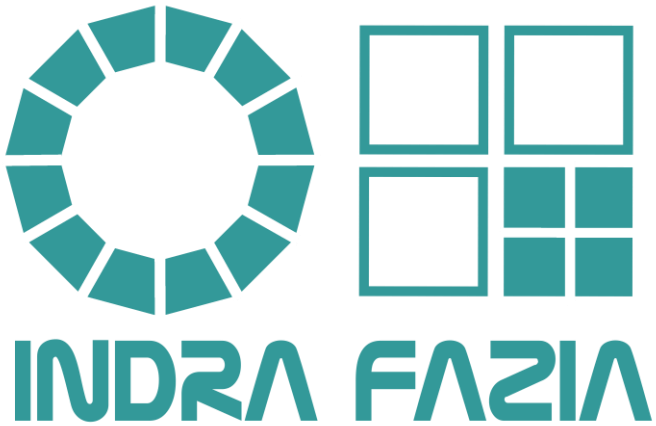
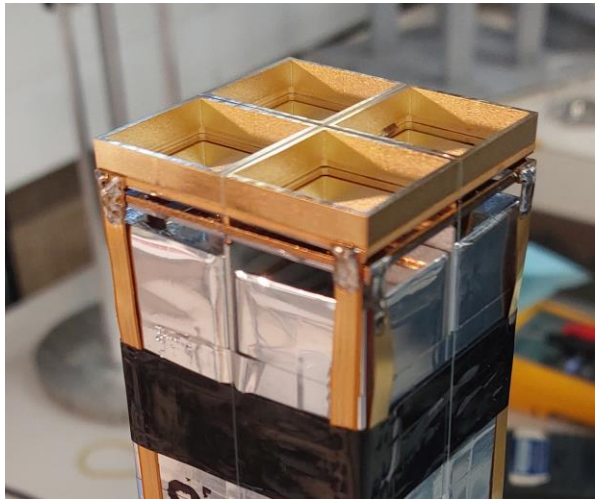
INDRA/FAZIA upgrades

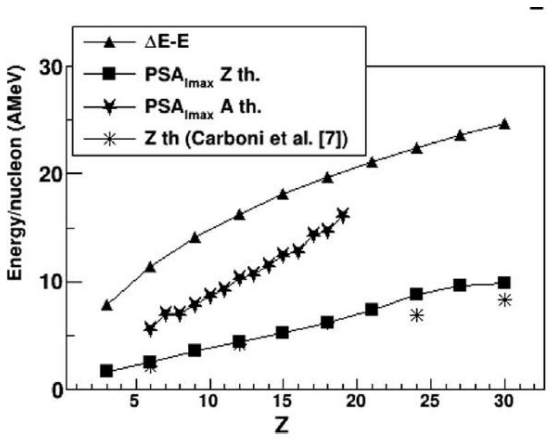


Nicolas Le Neindre
GANIL Community Meeting October 14-16th 2024

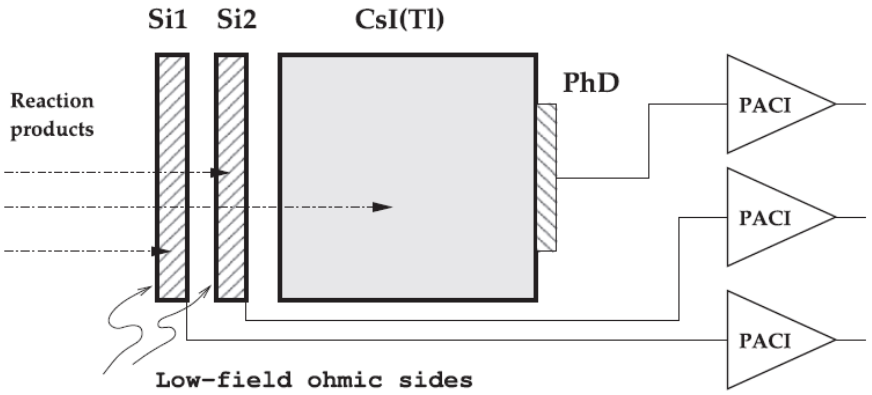
Thin silicon (~30 µm) as first stage of FAZIA telescope

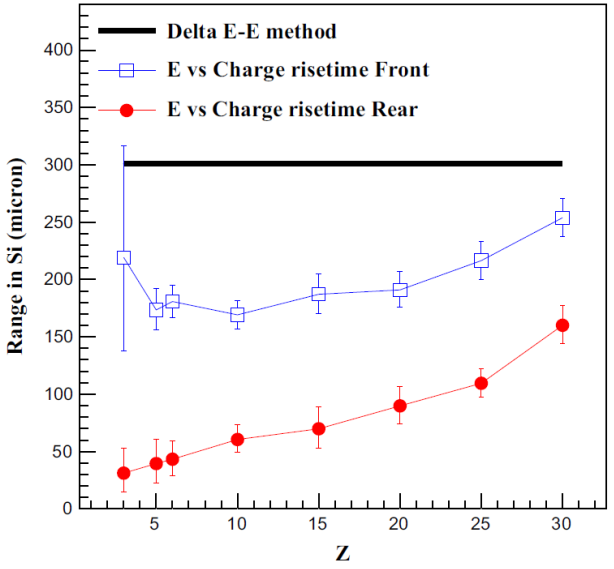


Standard FAZIA telescope
Si1 : 300 µm
Si2 : 500-750 µm
CsI(Tl) : 10 cm



PSA to lower the thresholds
but for low E physics still
50-100 µm limit vs Z.



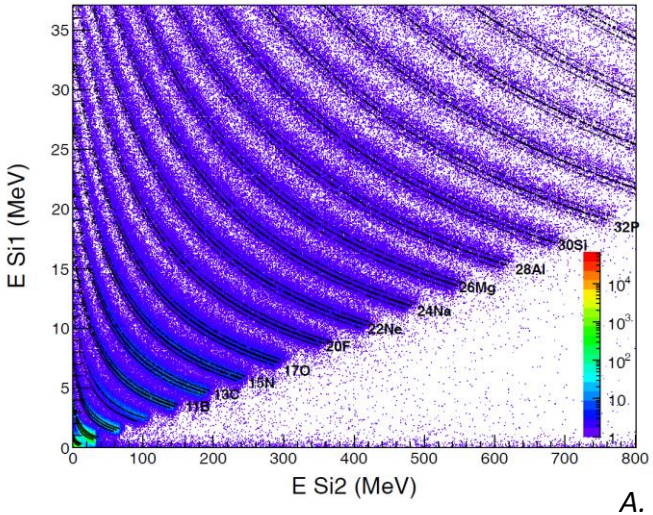


S. Carboni et al. NIM A664 (2012) 251
N. Le Neindre et al. NIM A 701 (2013) 145
G. Pastore et al. NIM A 860 (2017)b42

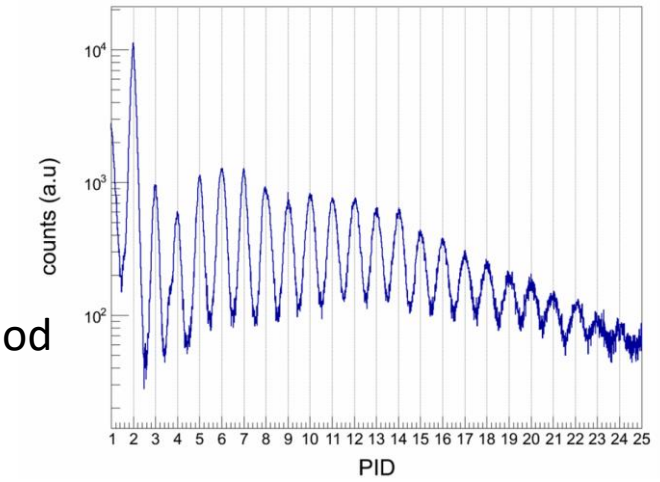
Thin silicon (~30 µm) as first stage of FAZIA telescope

If we want to still go to lower thresholds, PSA will not work!
⇒ No other solution that lowering the thickness of Si1.
⇒ ΔE-E method around ~25 µm.

We did some early tests in Catania during the commissioning phase 2014.
Epitaxial Si ~21 µm “custom made”



ΔE-E method

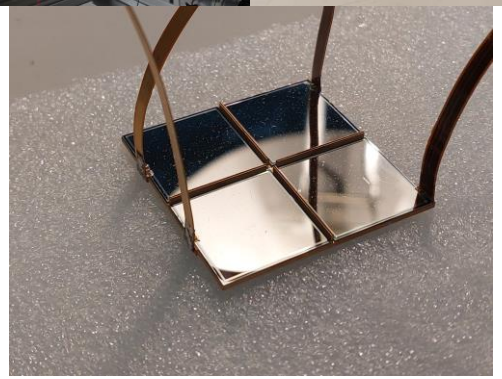


A. Kordyasz et al. EPJA 51 (2015) 15

Thin silicon (~30 µm) as first stage of FAZIA telescope

Now we go for prototypes compatible with standard FAZIA telescope
⇒ Mechanics.
⇒ Power supply and electronics.
Some fundings from INFN, detectors supplied by Micron Semiconductor

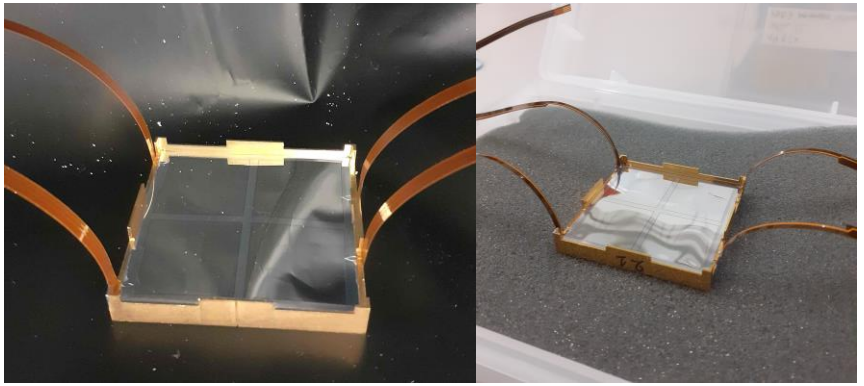
Previously one quartet was 4 x 20x20 mm single ship Si



Old

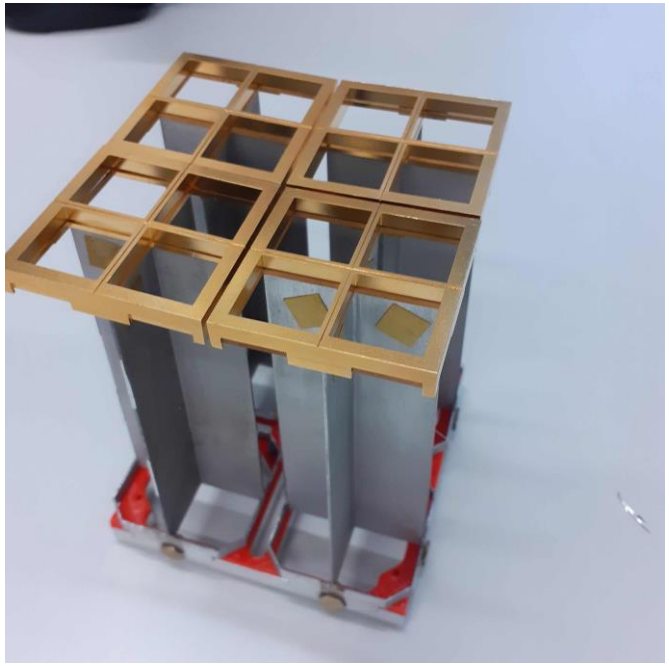
Micron went to 4 pads with compatible dimensions

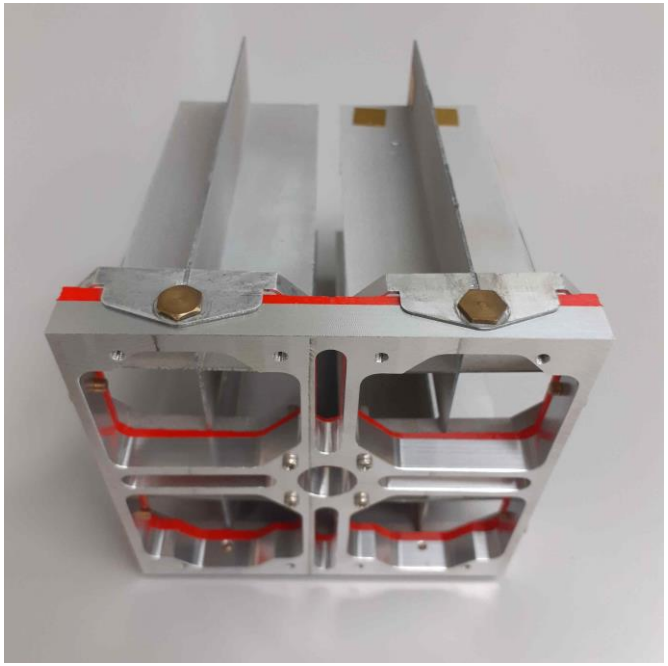
New

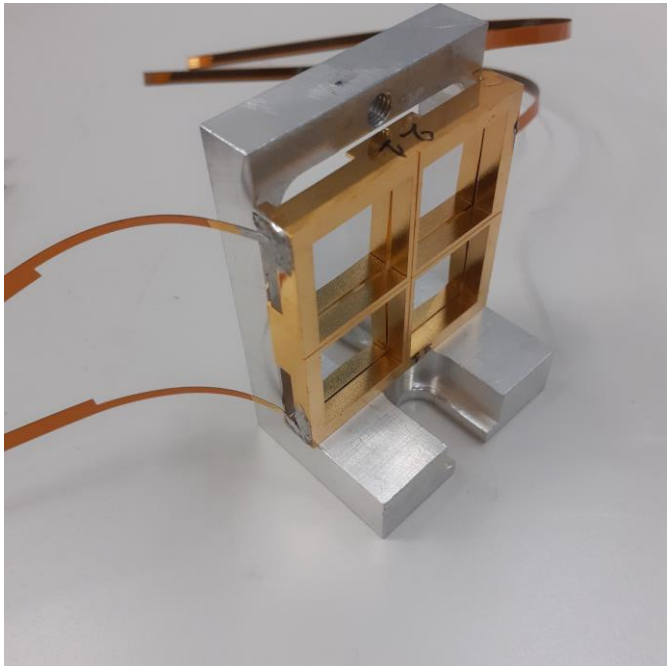


Thin silicon (~30 µm) as first stage of FAZIA telescope

New adapted mechanic to stay compatible with previous FAZIA blocks
Brass collimators, 3D printed interface…







Testing new FAZIA telescopes featuring customized ultrathin ΔE silicon stage for low-energy ion spectroscopy

Spokespersons: Lucia Baldesi, Simone Valdrè, Giovanni Casini for the FAZIA collaboration

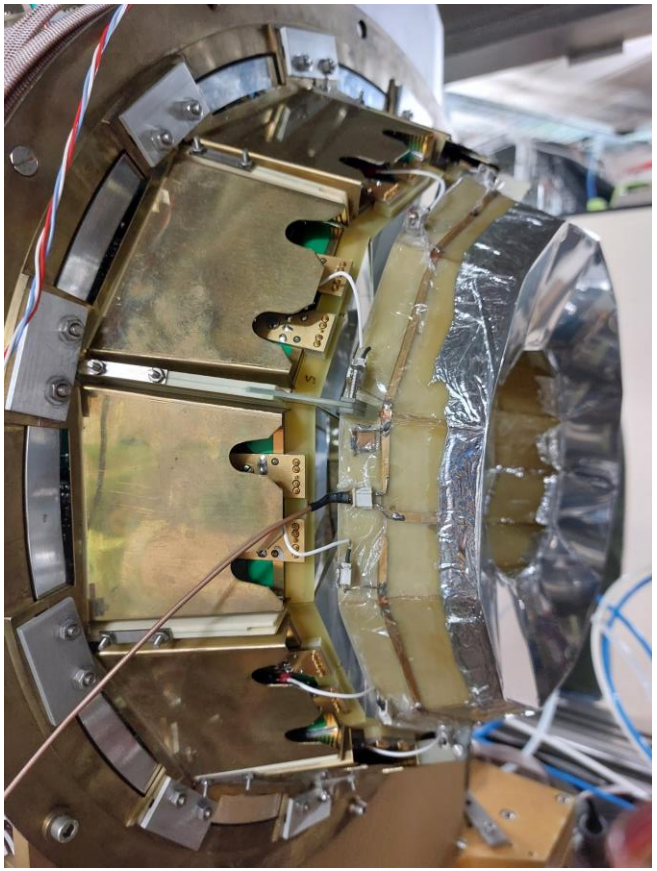
Accepted experiment in Legnaro 2024-2025

GANIL next?

TABLE I. Beam Request Summary

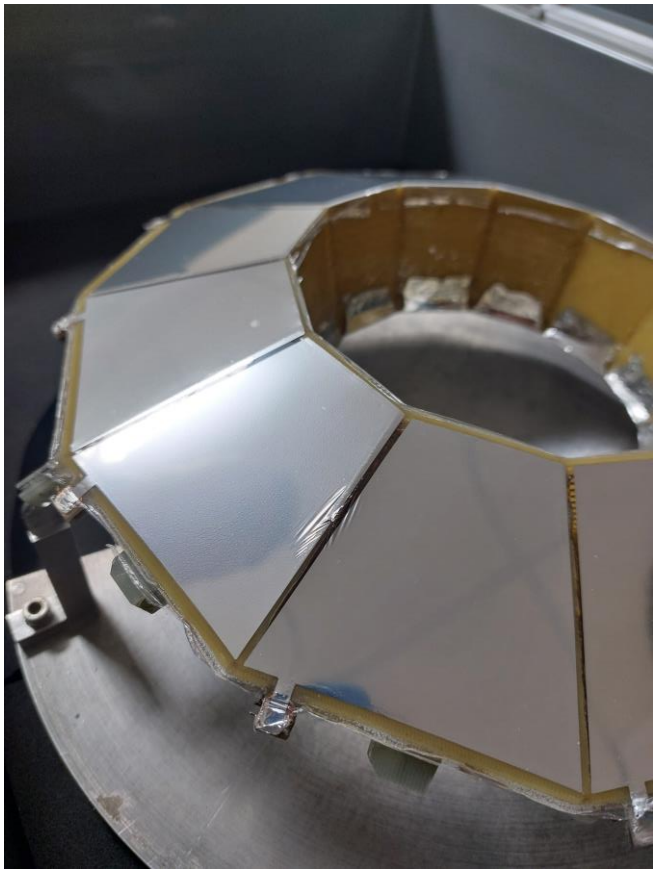
beam	target	thickness (mg/cm^2)	req. intensity (pnA)	Energy (MeV)	days
^{32}S	^{48}Ti	0.5	3-5	186	3

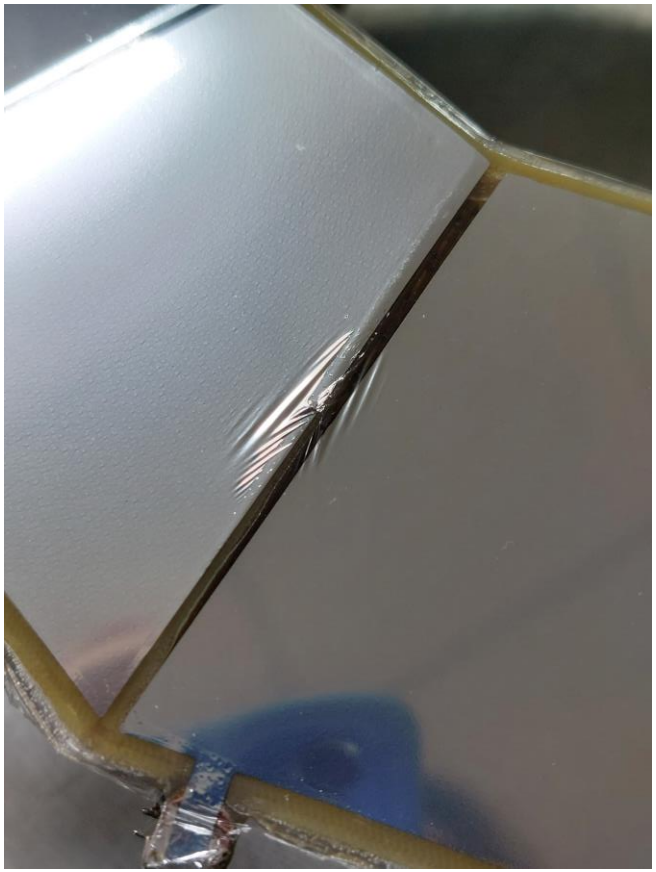
Upgrade for INDRA ionisation chamber


Chambre d’ionisation (ChIo): original concept from the 90’s, very fragile and difficult to repair.

Upgrade for INDRA ionisation chamber

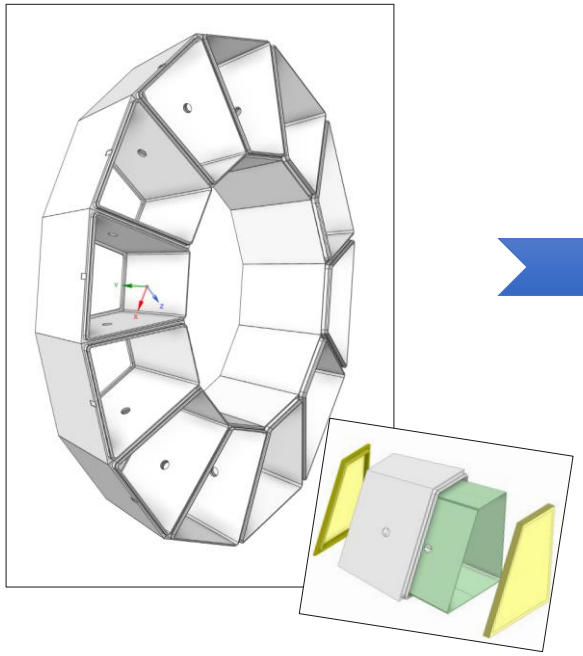


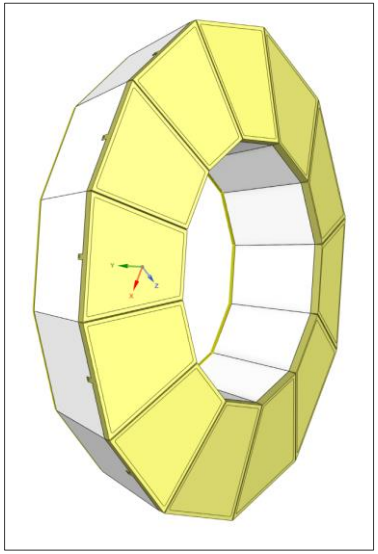


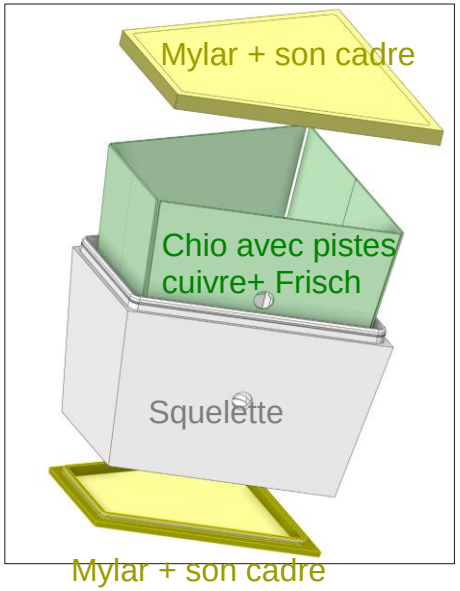
When one cell is punctured we must change the whole mylar surface of the ChIo completely!!
=>Very time consuming and not reliable.

Upgrade for INDRA ionisation chamber

Yohann Brelet
Hugues de Préaumont
Jérome Perronel
Livier Fedor



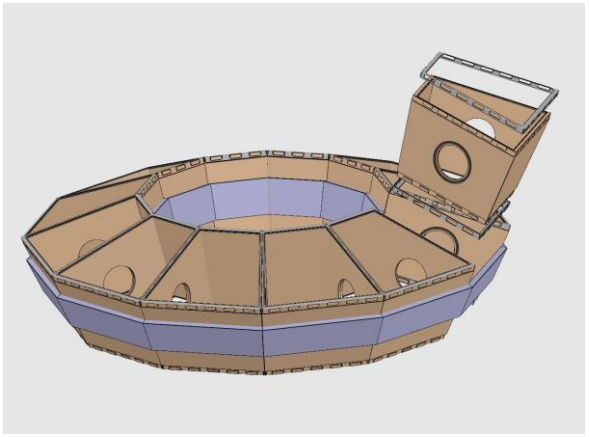


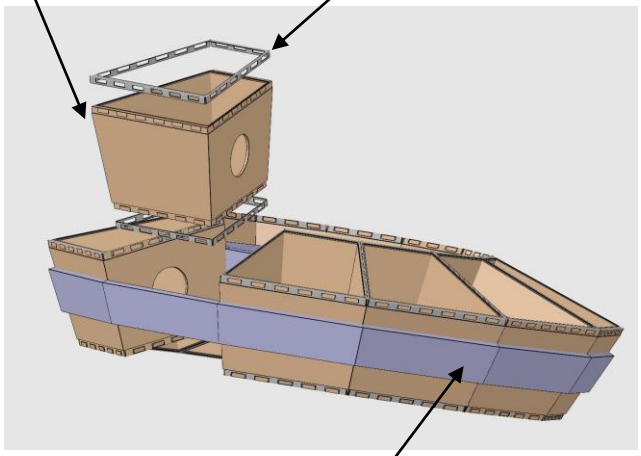


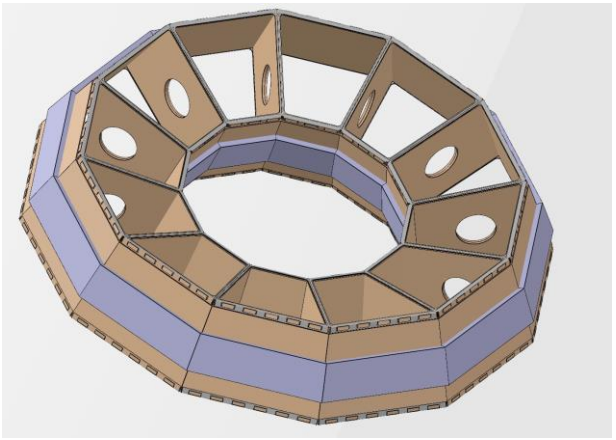
New concept: independent cells.
=> Much easy to replace, more spare.

Upgrade for INDRA ionisation chamber

Yohann Brelet
Hugues de Préaumont
Jérome Perronel
Livier Fedor



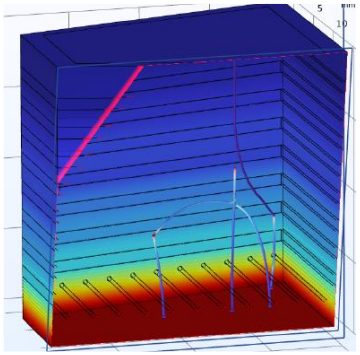


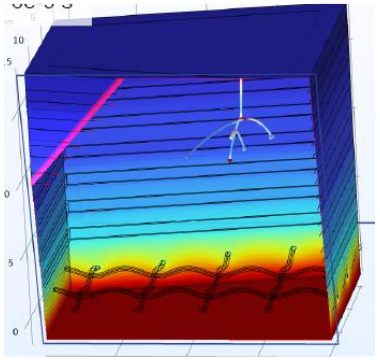


Upgrade for INDRA ionisation chamber

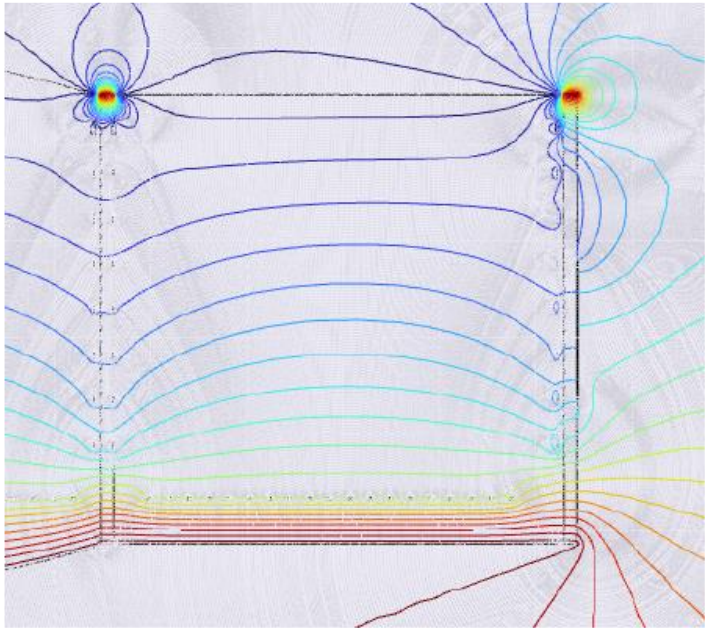
Yohann Brelet
Hugues de Préaumont
Jérome Perronel
Livier Fedor

Various configuration of Frisch's grid



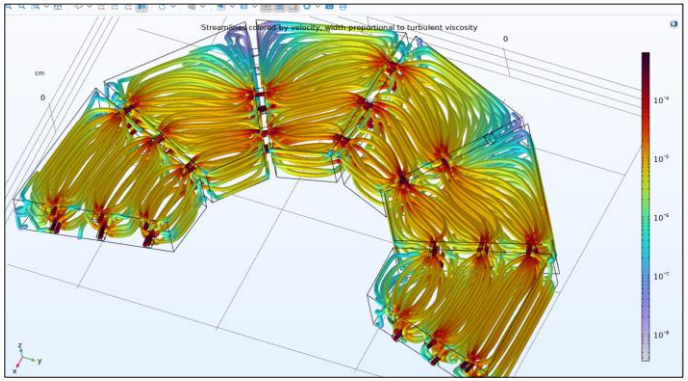


Electric field potential



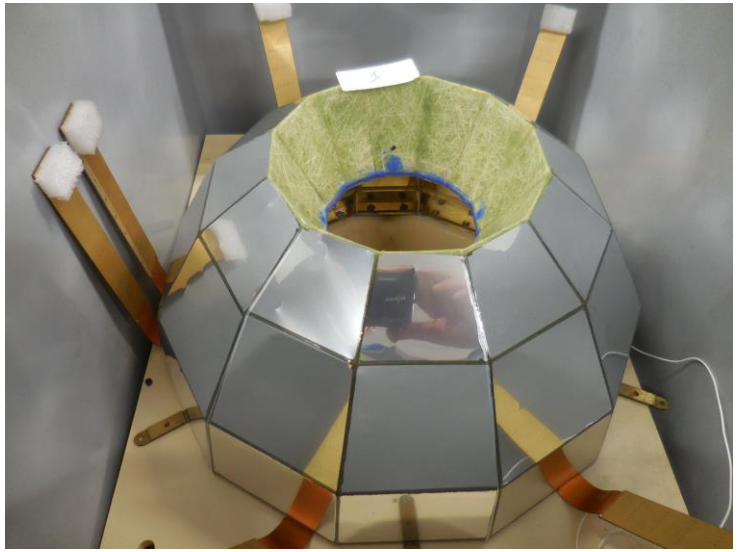
Simulations

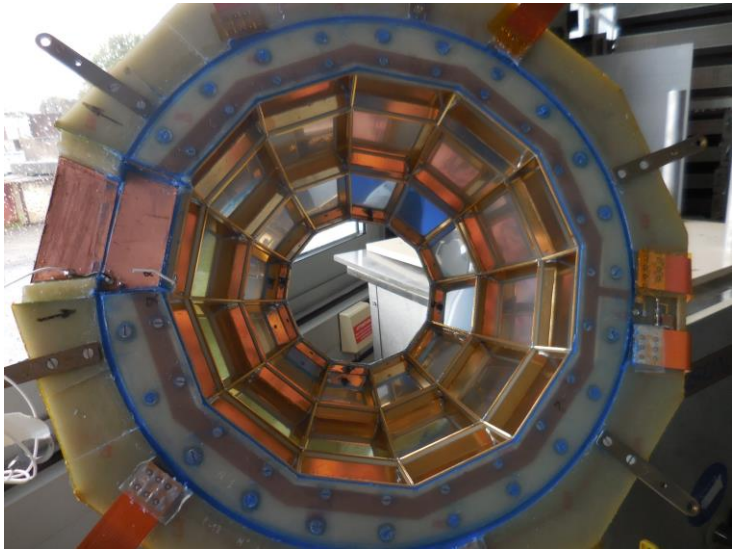
Gas circulation



Upgrade for INDRA ionisation chamber

Once we will have a good solution for the « simple » Ring 6-7 ChIo
=> What about the ChIo 8-12 (30°-90°) which is even more complicated?

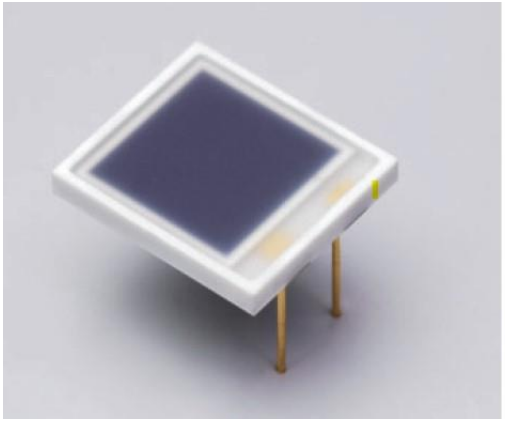




Custom made photodiodes for FAZIA CsI(Tl)

FAZIA CsI(Tl) are read by standard Hamamatsu PD s8650
but photosensitive area is only 10x10 mm².
CsI are 22.7x22.7 mm²!

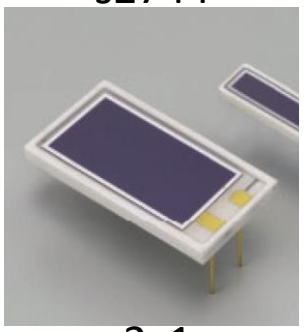
s8650



Increasing the photosensitive area

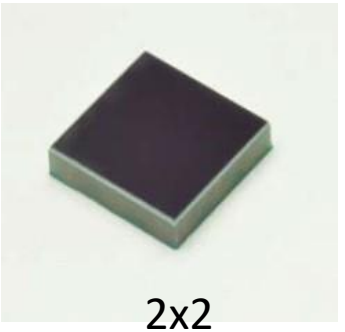
Other Hamamatsu models

s2744



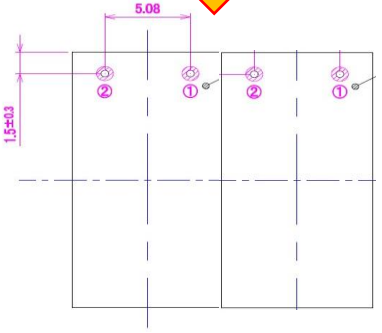
2x1

s13955

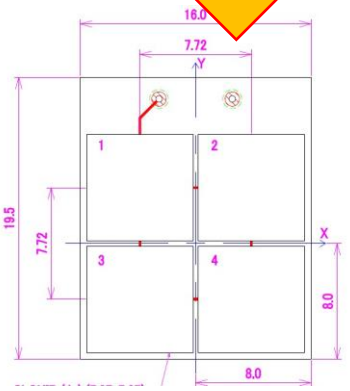


2x2

New custom made design



18.1x18.3 mm²



16x19.5 mm²

Real custom made PD 20x20 mm²
is too expensive.
=> Adapting existing one

Custom made photodiodes for FAZIA CsI(Tl)

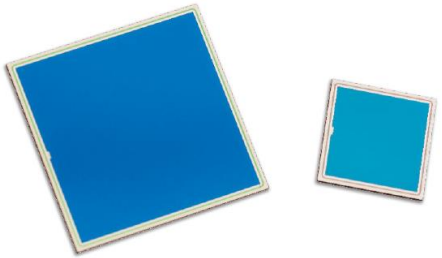
Similar solution by

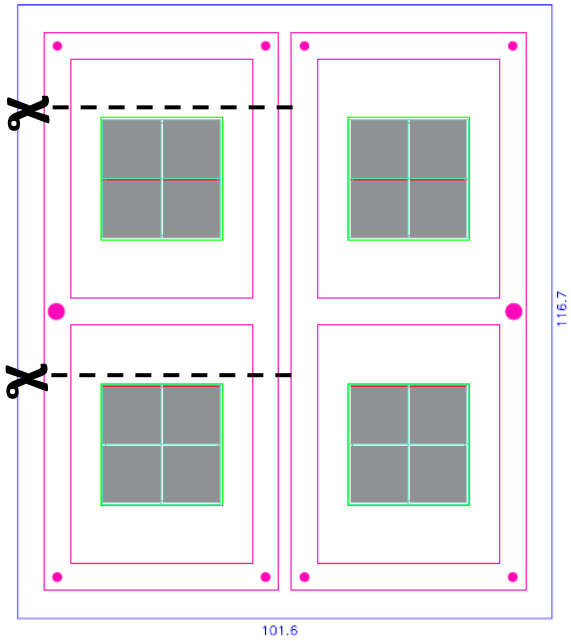
EXCELITAS® TECHNOLOGIES

Datasheet
Photon Detection

VTH21xx series Silicon Photodiodes

Silicon Photodiode for Alpha Particle Detection





Cheap photosensors 10x10 mm², 10.5 € for bare one
But 3 companies to produce the final product:
- 1st co. Excelitas for bare sensors.
- 2nd co. Aurel, mounting on PCB connectors.
- 3rd co. WatAJet, cutting the PCBs.

Total cost ~37 k€ for 200 pieces.

Summary

- Development of new very thin (~30 µm) silicon detectors for FAZIA for low energy physics (Spiral 1-2, LNL, Fraise at LNS…)

- INDRA ionisation chamber upgrade for more reliability.

- FAZIA custom made photodiodes, better light collection, better efficiency.

Not discussed today!

- Silicon detectors of various thickness 100, 300, 500, 675 and 750 µm.
- New updated Front End Electronics card.