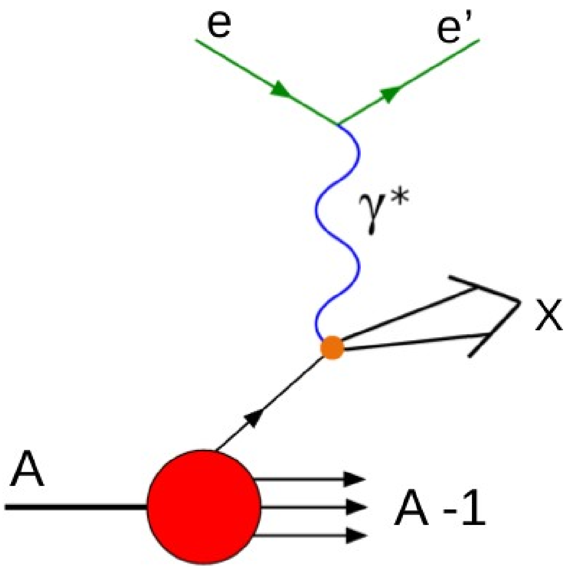
Mounting ALERT Hyperbolic Drift Chamber

Gabriel Charles for
J. Bettane, L. Causse, C. Domingues-Goncalves, R. Dupré, T. Hourat, M. Imre, F. Jouve, B. Mathon, M-L. Mercier, S. Olmo

Why ALERT?



Deuterium or helium target

To avoid interaction of the recoil nucleus with fragments measure the recoil particle at high angle and low momentum

=> $p < 150$ MeV/c, $\theta > 100°$
4π detection

Recoil nucleus can be :

proton,	deuterium,	tritium,	helium 3,	alpha
(p)	(1p,1n)	(1p,1n)	(2p, 1n)	(2p, 2n)

Detection of the electron and recoil nucleus

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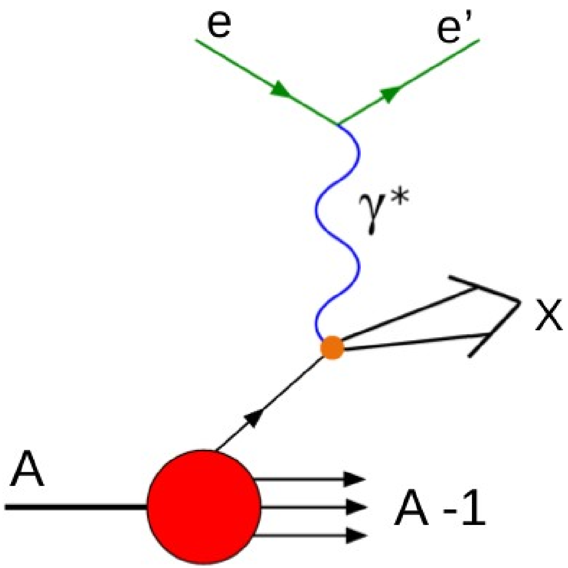

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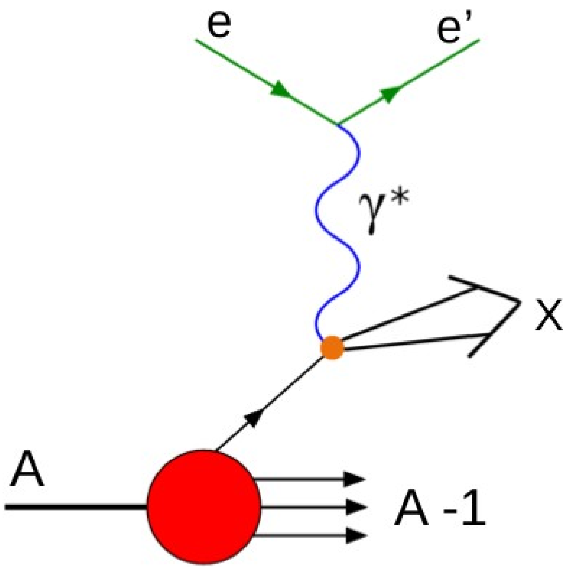

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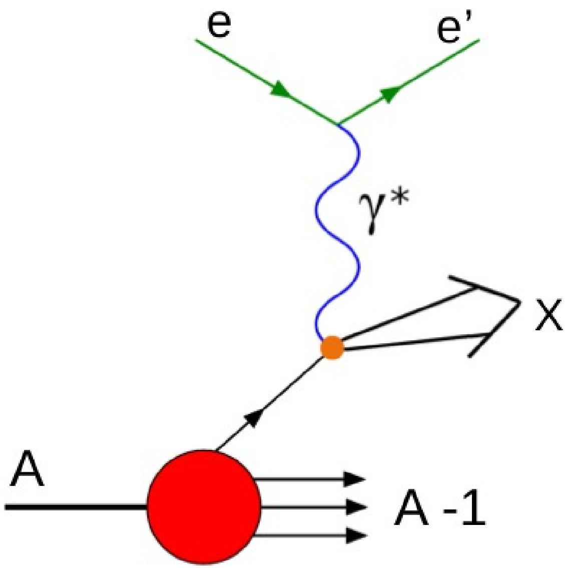

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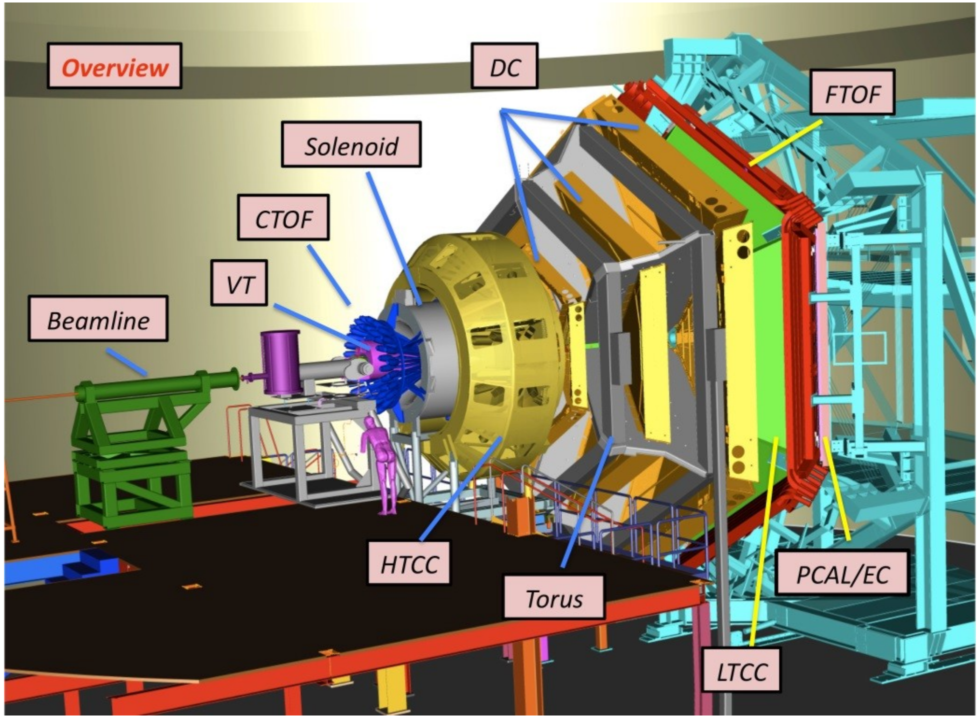
Tracker

ALERT with CLAS12@JLab

Hall B is perfect to reconstruct the electron. What about the recoil particle?

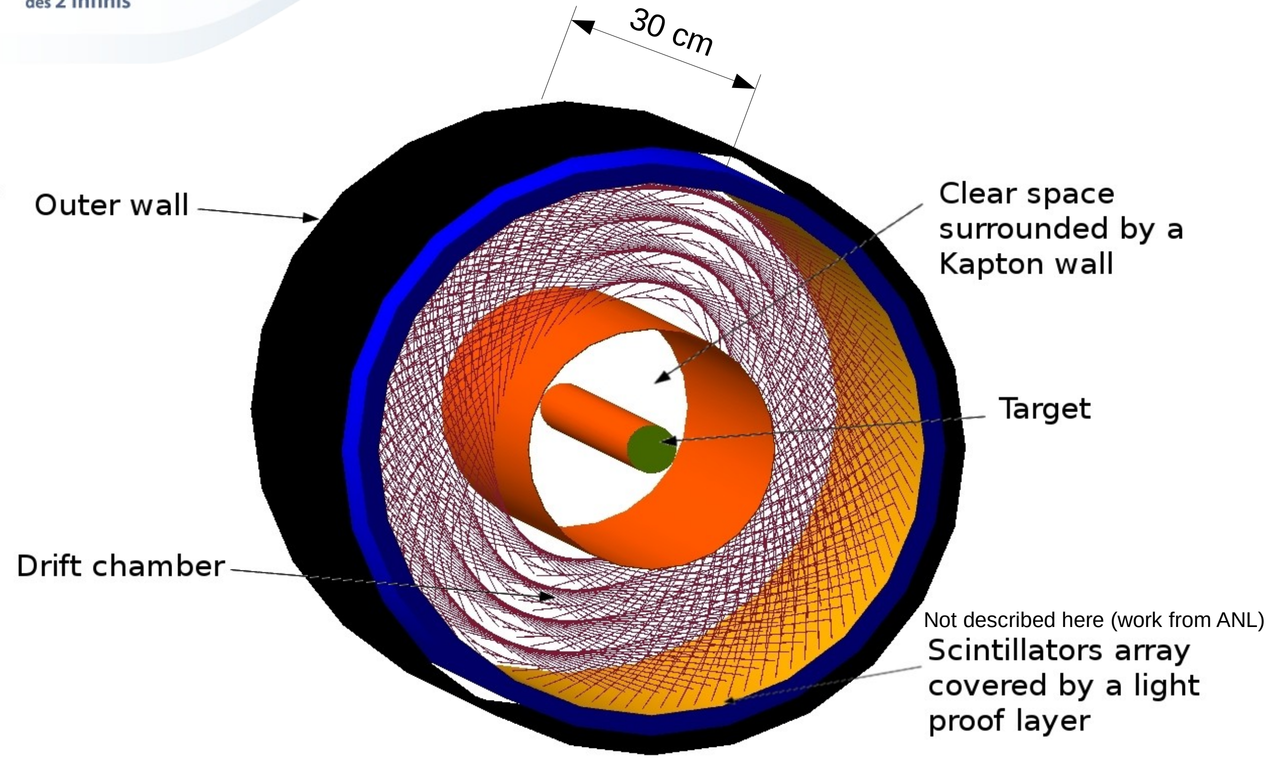
=> a new central tracker is required

12 GeV continuous electron beam



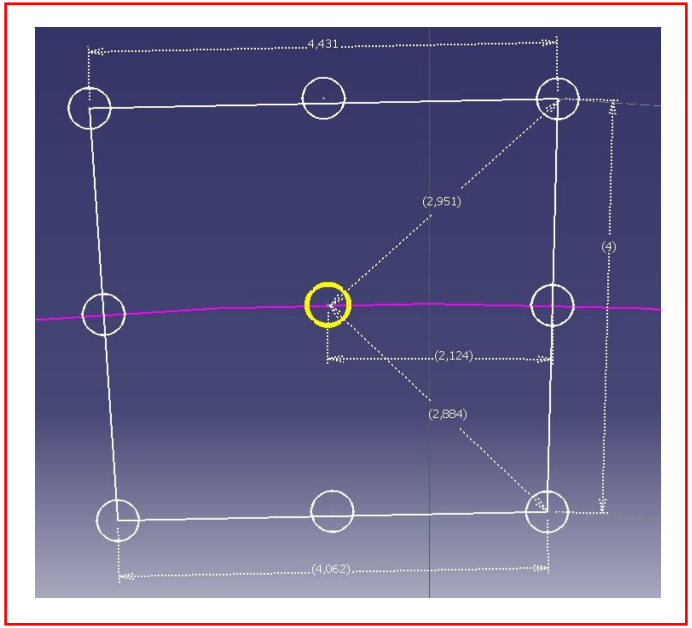
CLAS12 (Hall B)

ALERT: the concept 1/2



Flying wires, no field wires

3000, 30 cm long wires, 30 µm diameter, 23,9 wires/cm^2



All wires grounded, except 576 readout with positive voltage

ALERT: the concept 2/2

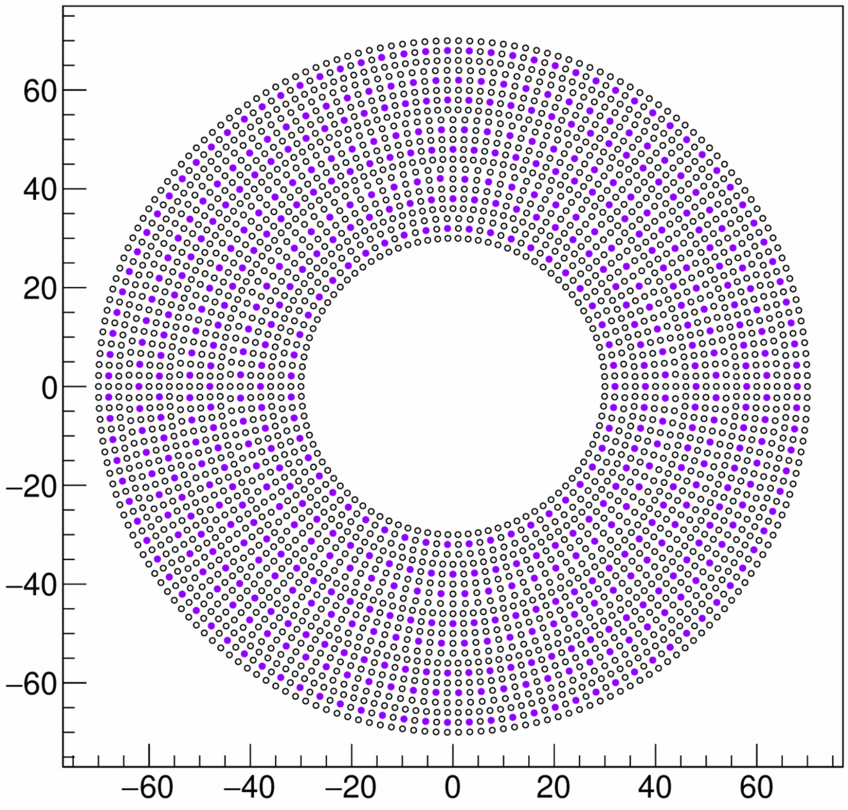
Only AlMg5 wires, no guard wires: all the structure is grounded

No ageing test: the detector will run 4 months with a maximum luminosity of 10 MHz (for the full volume)

Choice of lightest gas : He/CO_2 (80/20)

Superlayer structure: 3-5-5-5-3

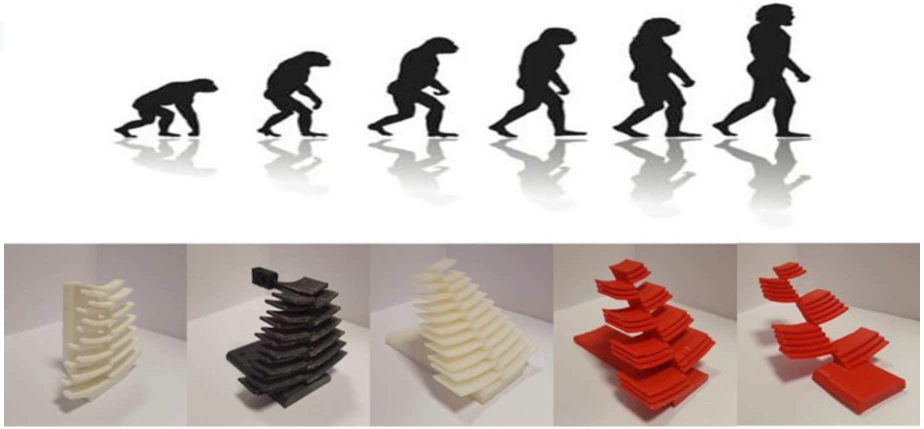
10° stereo angle



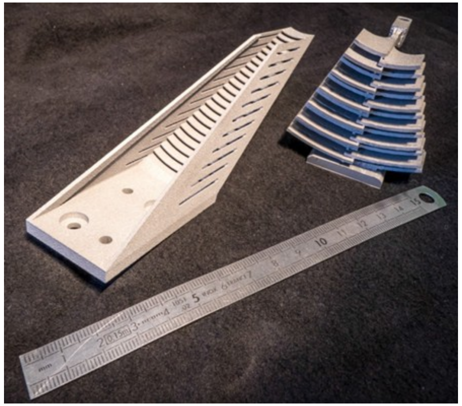
Mechanics

A modular detector 1/2

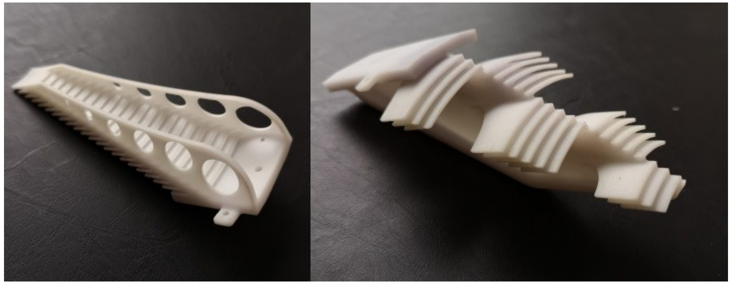
Slide from
B. Mathon



Evolution of the design of plastic printing FDM



3D printing in Aluminum and Titanium



VisiJet M2 RWT with the printer
ProJet MJP 2500 plus

Smoothering with Ultradur powder

A modular detector 2/2

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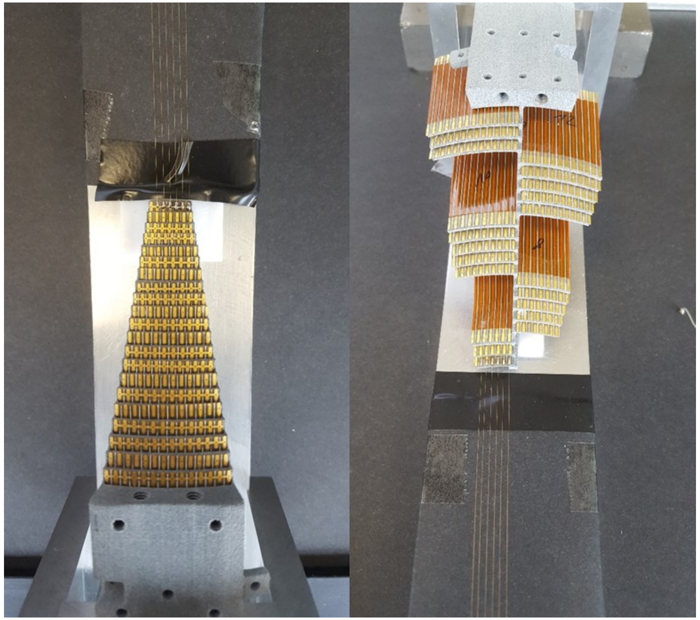

Soldering tests from elements printed in Ultradur and respecting the stereo-angle

Results:

Distortion or melting of the ABS during soldering.
Distortion of Ultradur too large due to the wire tension

Each time a wire is added the previous one loosen

Not possible to use elements in metal as it requires insulation.

Hard to place precisely the Kapton

Feedthroughs

No prior knowledge get in touch with a team from Japan (Shoji Uno for Belle II) and from ILL

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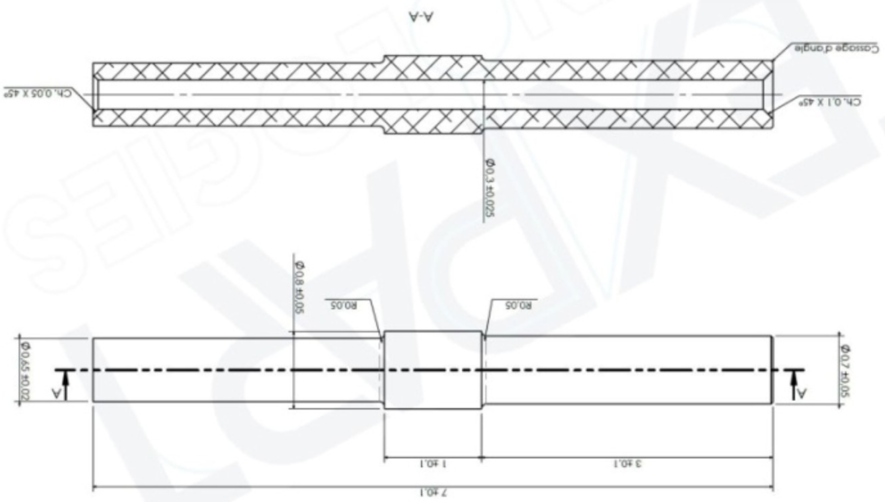
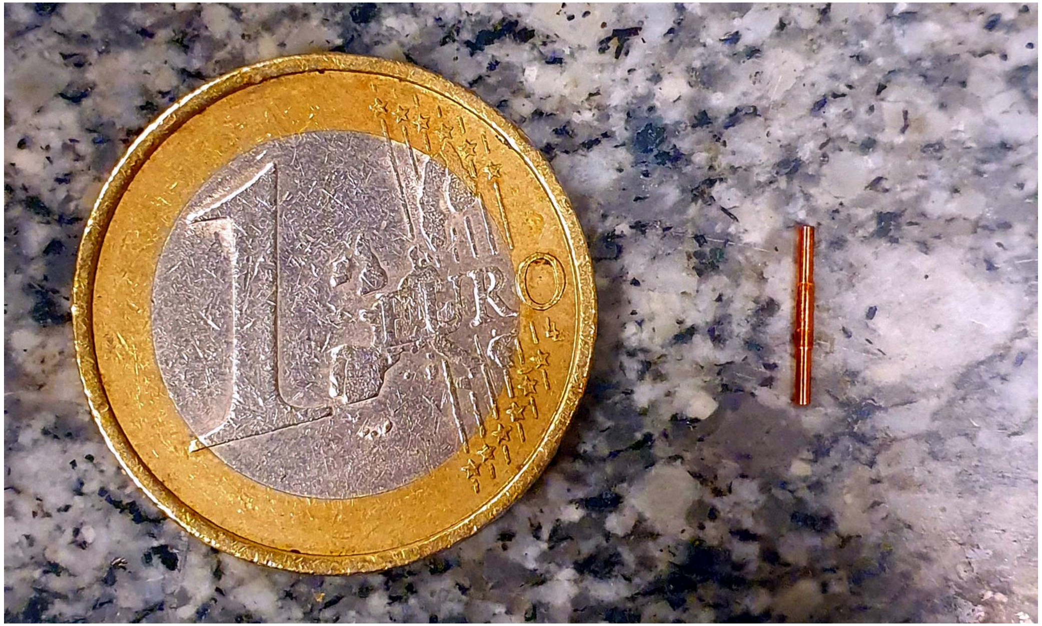


Design our own feedthroughs:
- symmetrical to ease the mounting
- aluminum for the downstream part
- copper for the upstream part



Tools for mounting

Clamp largely based on design from ILL

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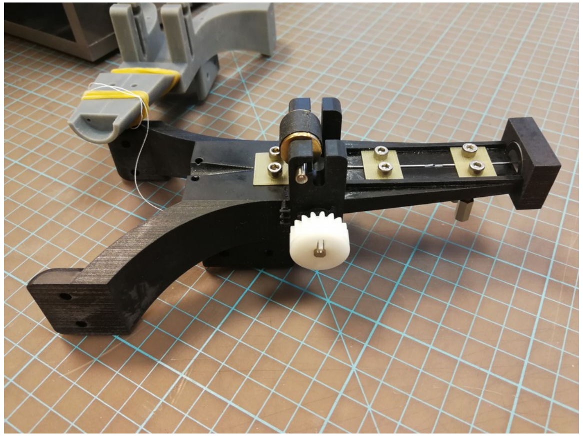
Clamp design based on data from ILL

Always close the same way (opens at the end of the hand closure)



Insertion assist: many things to align to insert the wire, too long

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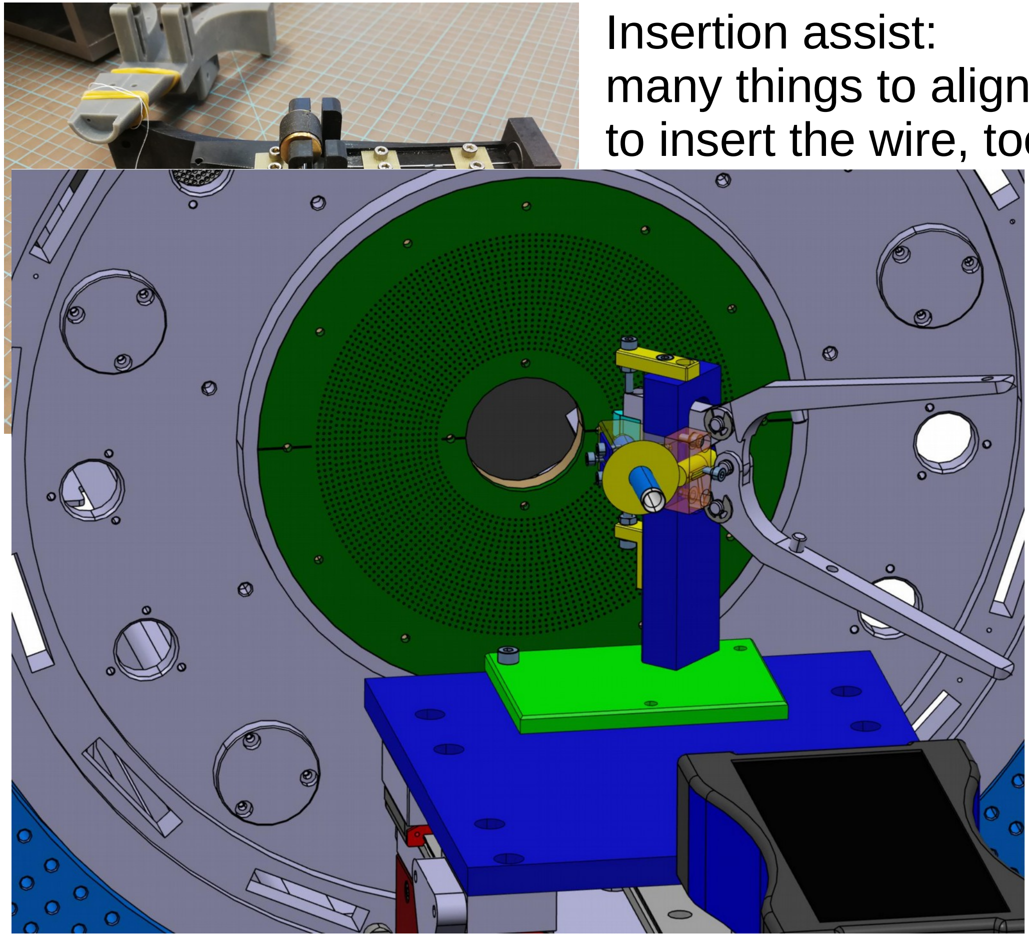
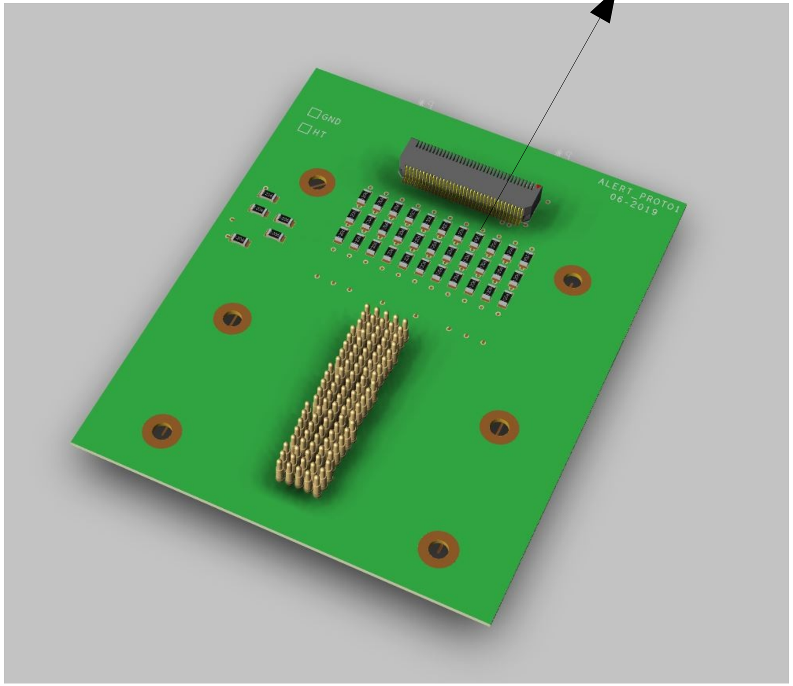
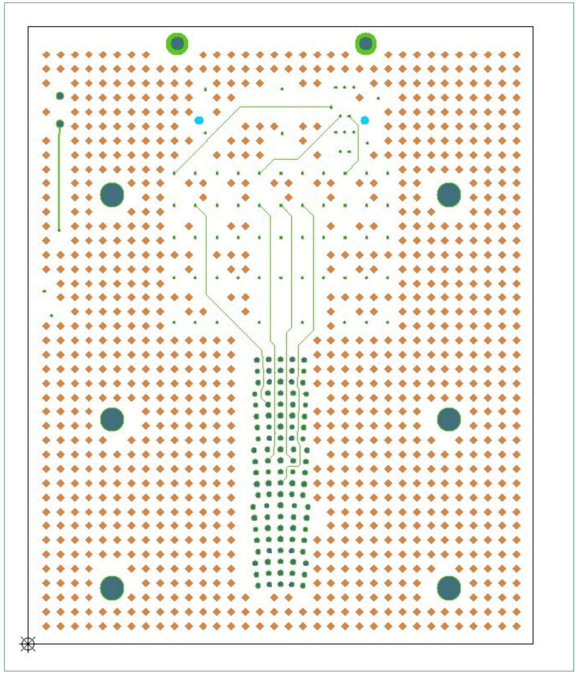


Electronic boards

First prototype

To DREAM electronics from CEA Saclay





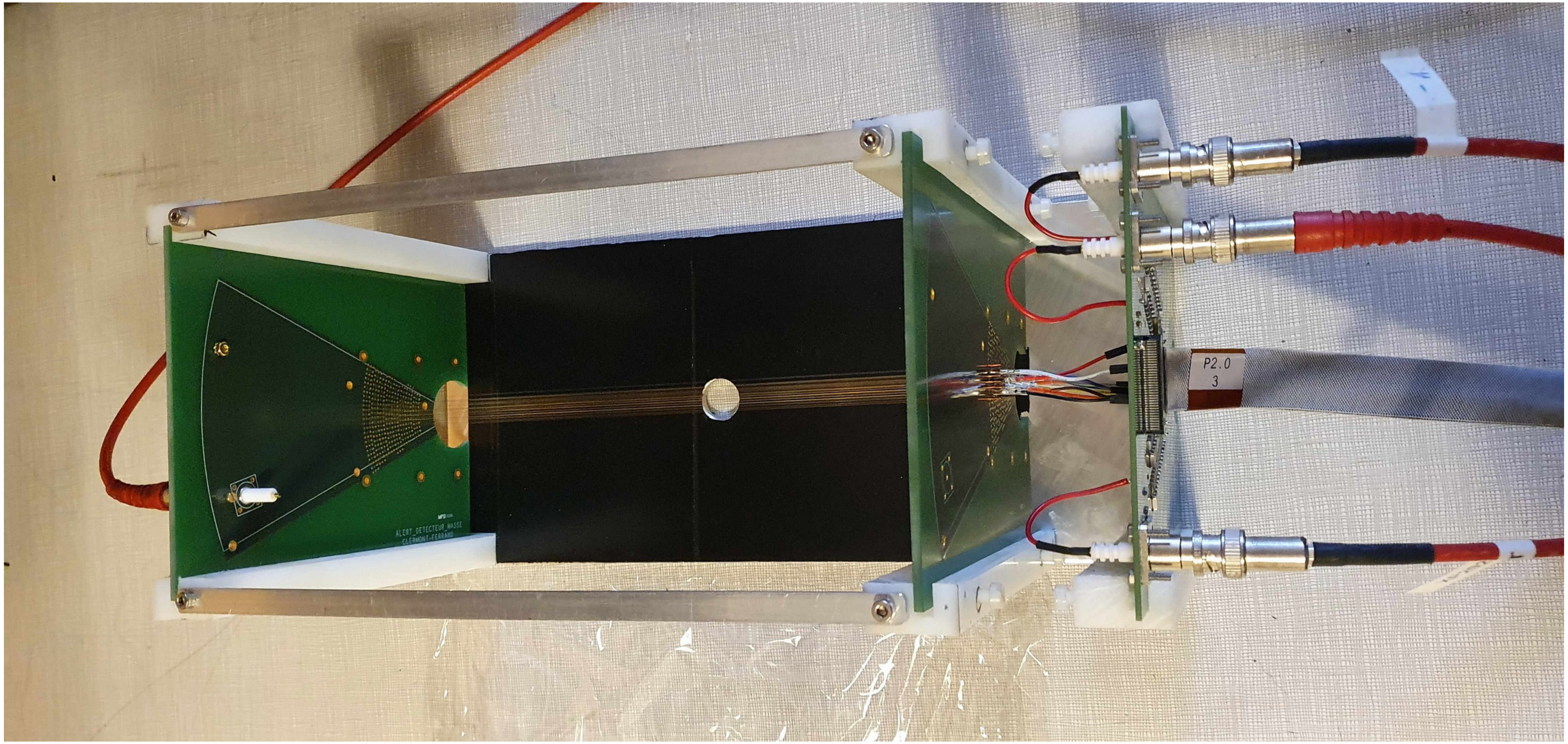
0.7 mm for 2 kV
→ discussions with P. Boyer from Würth Elektronik France, some PCBs hold 30 kV/mm

As soon as a slight pressure is put on the PCB, counting rate saturates (even just trying to screw it)

6 layers PCB, decoupling elements as read channels are polarized (2000 V max)

Second prototype

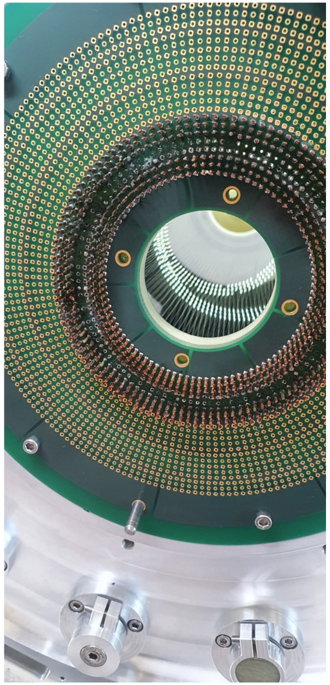
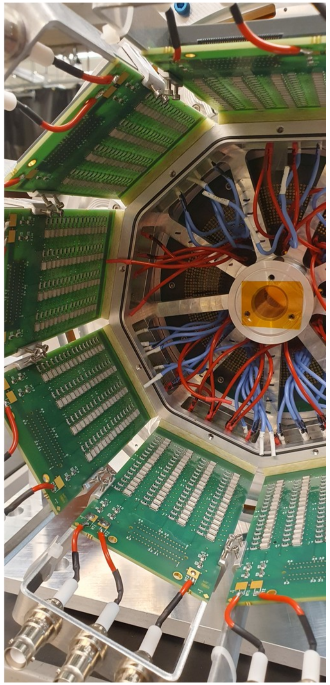
Pins PCB is separated from readout PCB. Works fine, very stable and brought to test at ALTO facility (Orsay, France)

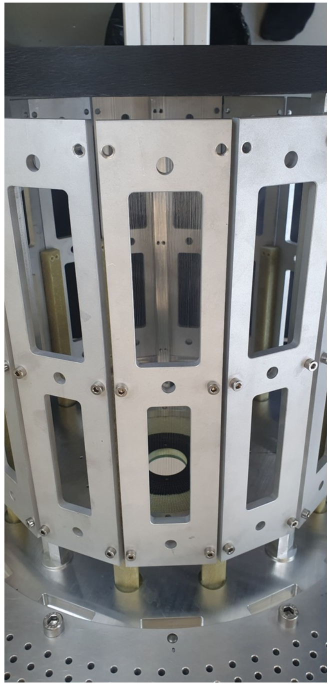


But seems impossible to connect all the jumper cables positionned this way

Third prototype

800 wires mounted on a full size detector
All AlMg5 wires (as planned for the final detector)



Some problems but no showstopper

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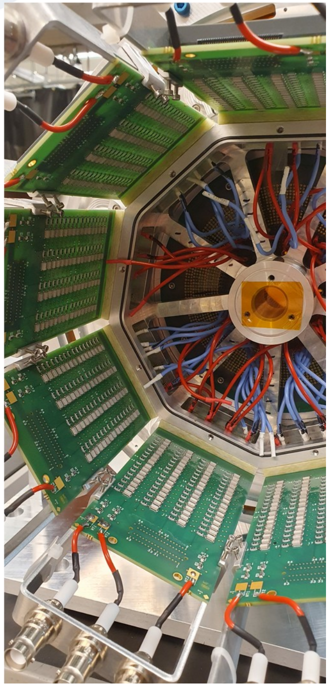


Still seems impossible to connect all jumper cables

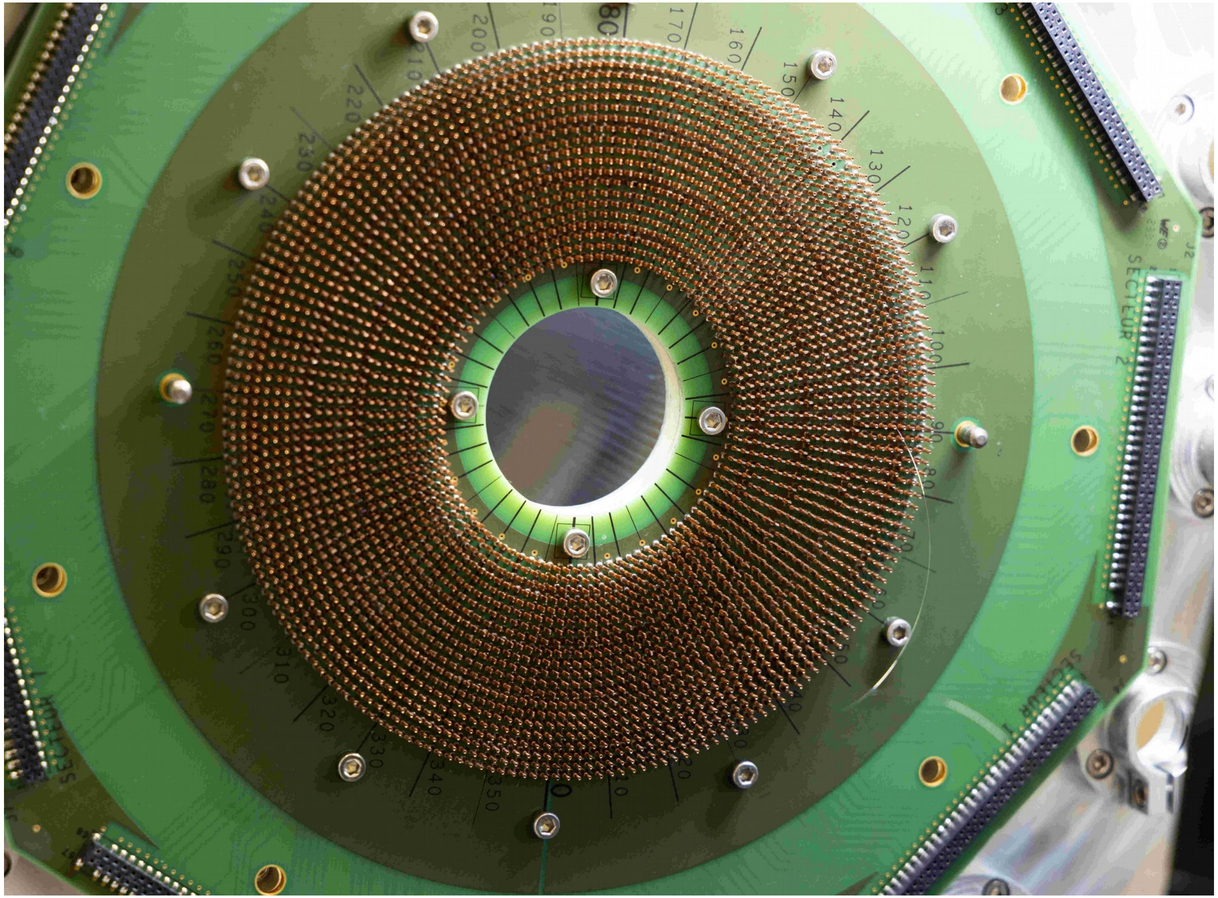
Problem with the quality of AlMg5 wire

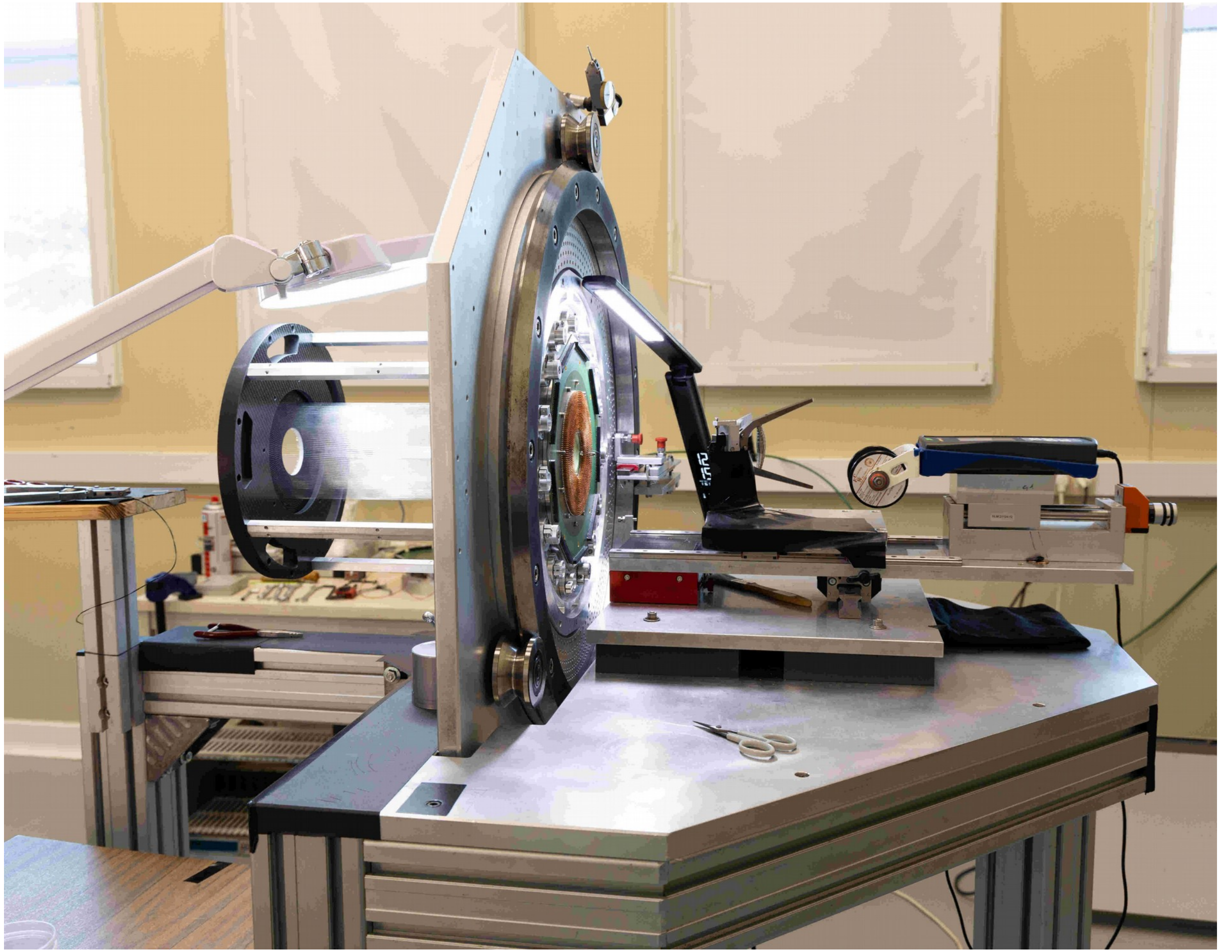
In the mean time, learn the source of the saturation of the electronics: humidity is guilty. **Clean the PCB, dry it, then insulate with the properb spray and it is stable even in humid conditions**

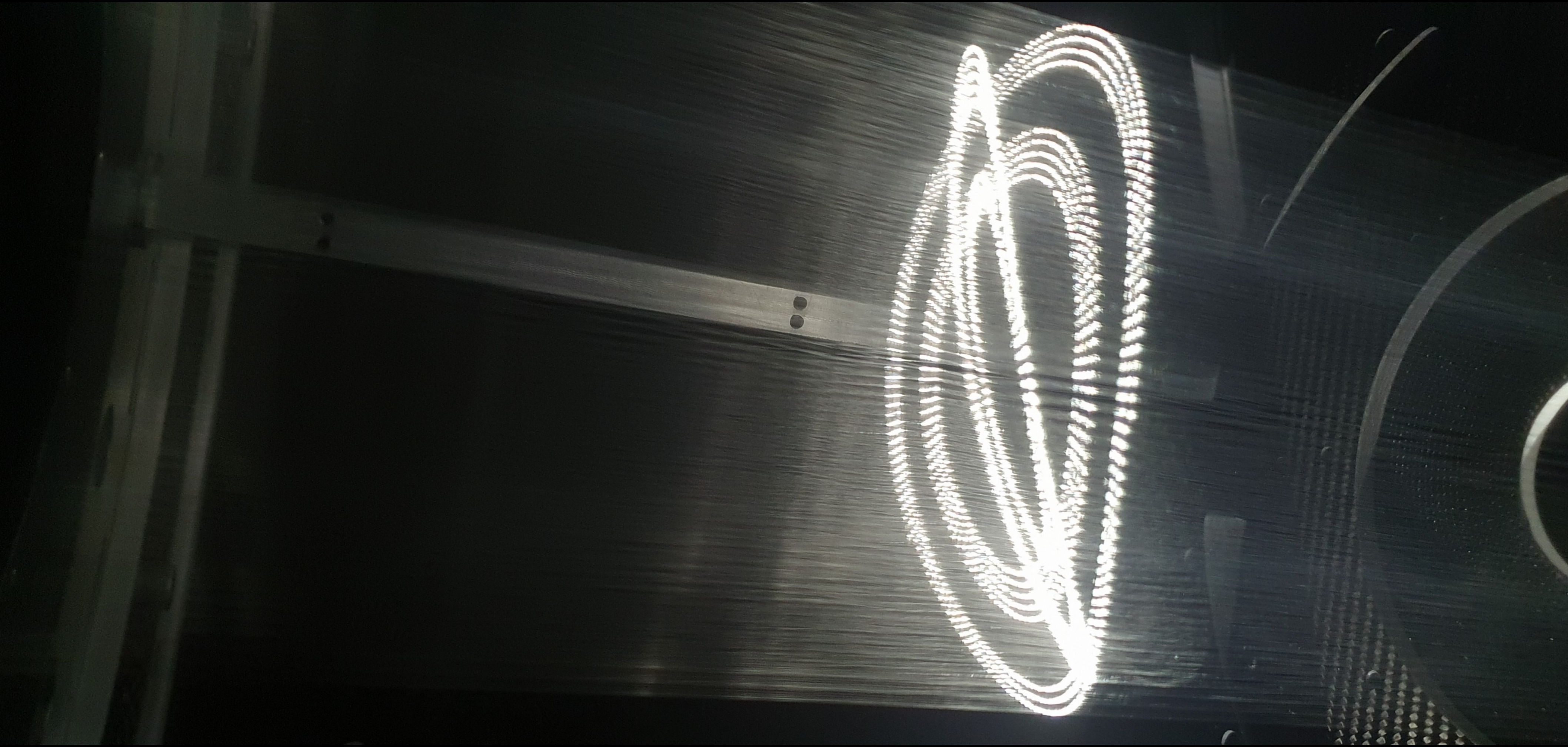
So… start a new design from the old design (after many tests on the previous prototypes of course)

ALERT
HDC

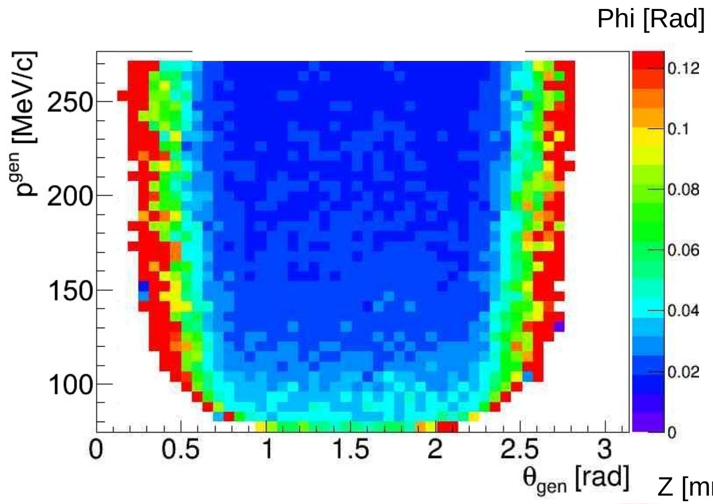
Fourth, and final, design

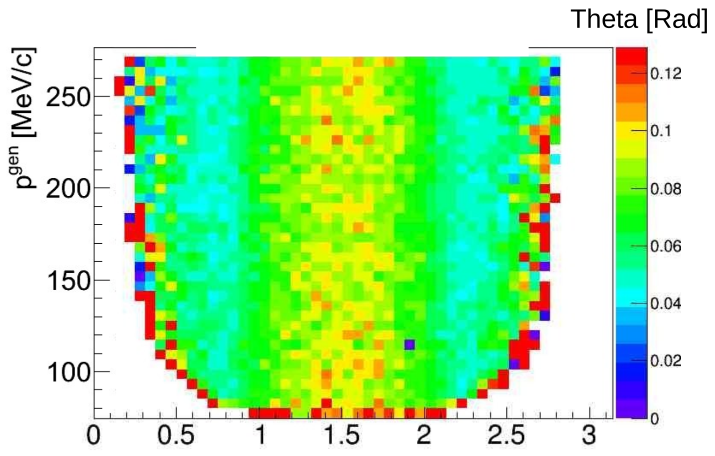






Backup slides


Phi [Rad]
p^{gen} [MeV/c]
θ_{gen} [rad]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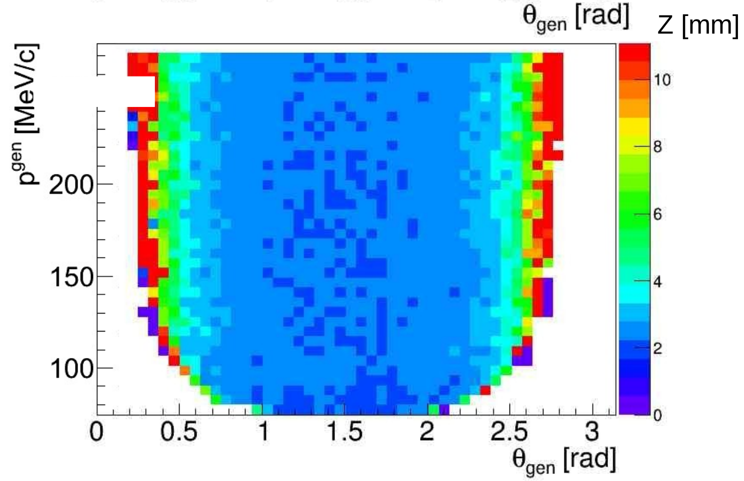
Z [mm]
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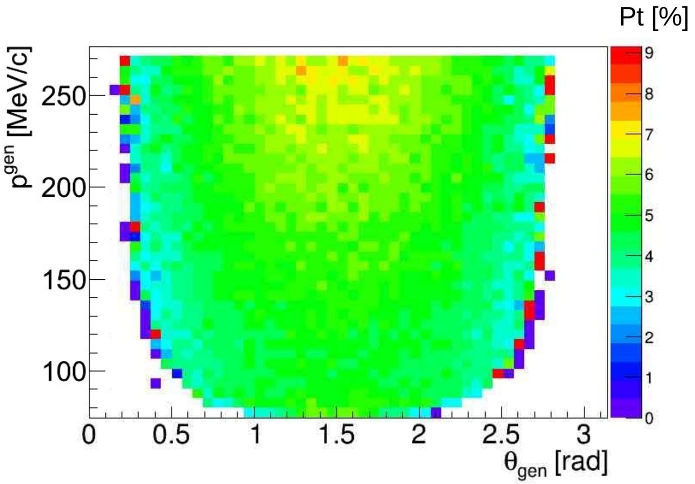
Pt [%]
p^{gen} [MeV/c]
θ_{gen} [rad]

Scintillators from ANL

Thomas P. O'Connor, Whitney R. Armstrong, Zein-Eddine Meziani *et. al*