Update on Gaspard/Hyde
Presente status and perspectives

I. Martel,
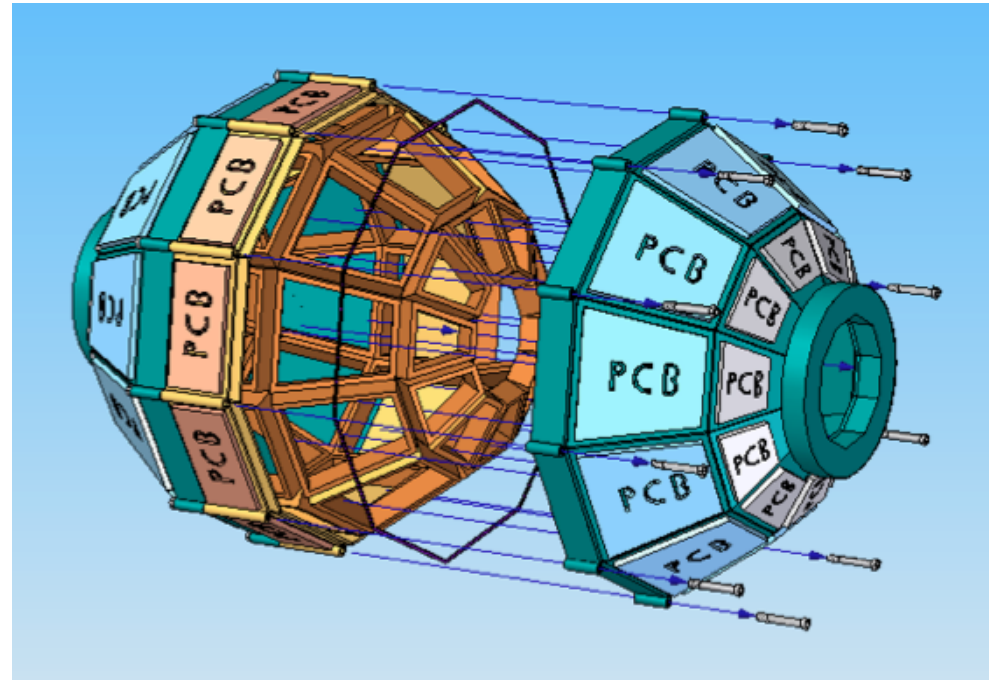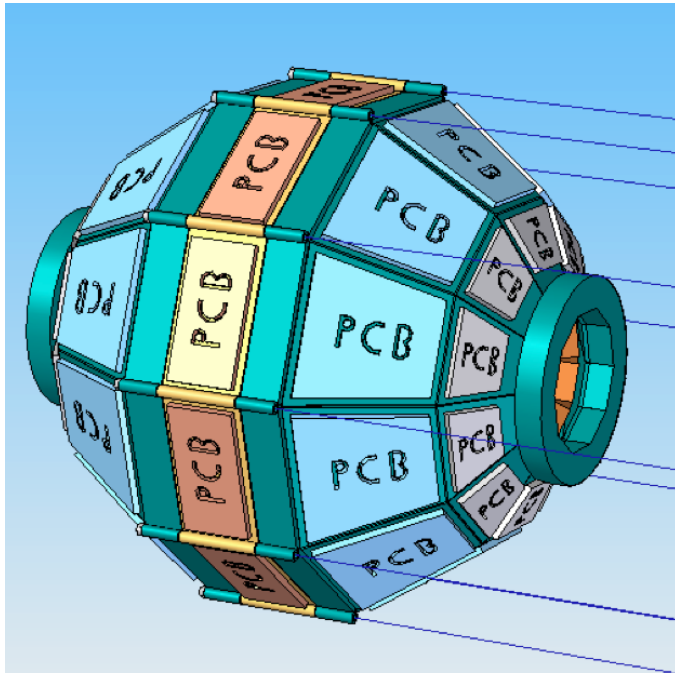
For the HYDE-GASPARD collaboration.

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Direct nuclear reactions for spectroscopy & dynamics at Spiral2/FAIR
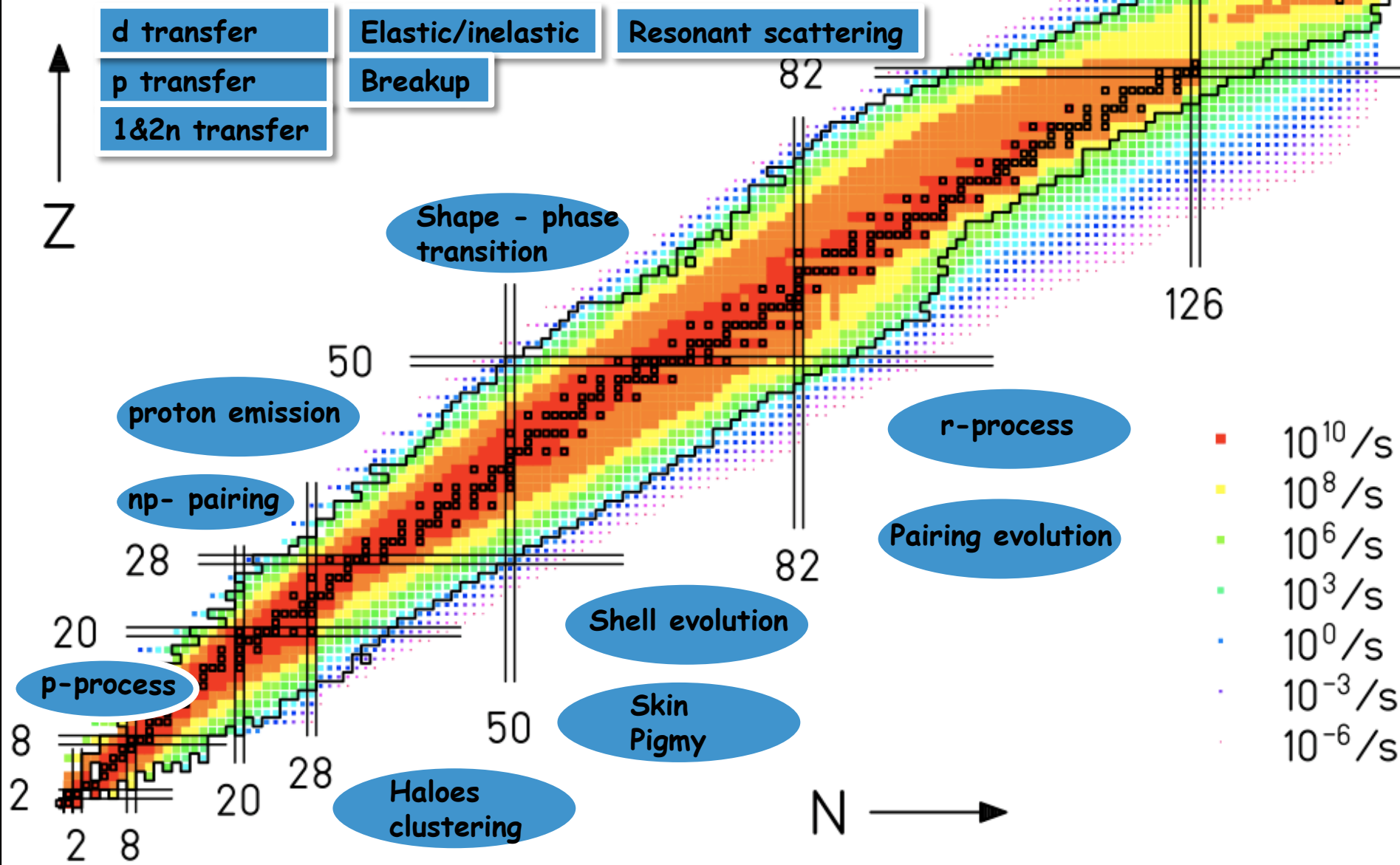
Mechanical design of HYDE

Characteristics:

~ 4 PI ARRAY
- Detection of charged particles.
- Particle ID using PSA , DE/E and TOF.
- Energy & angular resolution (< 150 keV, 1°/0.1°).
- Large multiplicity (> 3)

Construction:
- Chamber < 380 mm diameter
- 49 DETECTOR CELLS
- 3 different shapes: square + 2 trapezoids fitting 4" wafer.
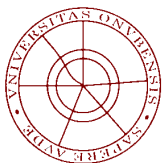- Cylindrical symmetry/10 sides

Mechatronics
- FFE on air
- 31.360 channels
- High density feedthroughs
- Multiplexing.

I. MARTEL, Univ. Huelva

Detector cell (Silicon)
- 4 inches, NTD silicon wafers
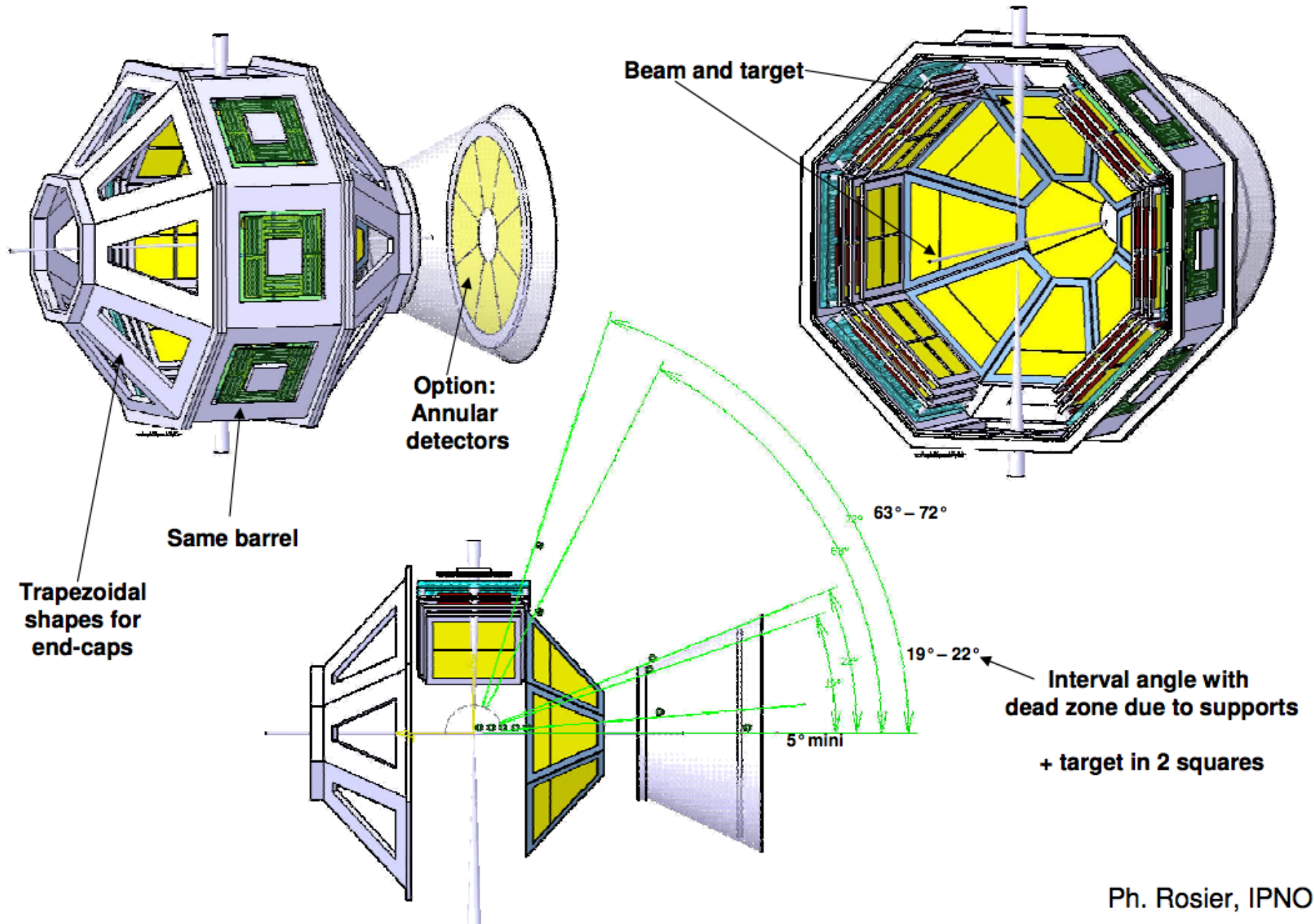- Strip size 0,4 mm, Multilayer (5 layer)

Design constraints:
- Subsystem of AGATA array
- Use at other RIB facilities (SPIRAL2, HIE-ISOLDE, LEGNARO-SPES)
- Modularity and portability

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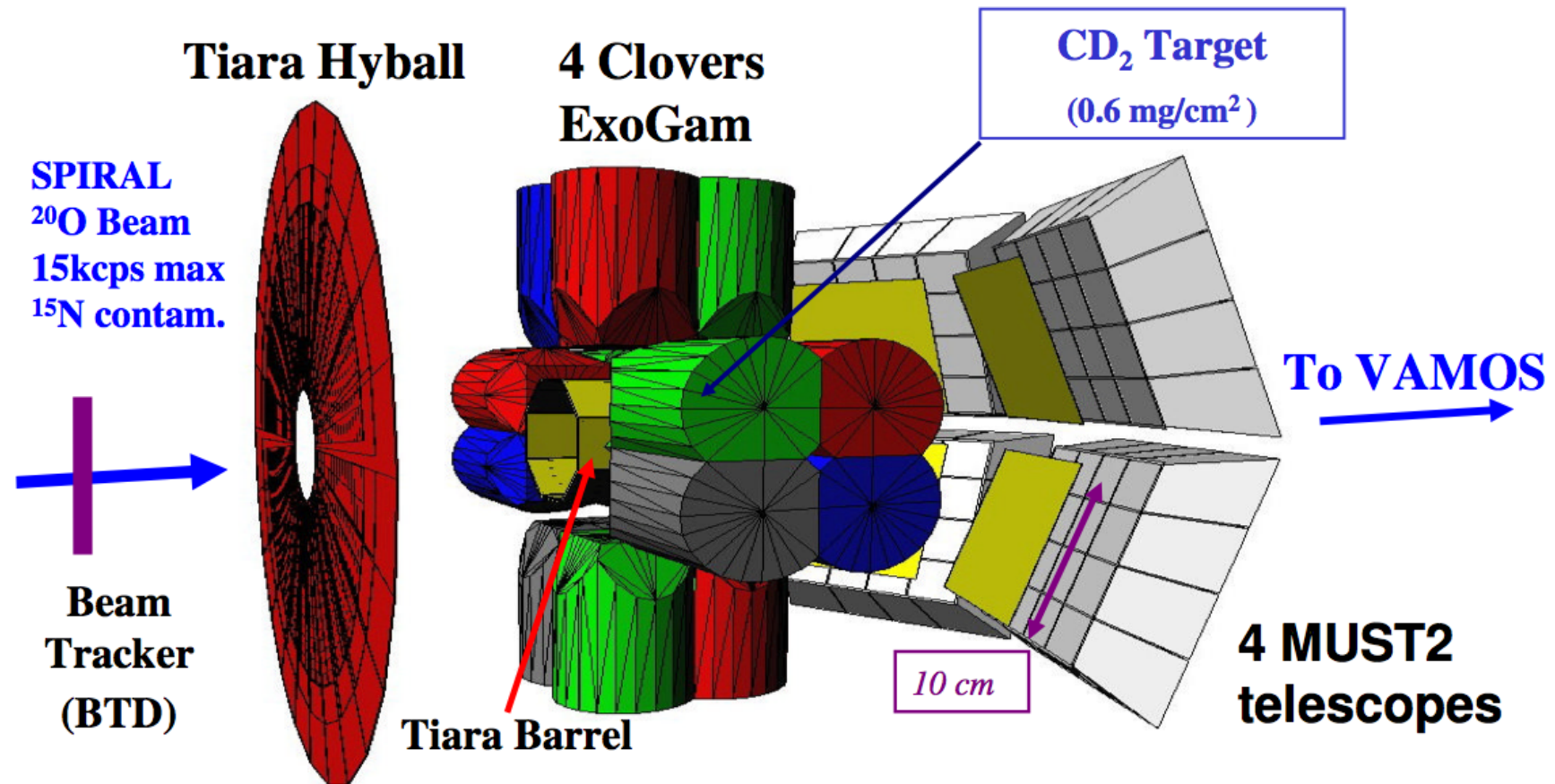# Towards a "GaspHyde" proposal

Beam and target

Option: Annular detectors

Same barrel

Trapezoidal shapes for end-caps

63° – 72°

19° – 22°

5° mini

Interval angle with dead zone due to supports

+ target in 2 squares

Ph. Rosier, IPNO

Limitations of the combined setup

A currently used combined setup:

Tiara Hyball

4 Clovers ExoGam

CD$_2$ Target (0.6 mg/cm^2)

SPIRAL
^{20}O Beam
15kcps max
^{15}N contam.

To VAMOS

Beam Tracker (BTD)

Tiara Barrel

10 cm

4 MUST2 telescopes

> Low efficiency for gamma-rays (5-10%)
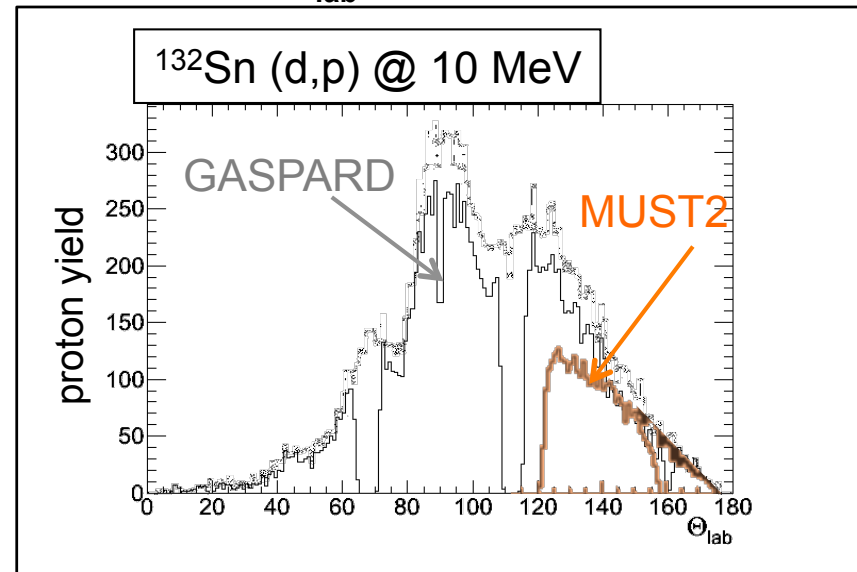> No flexibility to insert cryogenic target

Importance of angular coverage

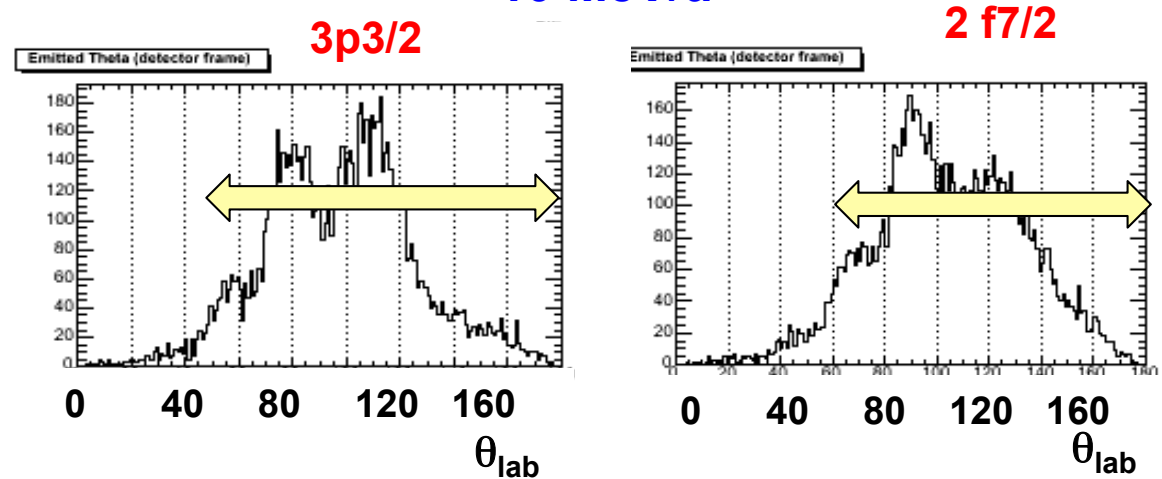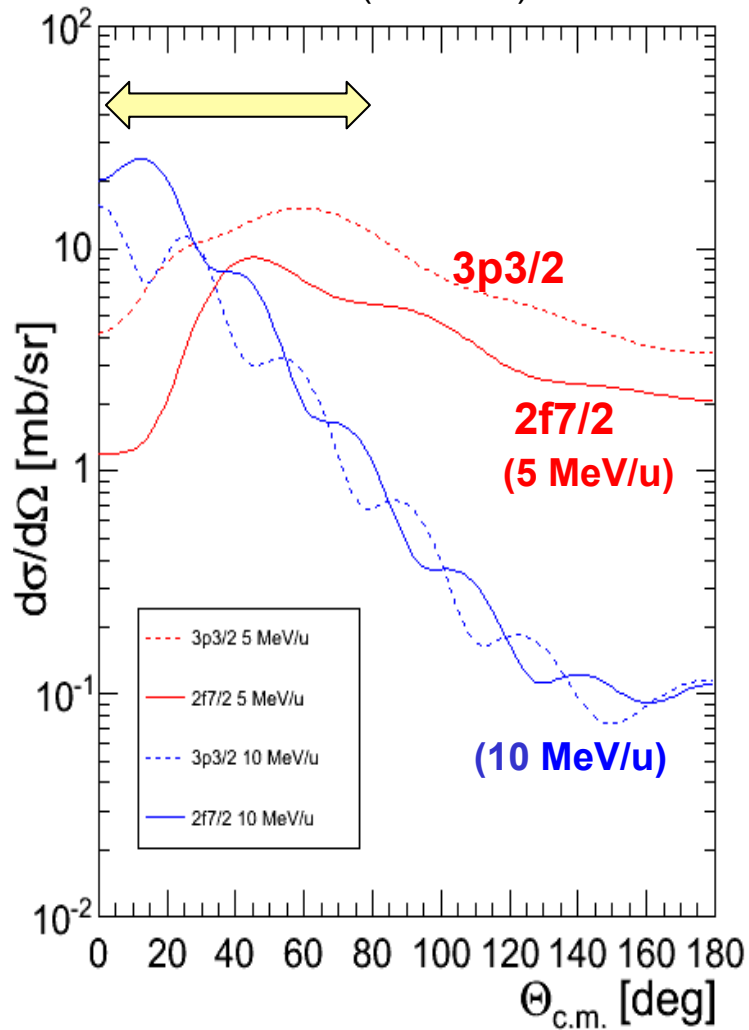*Simulations for $^{132}Sn(d,p)^{133}Sn$*

YIELDS

CROSS-SECTIONS
FRESCO (ZR-FRC)

N. de Séréville, IPNO

10 MeV/u

3p3/2

2 f7/2

^{132}Sn (d,p) @ 10 MeV
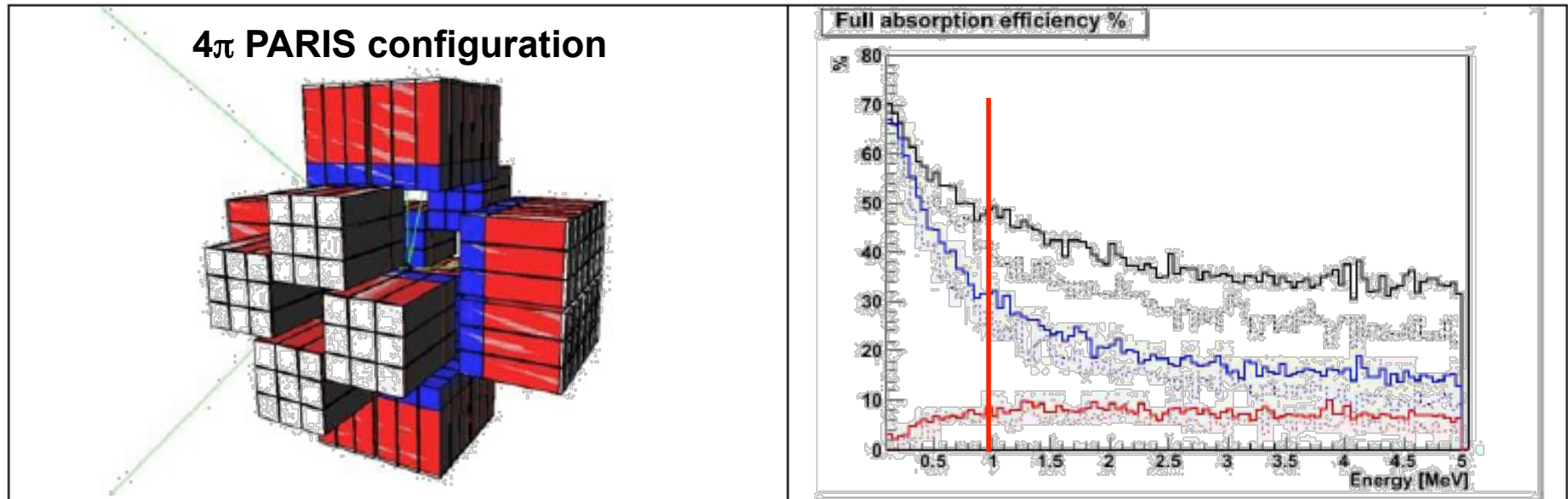
The GASPARD array : Gain in efficiency

GAmma SPectroscopy and PArticle Detection

4π silicon array fully integrable in PARIS, AGATA

4π PARIS configuration

Efficiency gain ~20 for p-γ coincidences for ^{132}Sn(d,p) @ 10 MeV/u w/r to previous MUST2 + EXOGAM setup

Resolution: ~40 keV at 10 MeV/u with 2mg/cm^2 CD2 target

Large improvement in particle/gamma efficiency

The CHyMENE H/D windowless target
Cible d'HYdrogène Mince pour l'Etude des Noyaux Exotiques

Spokeperson: **A. Gillibert** coll: **CEA/IRFU Saclay, CEA/DAM Bruyères, IPN Orsay**
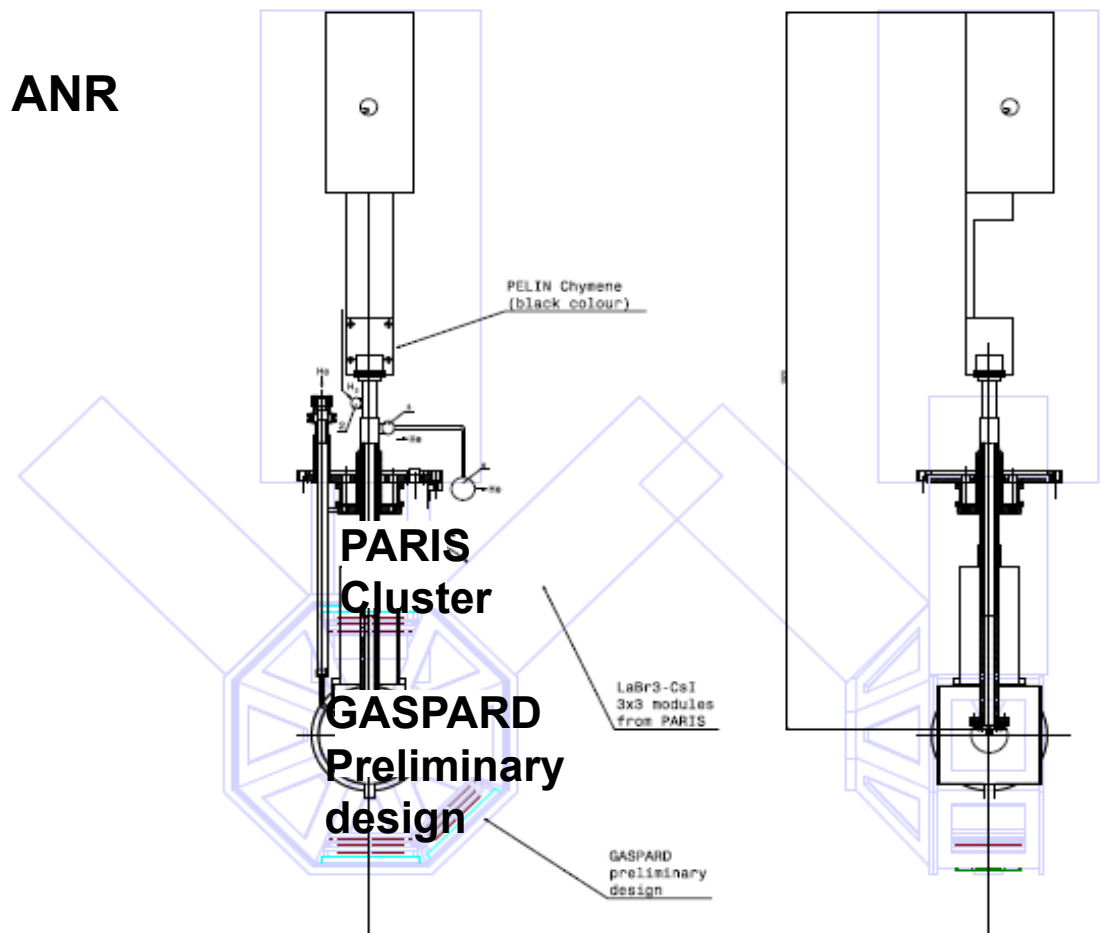
System providing continuous extrusion of ^1H or ^2H through a rectangular extruder nozzle defining the target-film thickness

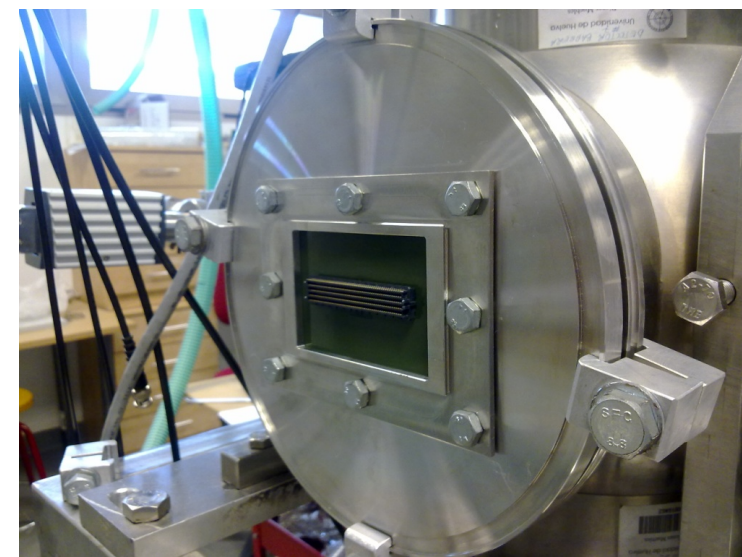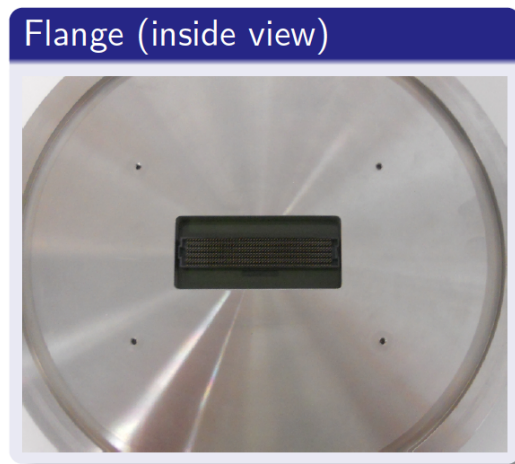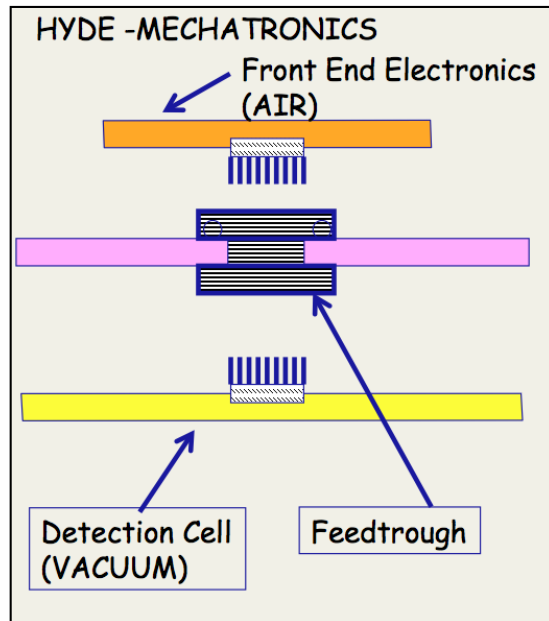**PELIN prototype with GASPARD/PARIS :**

Now funded by the French agency ANR ~ 550 k€ over 4 years

100 μm thick target of pure H "routinely" produced with the old PELIN prototype

CHyMENE now being designed for integration in the present design of GASPARD

PELIN Chymene
(black colour)

PARIS Cluster

GASPARD Preliminary design

LaBr3-CsI
3x3 modules
from PARIS

GASPARD
preliminary
design

512 channels vacuum feed-through tested at Huelva

HYDE -MECHATRONICS

Front End Electronics (AIR)

Detection Cell (VACUUM)

Feedtrough

Flange (inside view)

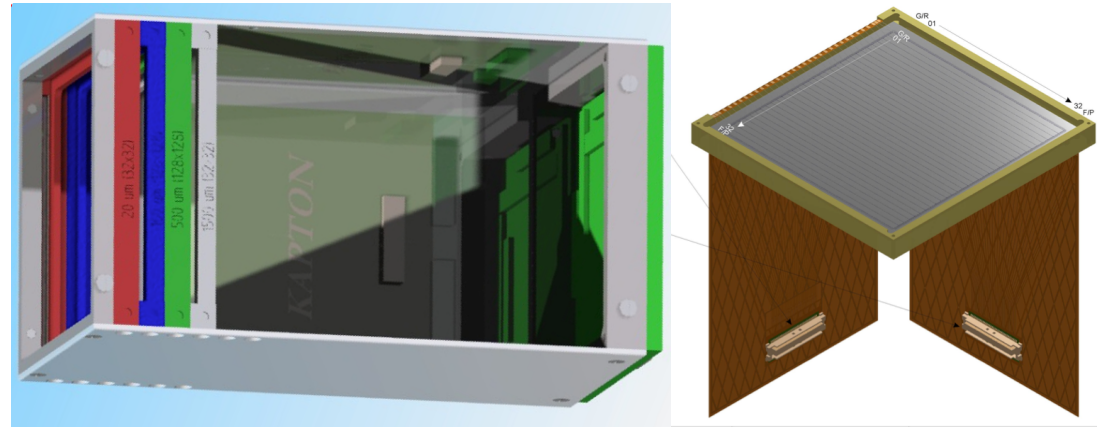I. MARTEL, Univ. Huelva

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HYDE – GASPARD DETECTOR CELL – Prototype

4-Layer prototype (~62 x 62 mm2)

- NTD-20 μm 32 strip/side (*PSA, ΔE, E*).
- NTD-100 μm 128 strip/side (*PSA, ΔE, E*).
- FZ-500 μm 128 strip/side (*PSA, ΔE, E*).
- FZ-1.5 mm stack 32 strip/side (*ΔE, E*).
- 640 electronic channels/cell.

(128 x 128, 0.4 mm pitch, $\delta\theta \sim 0.1°$)

DE/E & TOF & PSA: on the 20 or 100 um layer.

TEST program:
LNS (Catania, Italy) ~ 4He & 12C + CH/Au @ 60 AMeV
9-13 July 2012

LNL (Legnaro, Italy) ~ 16O+32Si@150MeV
October-December 2012

HYDE-GASPARD Test bench

PSA: PACI + MATACQ (2 GS/s, 12-14 bits)
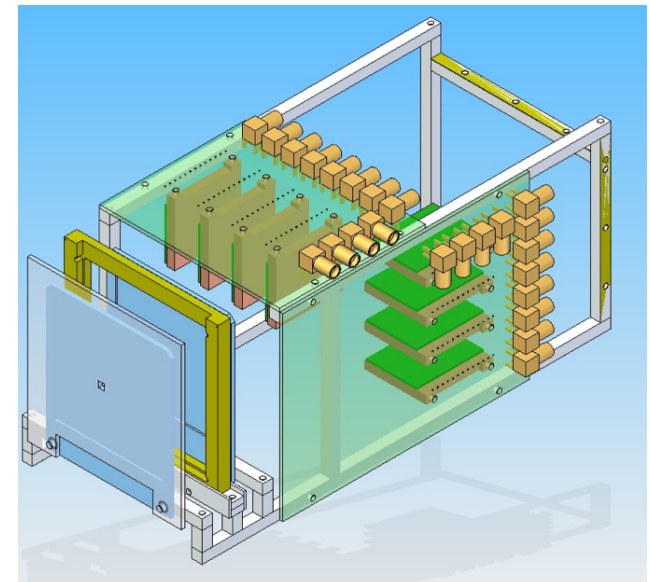**UHU-CEA-GANIL**
Identification of particles (Z & A) for $1 \leq Z \leq 21$.
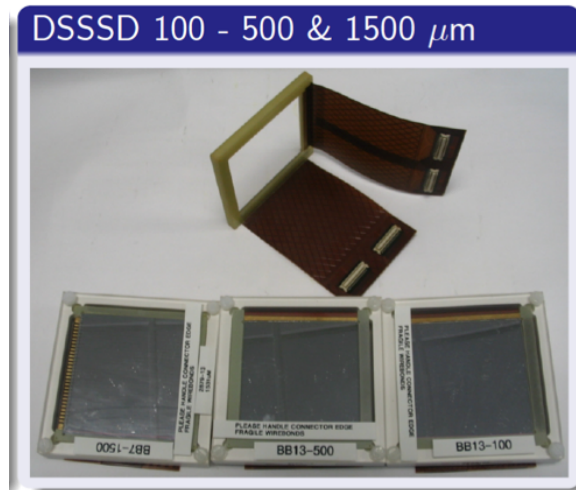Detectors thickness: 20, 100 μm.
Optimum sampling rate.

See presentation of J. Duenas

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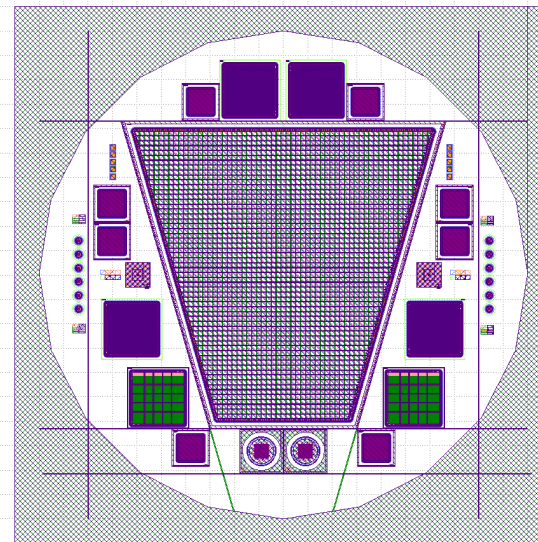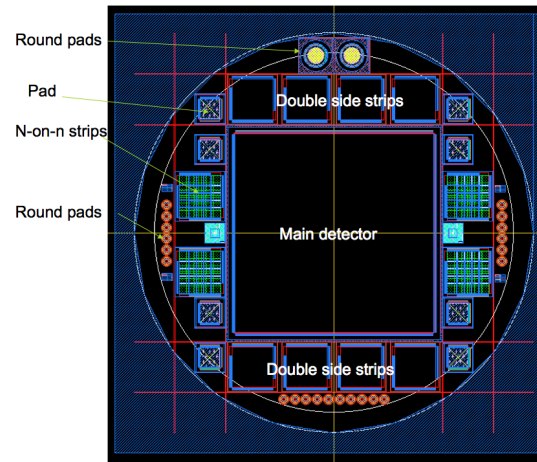# HYDE-GASPARD - DETECTOR CELL – Prototype

DSSSD 100 - 500 & 1500 μm

DSSSD 20 μm (32 × 32)

Micronsemiconductors Ltd.

Round pads
Pad
N-on-n strips
Round pads

Double side strips
Main detector
Double side strips

Centro Nacional de Microelectrónica (CNM), Barcelona (Spain)

•**DSSD production**

• NTD 500um
•Interstrip gap: 90um
•Strip pitch: 390um
•DC coupled
•128 strips on each side
•Electrode strip material: Al (100nm).
•Biased guard ring: 300um wide
•Floating rings: 3
•P-stop isolation for n-side strips.
•Strip length: 49830um
•Angle between n and p strips 90º.

SQUARE: 54.2 x 54.2 mm

TRAPEZODIAL: 96.4 x 61.5 x 96.7 mm/ strip pitch 1mm

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PSA Preamplifier & FEE electronics

DSSD	Feedtr ough	PREA MP Q,I	PSA ASIC
			ST ASIC

IPNO preamplifier ASIC design based on PACI preamplifier

UHU working designs (SMD format):
→ preamplifier (paco), shaper, CFD, G&D & TAC
Next, → ASIC implementation

FPGA implementation of PSA using neural networks

(1) ^{12}C 98.48 MeV
(2) ^{13}C 96.74 MeV
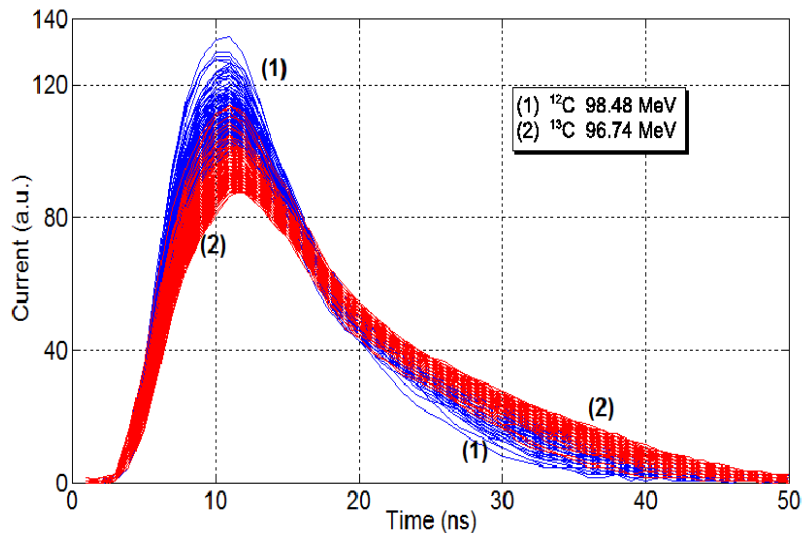
Configuration parameters

Neurons per MLP: 2
Architecture: 8x8x2 layers
Data size: 14 bits

No. MLP in FPGA: 8
Device: Spartan3AN-700

Maximum operation frequency: 74 MHz

R. Jímenez-Naharro et al., NIMA 54210

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Summary and conclusions

Mechanical design fixed: gain in efficiency of GASPHYDE+PARIS w/r to a recently used MUST2+EXOGAM setup is a factor of about 15-20

CHyMENE (fully funded) is presently being designed for integration in GASPHYDE.

Test experiments at LNL and LNS with GASPHYDE prototypes

PACI-ASIC preamplifier under development at IPN3.

ASIC shapers & logic under development at UHU.

FPGA implementation of PSA using neural networks.

Production of square and trapezoidal DSSD prototype detector at CNM- Barcelona.

GASPHYDE demonstrator is envisioned for the end of 2015.

Thanks for your attention!