π^- short fibers



60 GeV π^- short/long fibers



Peak mean value can be used to scale calibration constants of long fibers to obtain the short fiber ones, even for the Cherenkov signal.

Conclusion

A dual-readout calorimeter has proven to be a good option for FCCee both with simulations and hardware.

- **The fiber fully projective calorimetry is described in simulations and now has to be implemented in a real experiment software. However,…**

- **The endcap geometry will probably be redesigned.**
- **Possible solutions for longitudinal segmentations must be investigated: staggered fibers, timing informations, …**
- **Several properties can already be explored with single test-beam like calorimeter simulations before being ported to the collider geometry, e.g. PID in jet and tau decay products and the effect of different absorber materials.**