Istituto Nazionale di Fisica Nucleare
LABORATORI NAZIONALI DI LEGNARO

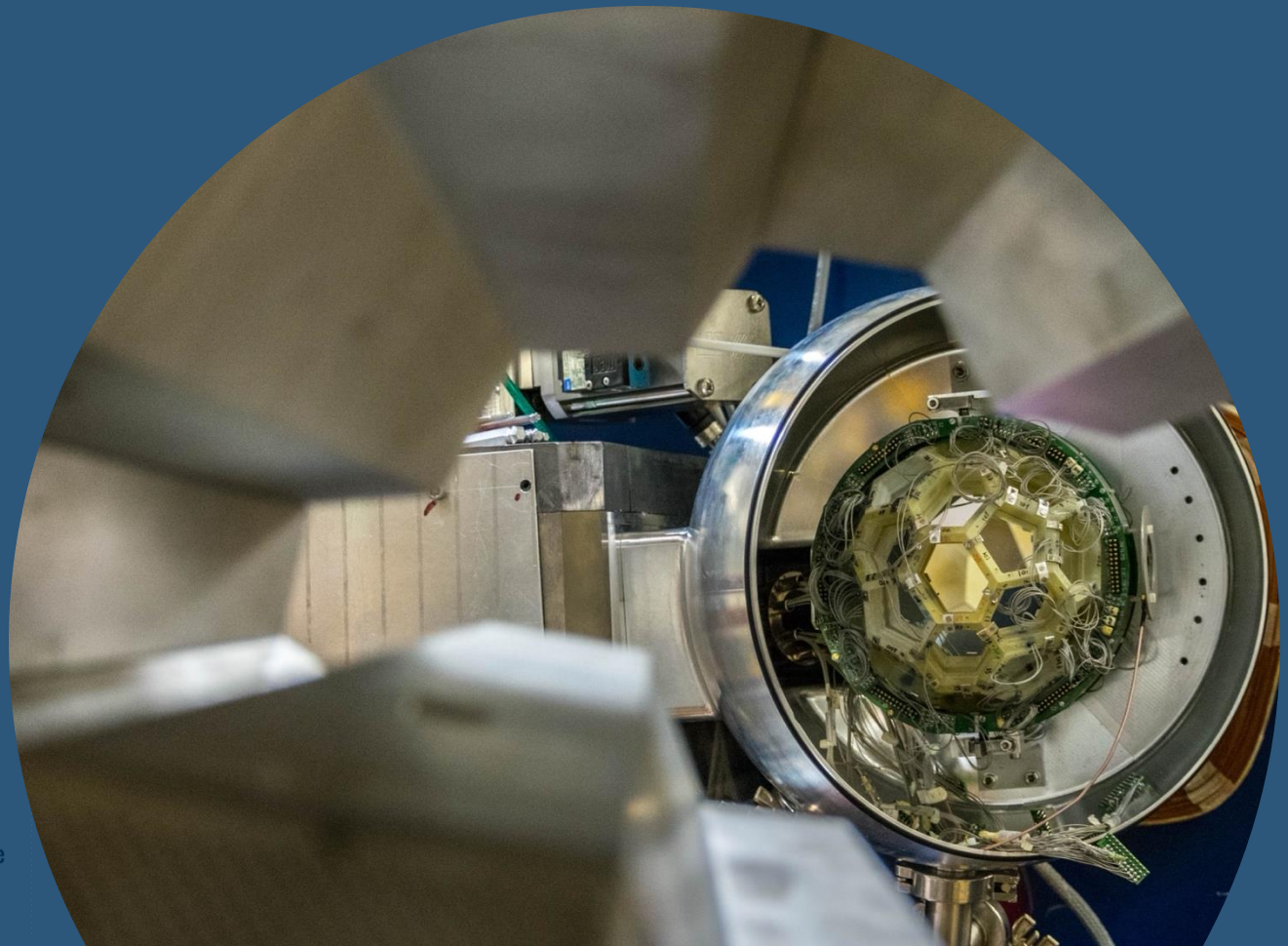
ANCILLARIES AT LNL

ALAIN GOASDUFF – INFN LNL

AGATA
ADVANCED GAMMA TRACKING ARRAY

CHARGE PARTICLE DETECTORS

fusion-evaporation studies
Direct reaction with light ions

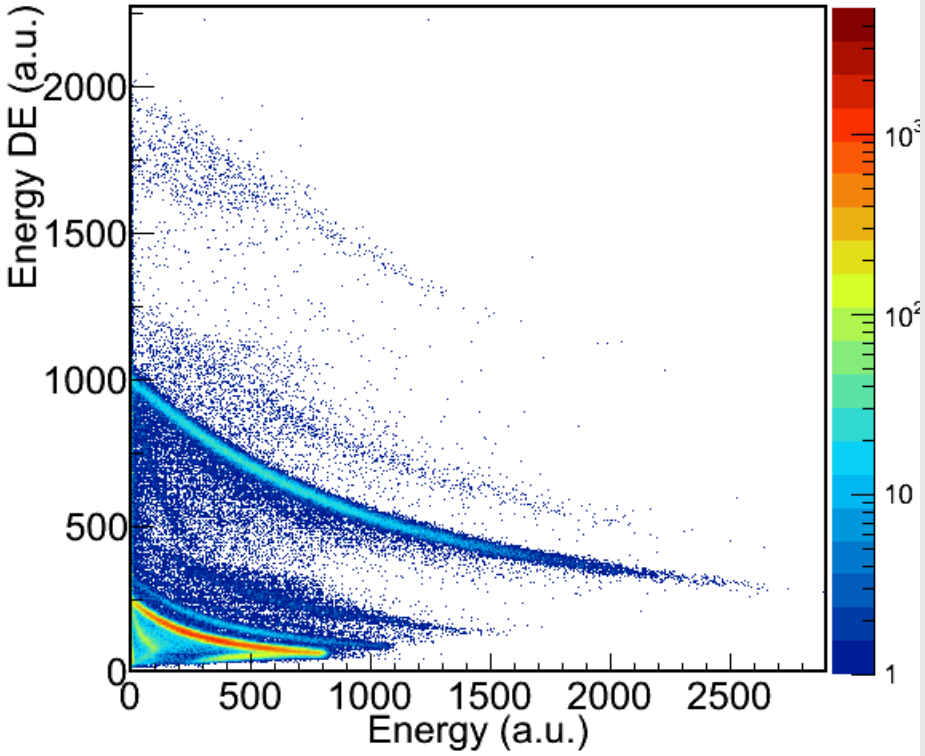


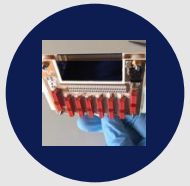
LIGHT CHARGED PARTICLES

EUCLIDES

- 80% coverage of the solid angle
- ΔE layer ~ 150 μm
- E layer ~ 1 mm
- 110 channels
- Low angular resolution
- Possibility to couple part of it with the plunger

ISSUES WITH THE TRIGGER OF AGATA





TRACE

- Highly segmented telescope
- Pad detectors (4x4 mm^2)
- ΔE layer ~ 200 μm
- E layer ~ 1 mm
- PSD Capabilities for particles discrimination down to 2 MeV
- Up to 5 telescopes in the chamber

TEST SCHEDULE FOR DECEMBER 2024

TRIGGERING ISSUE WITH EUCLIDES

Typical rates on EUCLIDES E-DE telescopes at a few pnA (trigger on the DE

- 10-40 kHz for the most forward rings
- 500 Hz for the backward ring

Rates are larger than what can be dealt with the AGAVA board (< 20kHz):

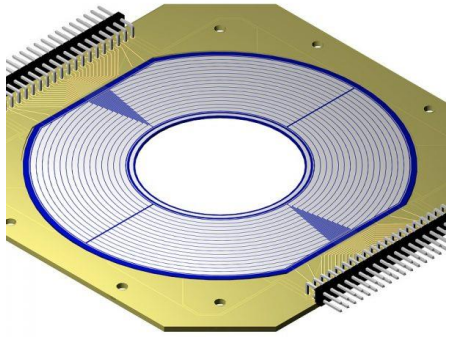
- **Enormous** dead time due to the readout of the AGAVA (>50% see slide 23 …)
- Artificial dead time on AGATA (ancillary trigger request not transmitted to the TP)

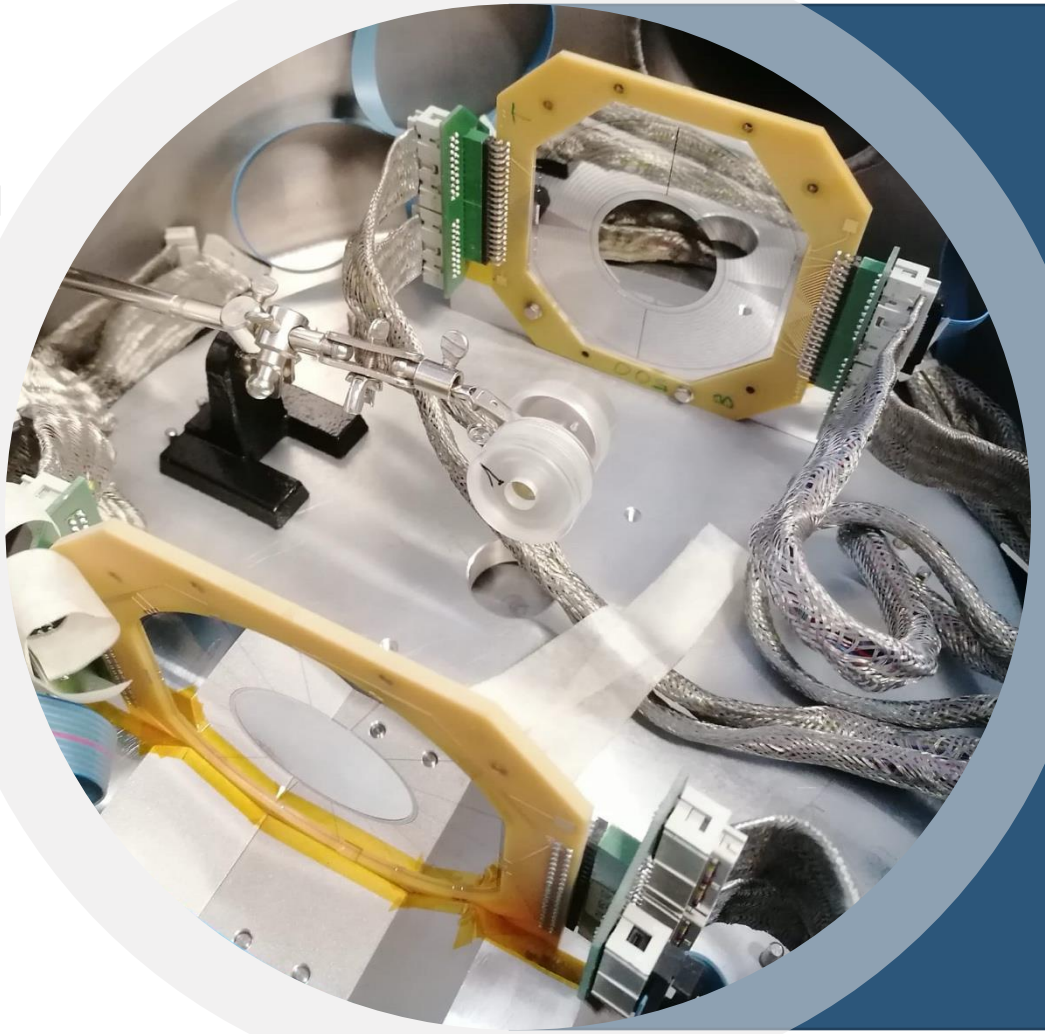
NEW AGAVA SOLUTION IS NECESSARY (for GTS / SMART) for the use of TP

- Clock output in LVDS with if possible the possibility to convert the 100 MHz to 50-200 MHz via PLL
- Simple I/O with for trigger validation/rejection to add the AGATA backpressure to the ancillary

NEW ADDITIONS: S1 DETECTORS

- Three new S1 (0.3 and 0.5, 1.5 mm) have been added to the list of available detectors
- Up to 2 detectors in the PRISMA chamber
- 80 channels / detector





- First experimental campaign Nov. 2023 at 5 cm from the target ($\Delta\theta$~1.2 deg)

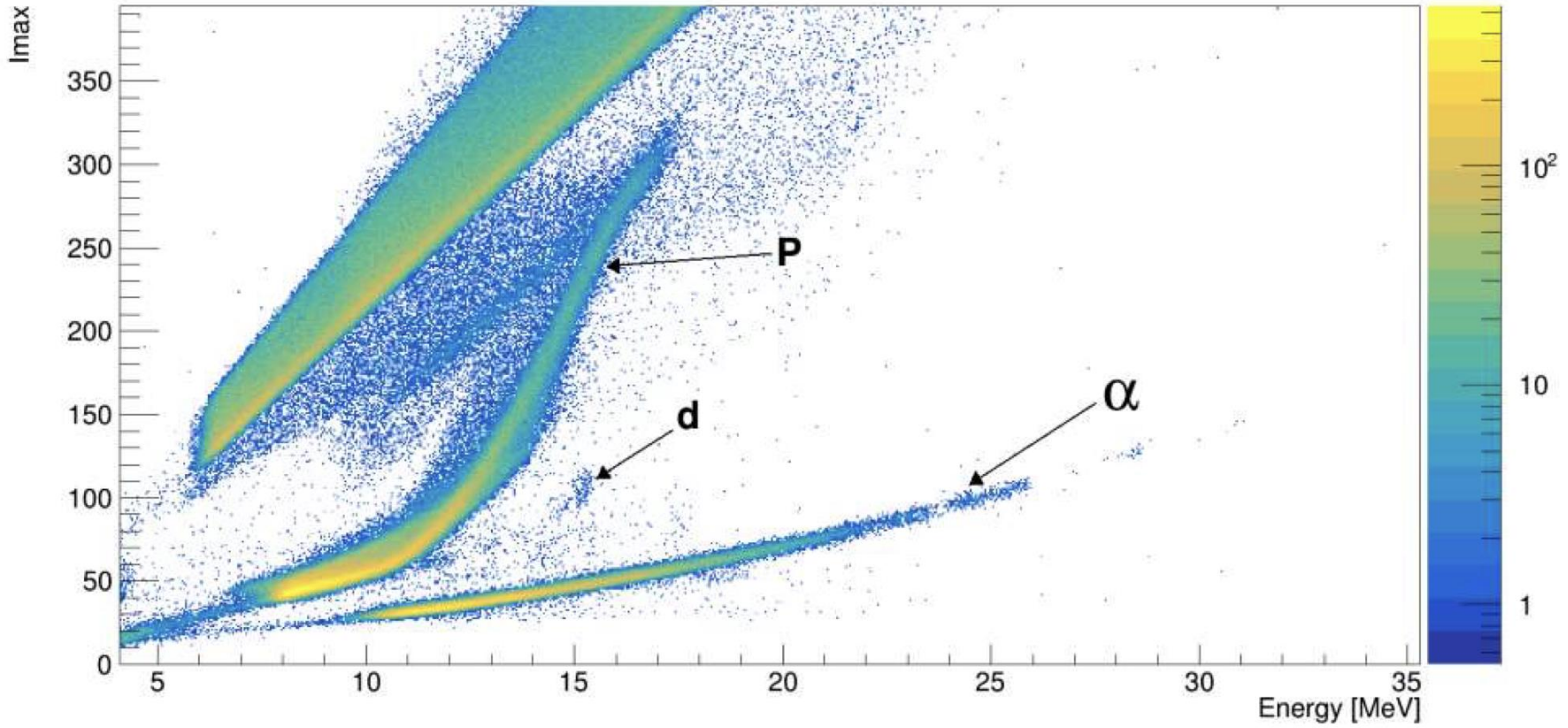
PARTICLE DISCRIMINATION WITH THE S1

Short traces passed to the DAQ:

- Online calculation of the I_{max}
- Dedicated data frames with PSA informations

Traces so far limited to 1 µs with the trigger centered in the traces

Discussion on-going with CAEN to include the I_{max} determination in the FW of the VX2740

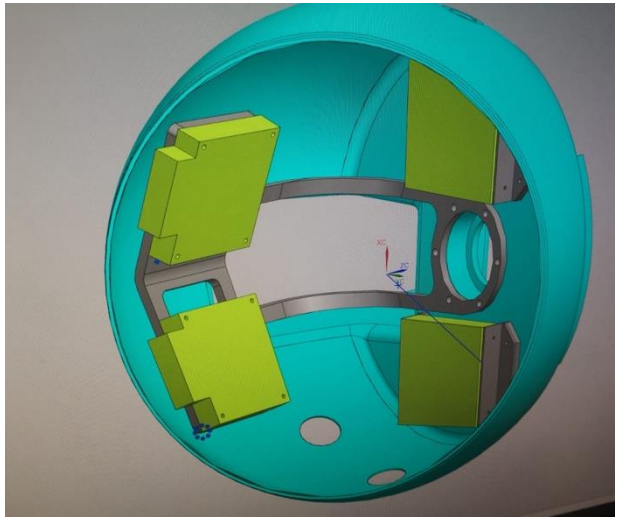


NEW ADDITIONS: OSCAR

Hodoscope constituted by two detection stages

- 20 µm Single Sided Silicon Strip Detector (SSSSD)
- 300 µm Silicon pads

Up to 2 detectors in the chambers



First experimental campaign Dec. 2023

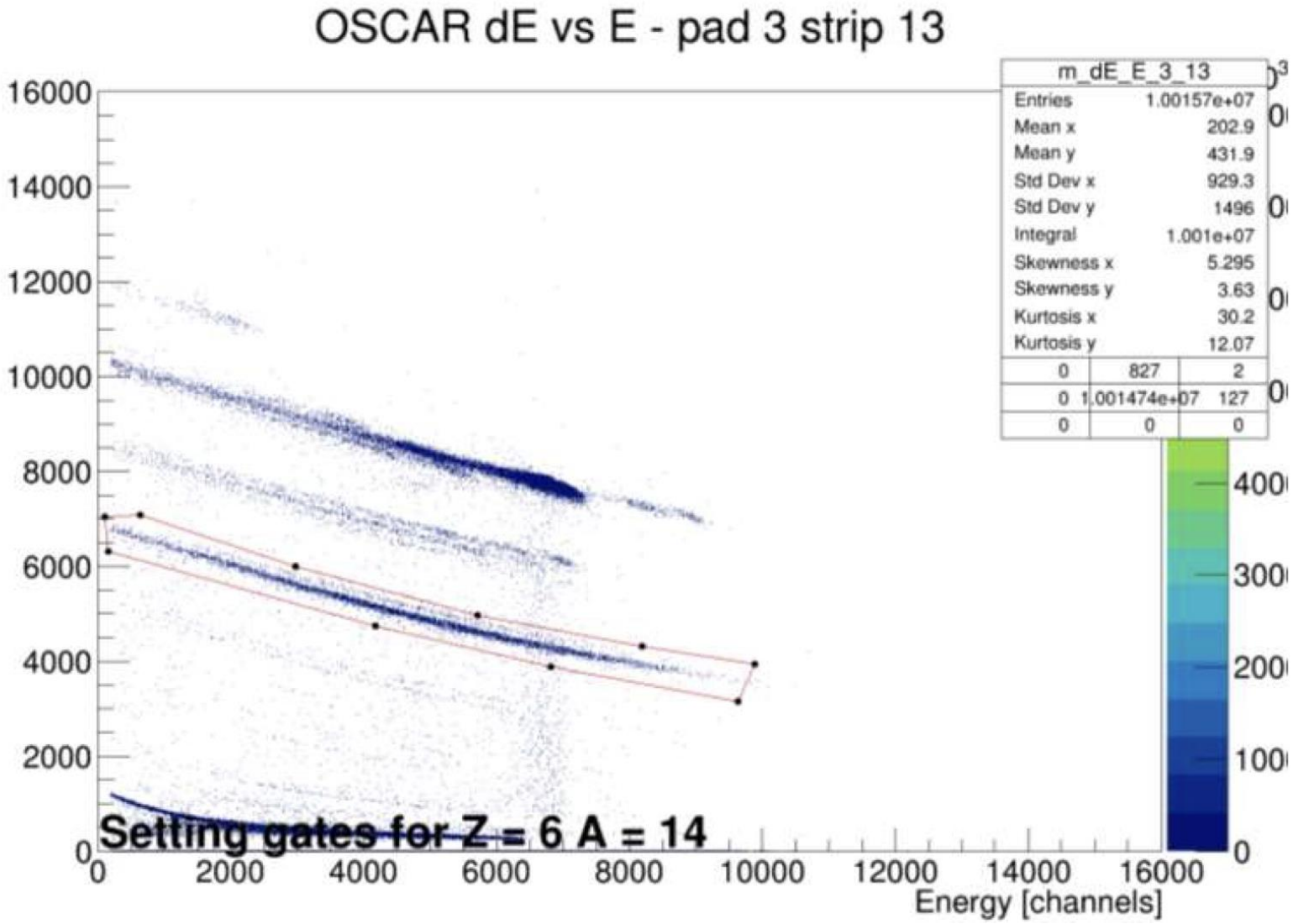
D. Dell'Aquila et al., NIM A 877 (2018) 227

FIRST EXPERIMENTS

Included in the system:

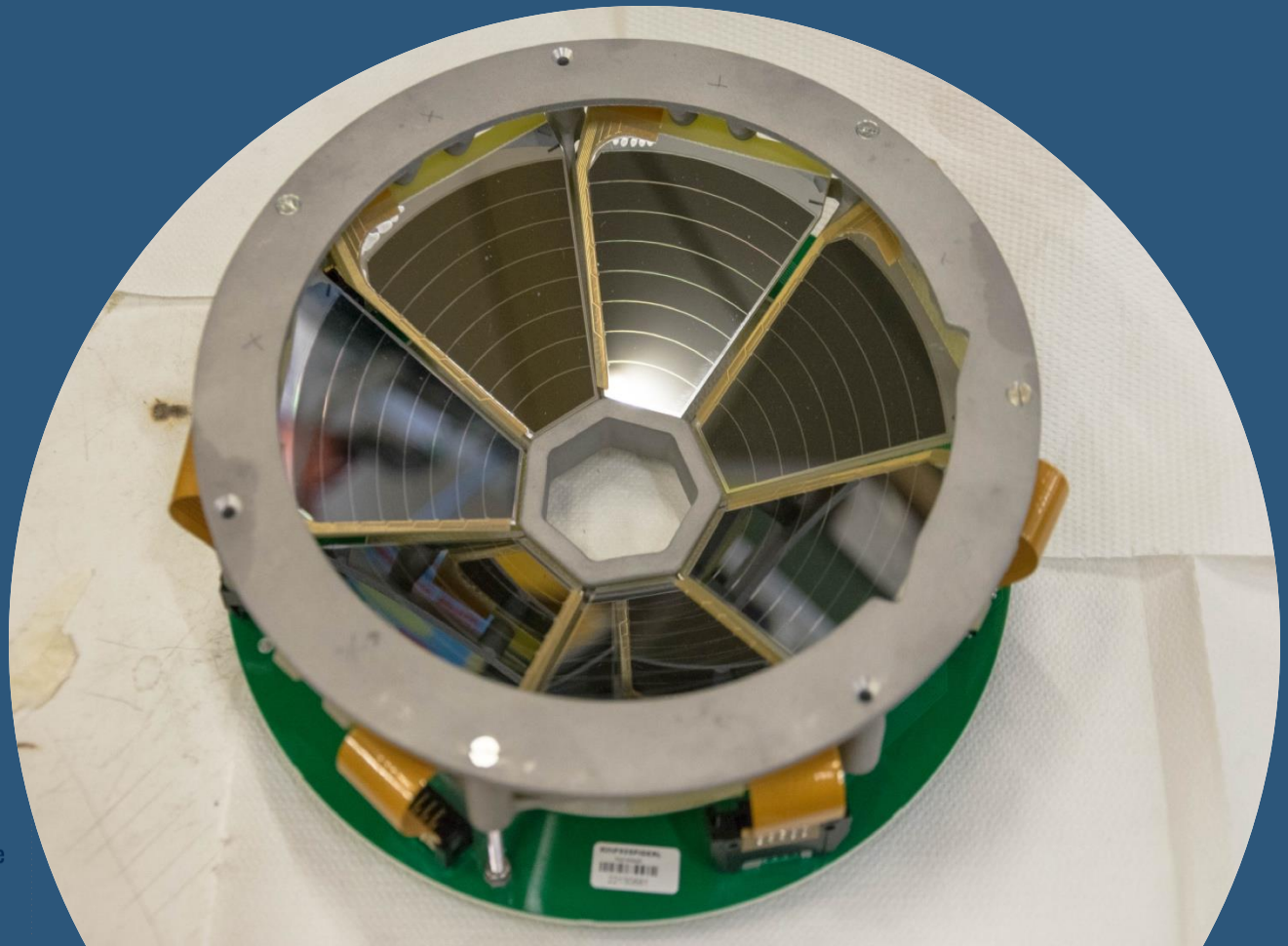
- V1725: 2 boards / telescope
- Trigger of AGATA:
  1 AGAVA per telescope.

See talk of M. Balogh at the ACC
12/09: 15:15



HEAVY ION DETECTORS

Coulomb excitation measurement
Deep-inelastic and multi-nucleon transfer reaction
Fusion-fission and transfer induced fission



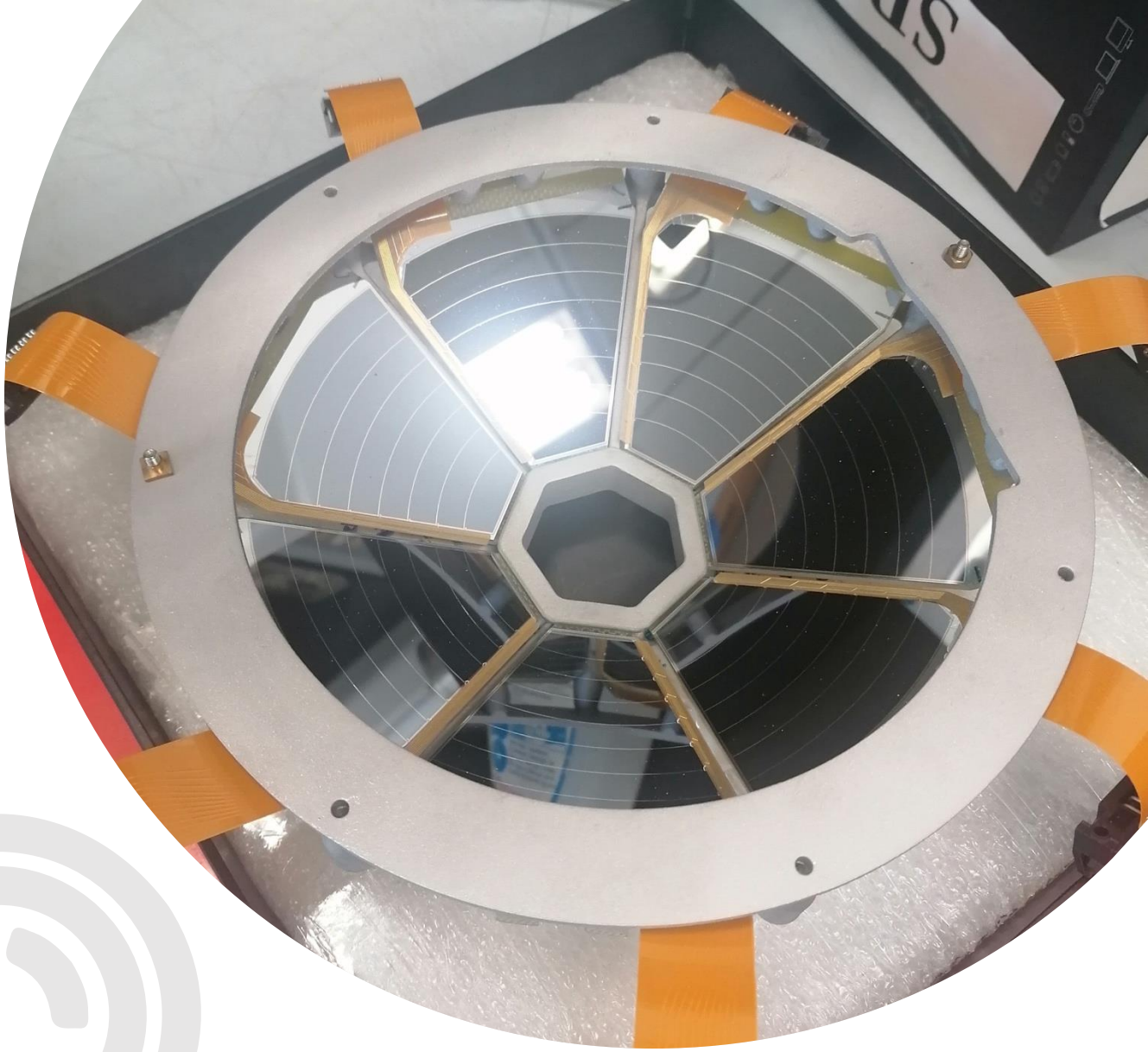
SPIDER

Designed for Coulomb excitation studies:

- 7 sectors
- 8 segments

Typical performances for Doppler correction coupled to AGATA:

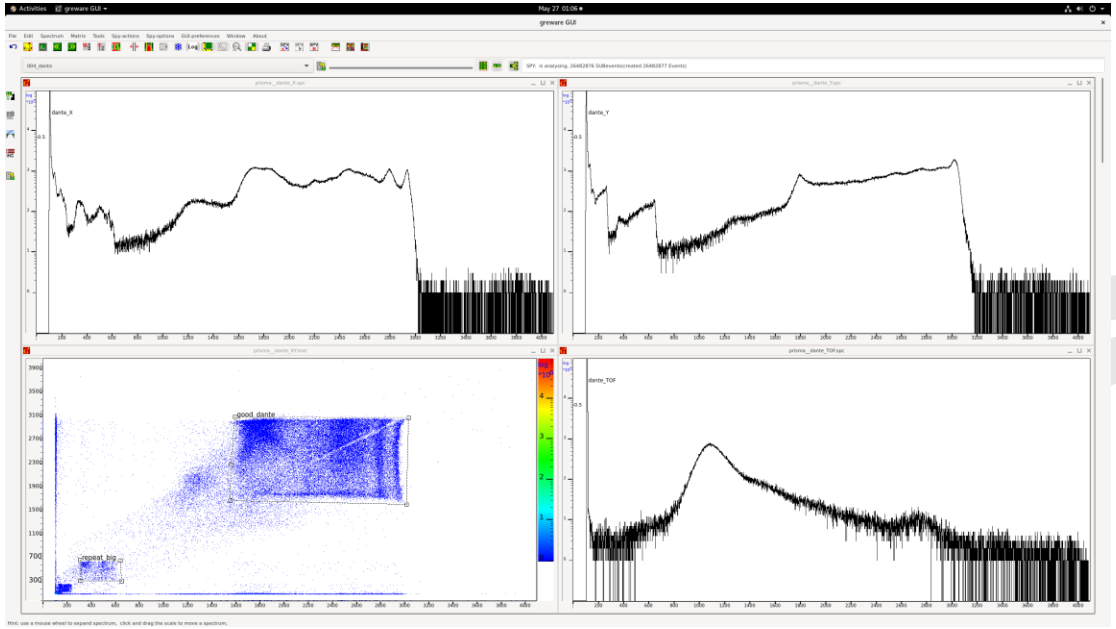
- 8-10 keV @ 1 MeV depending on the target thickness

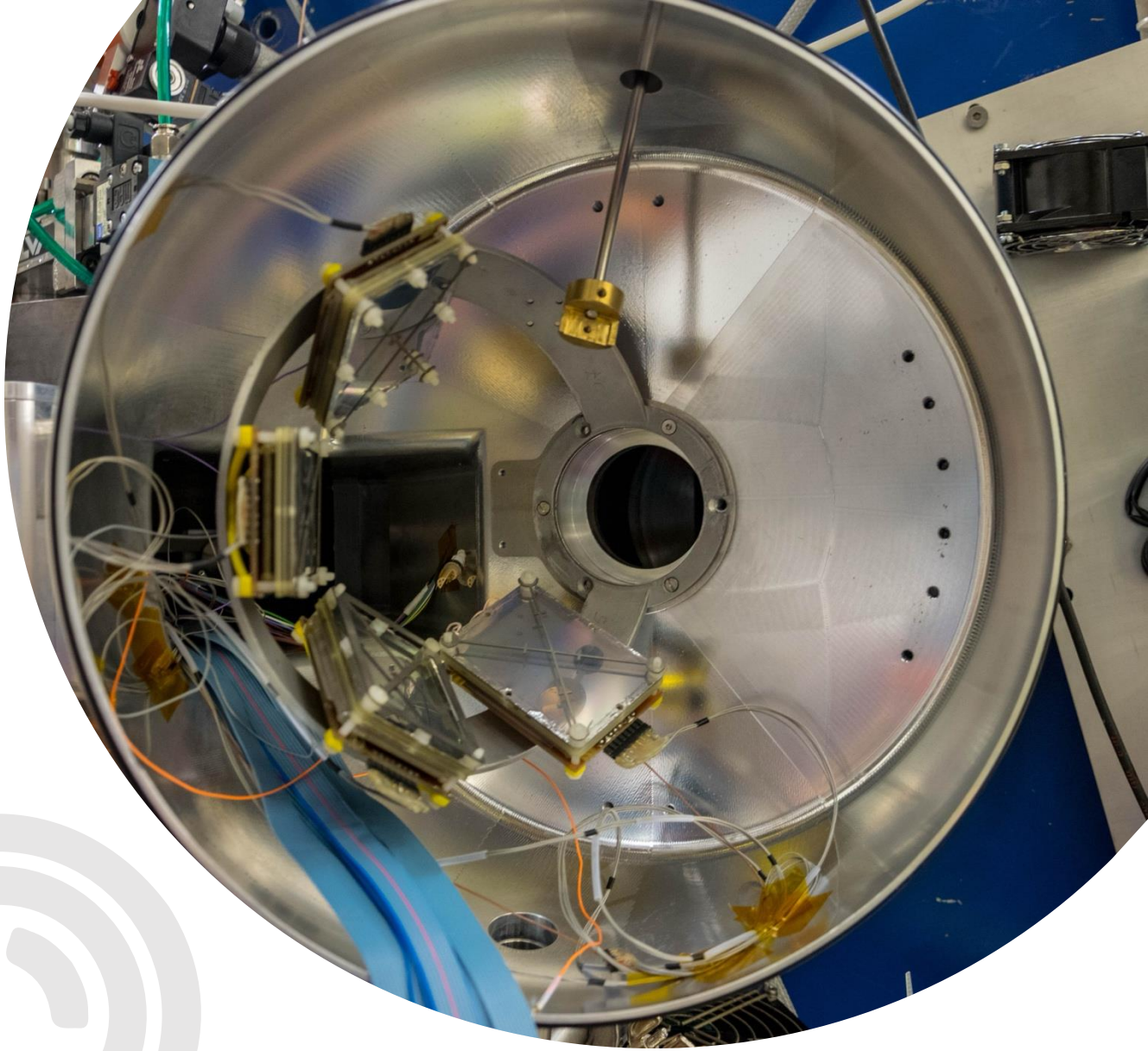


DANTE

Used for kinematics coincidences:

- multi-nucleon transfer with light actinides (Th/U targets)
- Coulomb excitation studies

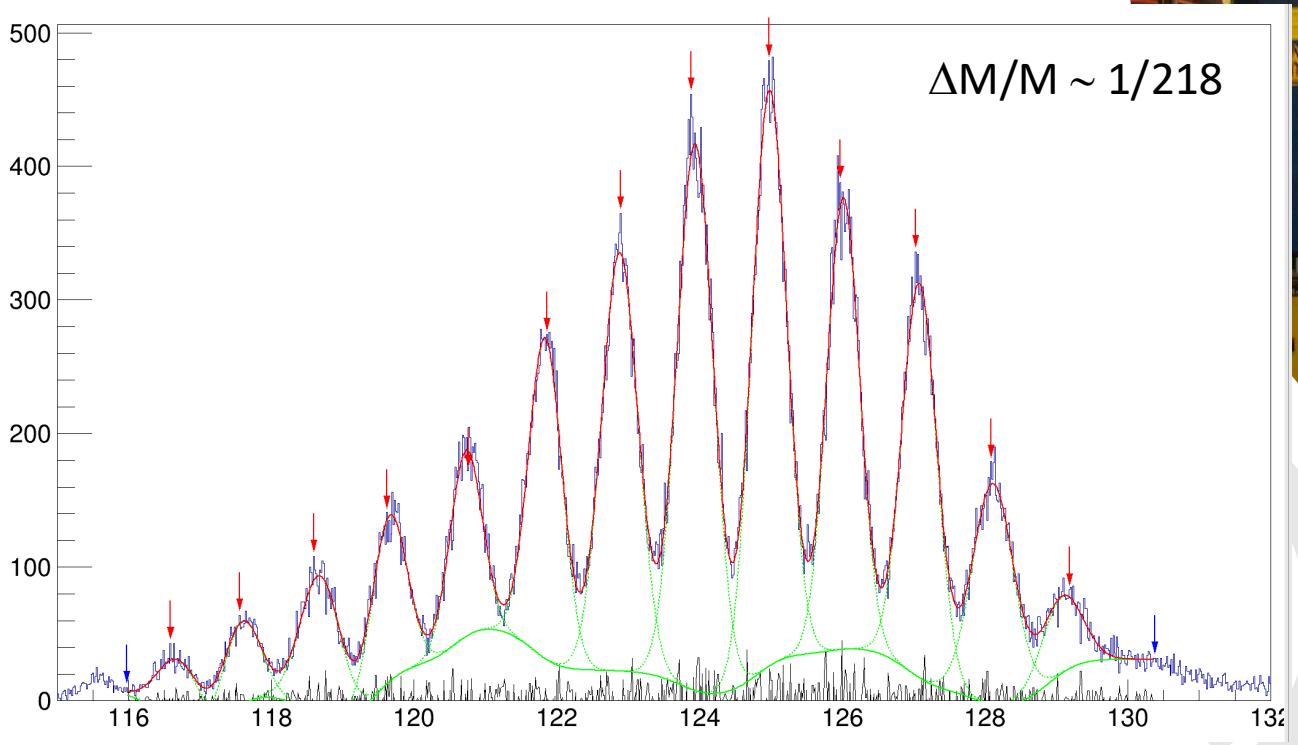




PRISMA

Full identification (Z,A)

Kinematic reconstruction … all details are in the pre-Pac documentation



SCINTILLATOR DETECTORS

LABR3 ARRAY

Up to 9 detectors, presently mounted:

- 5 3x3 inches
- 4 2x2 inches

For the 0-degree campaign:

- Possibility to couple to PARIS under discussion
- Definition of a dedicated mechanical support

NEDA

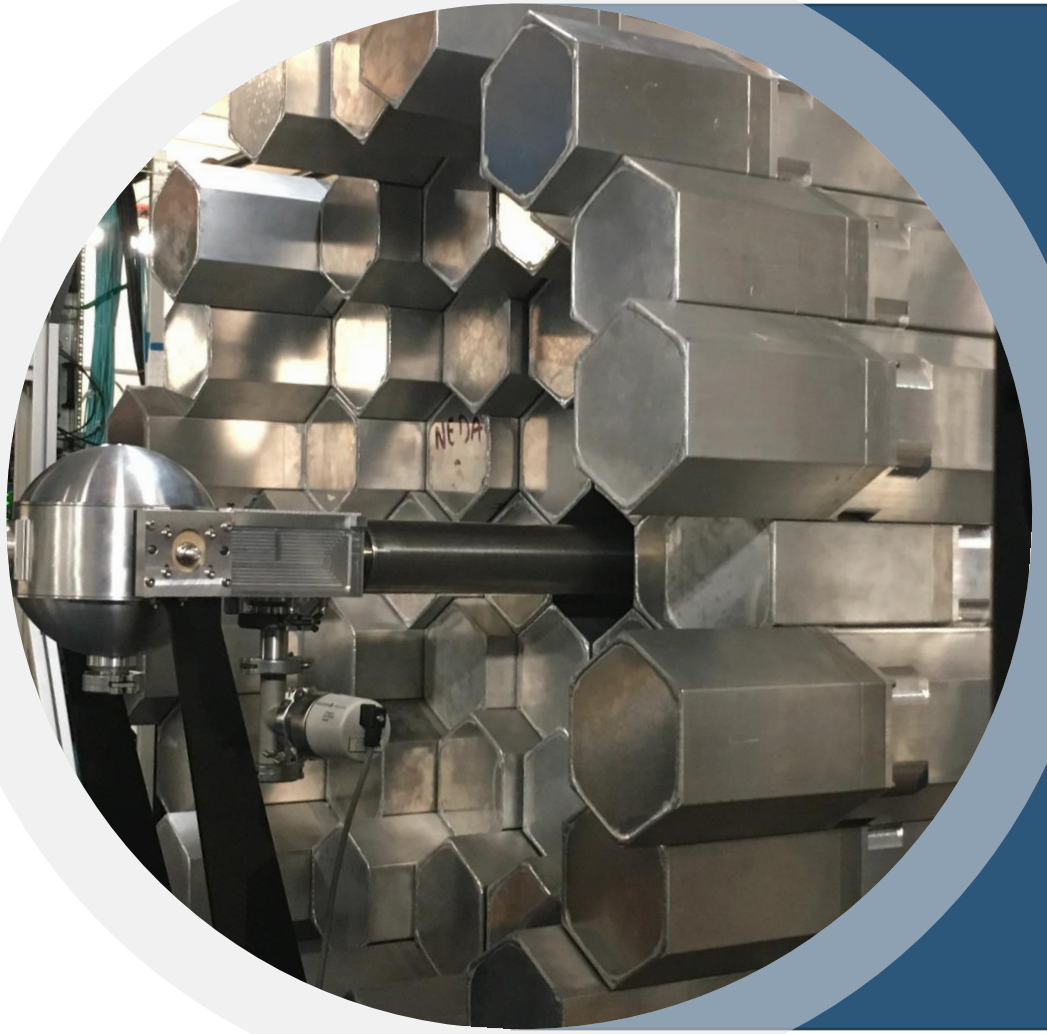
54 available NEDA detectors

96 NUMEXO2 channels

Work to be done:

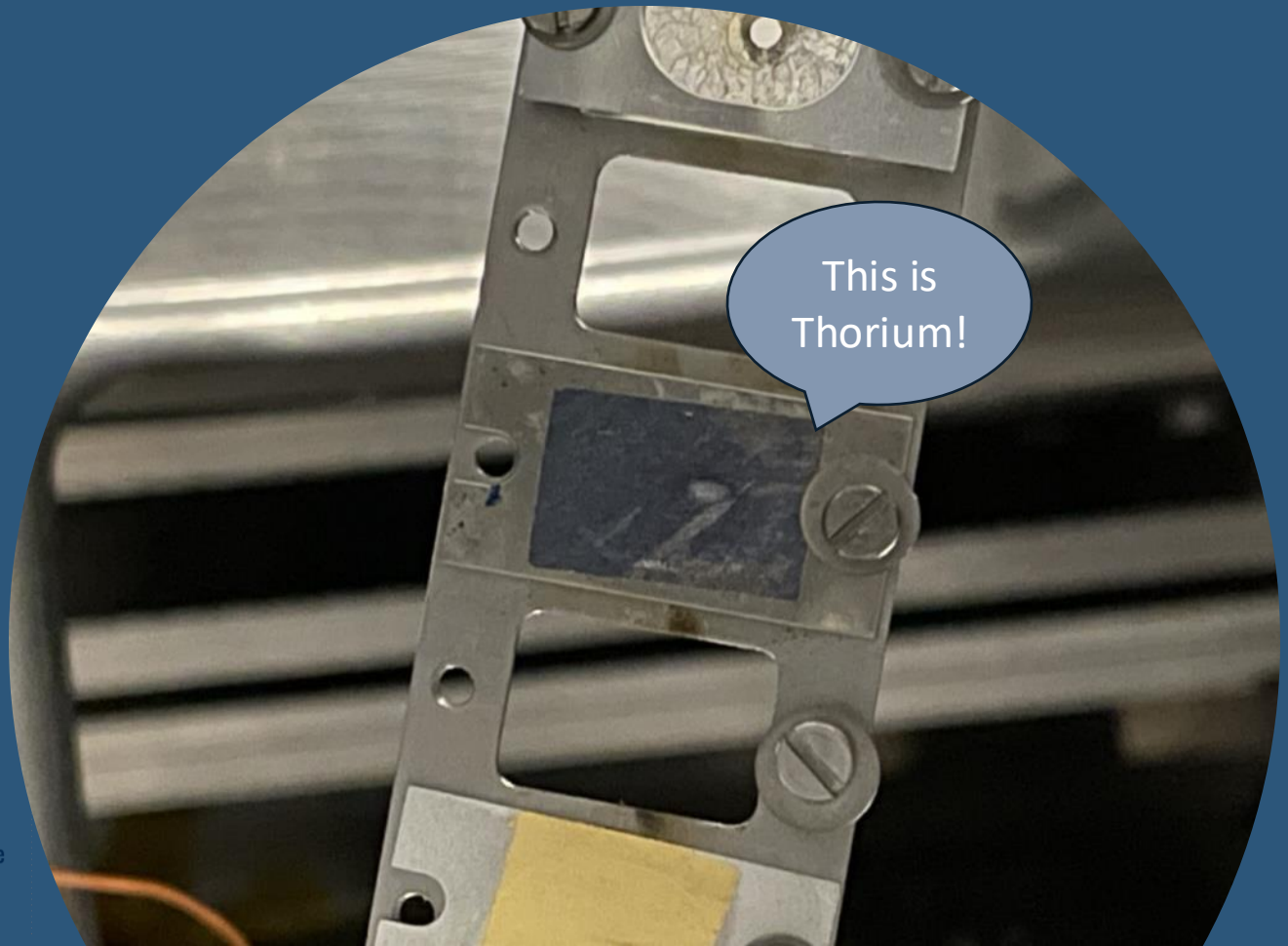
- Definition of the support mechanic
- Disucssion within the NEDA collaboration to produce additionnal detectors
- Integration of the NUMEXO2 in XDAQ

First NEDA server and NUMEXO2 delivered to LNL for integration in XDAQ



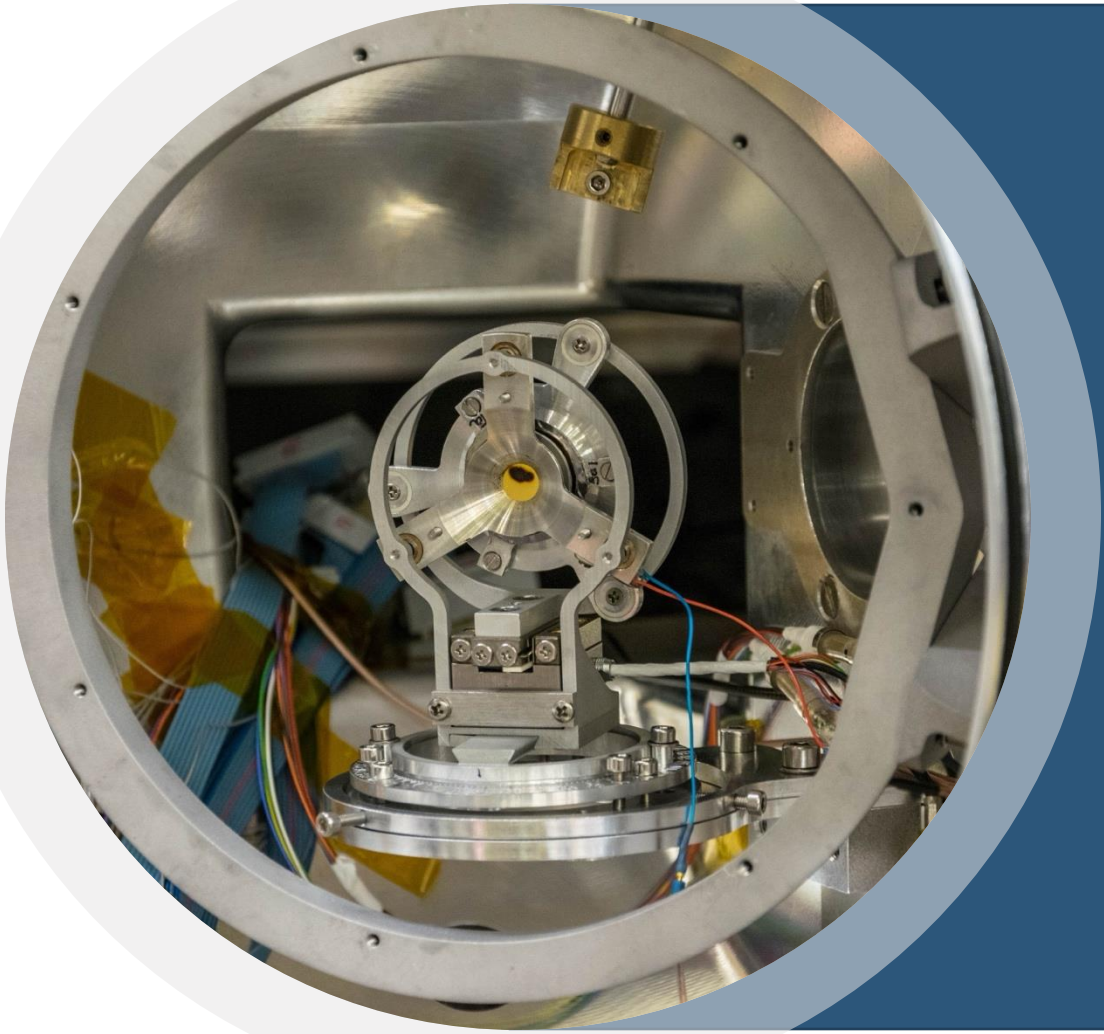
TARGET DEVICES

(big thanks to the LNL Target laboratory)



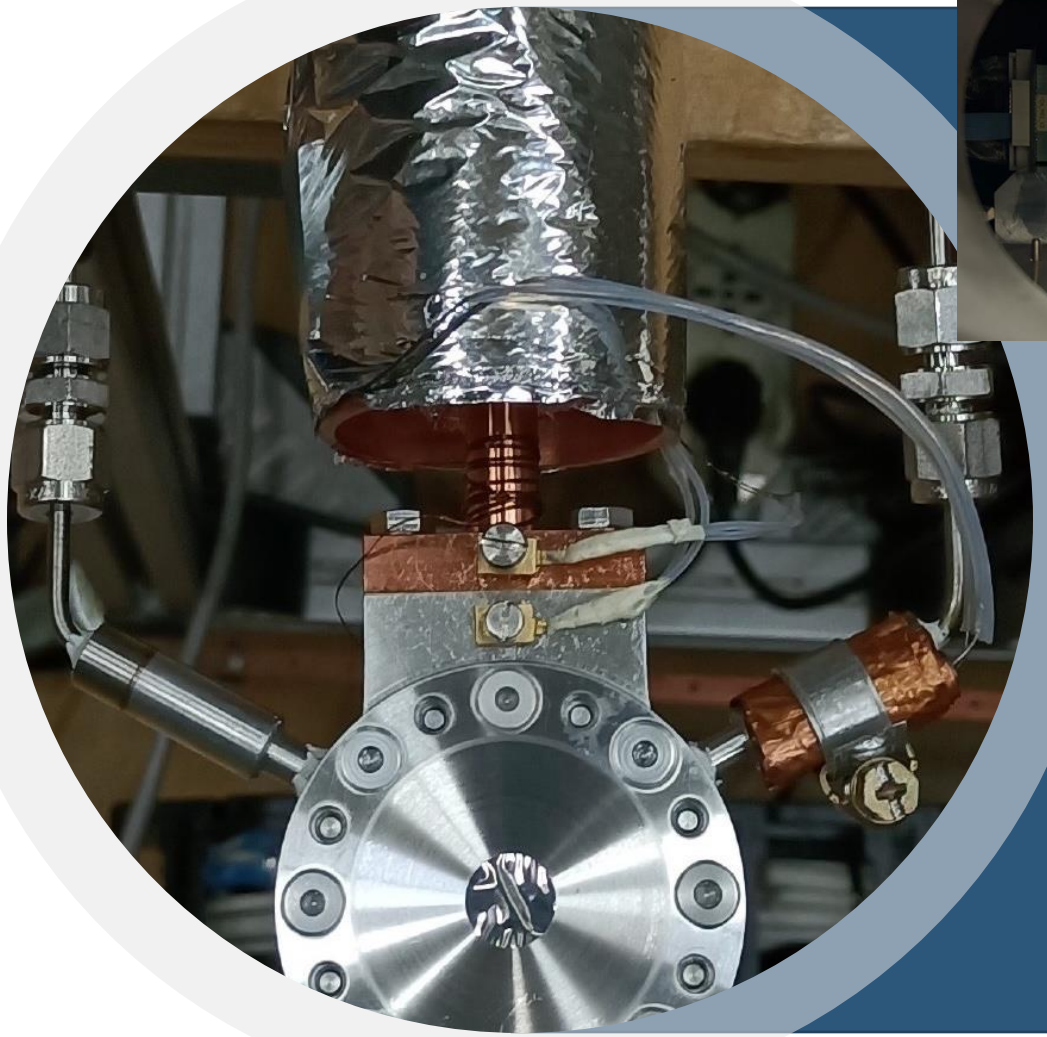
PLUNGER DEVICES

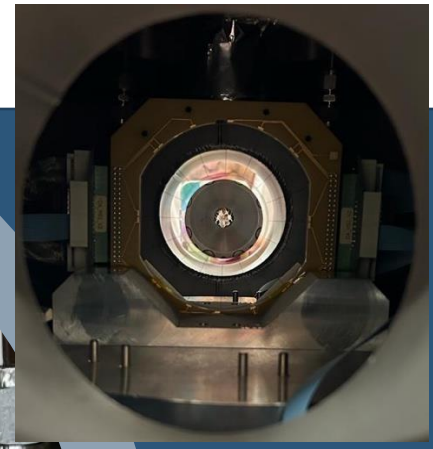
- Two available plunger devices:
  - GALILEO plunger (IKP-LNL)
  - Tri-foil plunger (IKP)
- Identical support structure and feedthroughs
- Compatible cones and targets
- Mechanically compatible with:
  - PRISMA
  - SPIDER
  - EUCLIDES (forward rings)
  - …
- Used in different configurations:
  - Direct (usual configuration)
  - Reverse plunger
  - “Mirror configuration”



CTADIR

- Based on a two-stage Gifford-McMahon cryocooler
- 3.8 mm Havar windows
- Gas cell:
  - 10 mm diameter
  - 4 mm thickness
  - 1 bar @ 9 K ~ 10^{20}-10^{21} at./cm^2

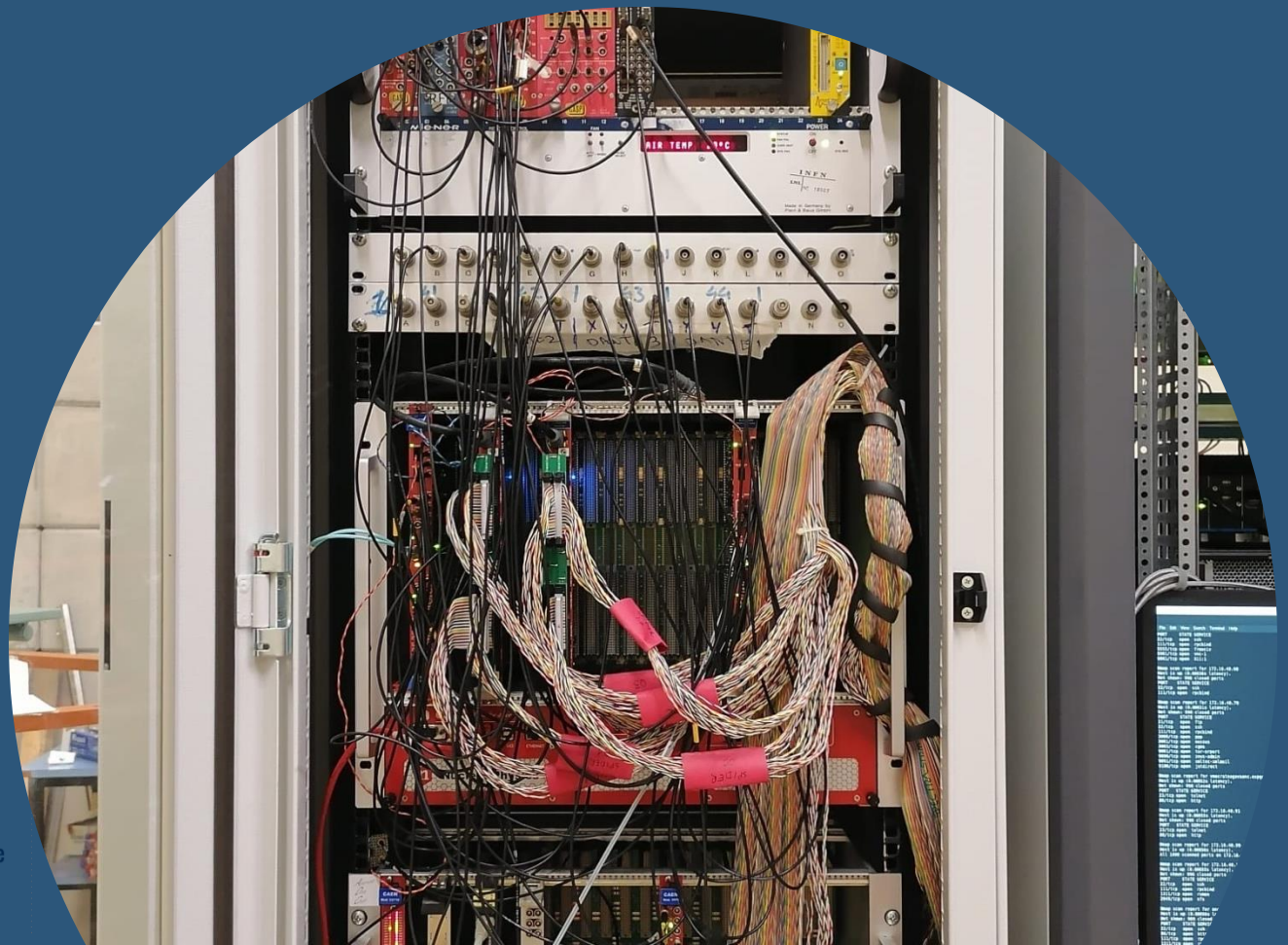




- Second in-beam test at the end of the week at CN accelerator using the S1 detectors to check the homogeneity of the target

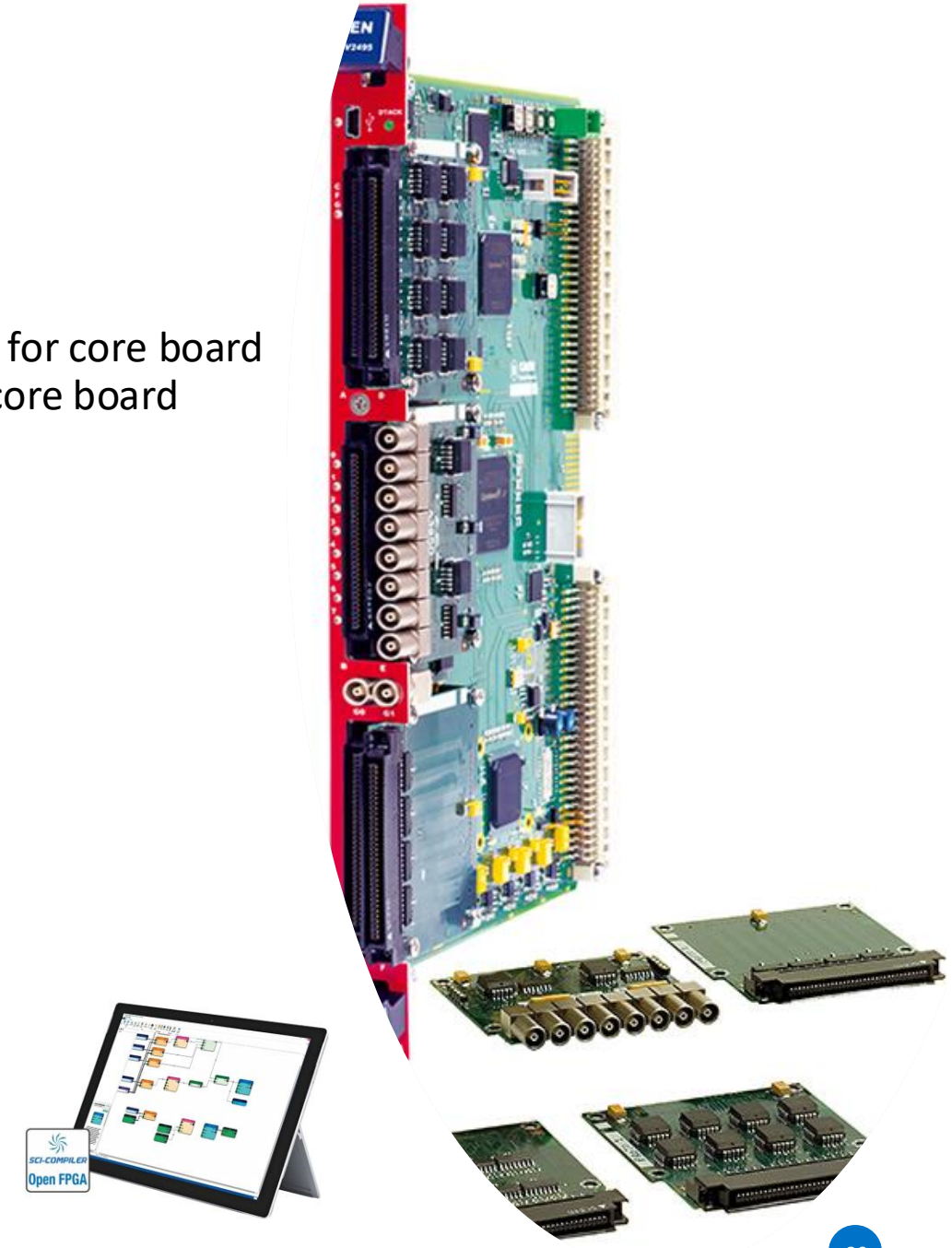
ELECTRONIC AND DAQ

(Thanks to C. Boiano, S. Brambilla, S. Capra, N. Toniolo)



AGATA GAMMA-OR

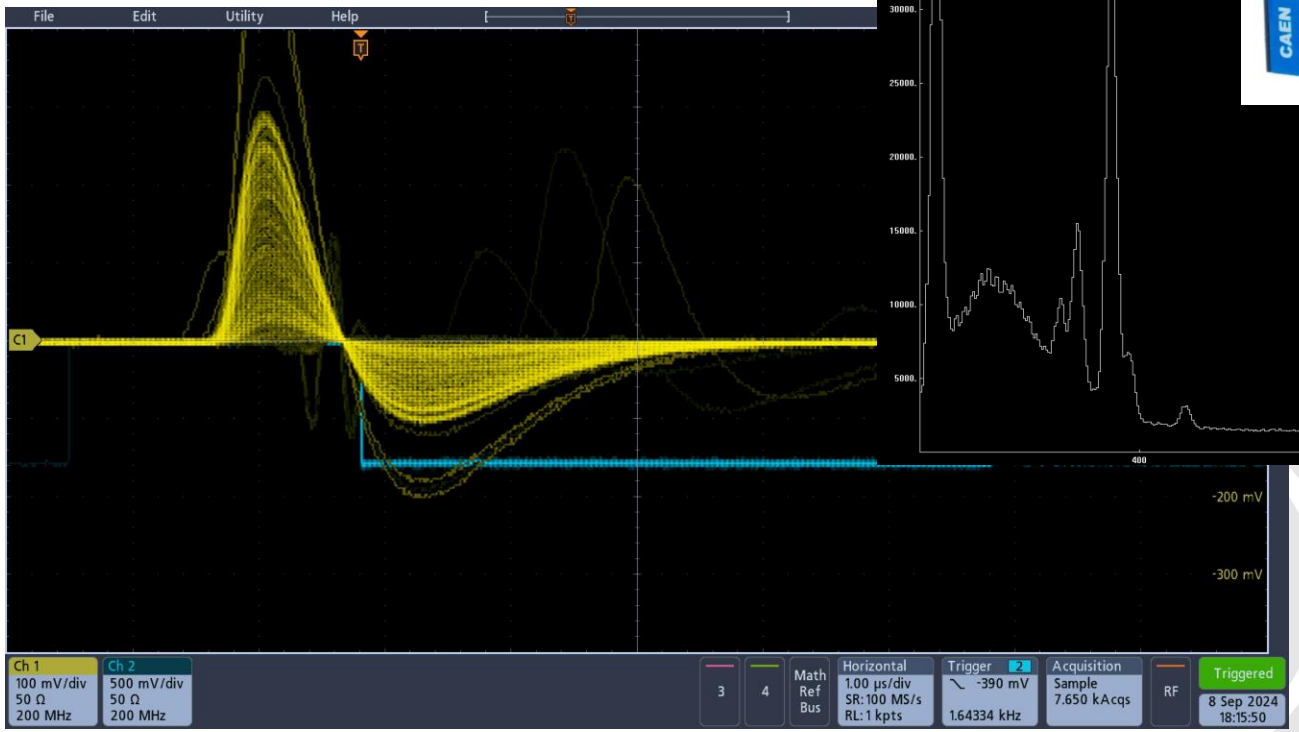
- Slow control of DigiOpt-12 Core board fine trigger threshold:
  --corethreshold arg adc: Set value of LE trigger threshold (0..127) for core board
  --coremodtreshold arg adc: modify value of LE trigger threshold for core board
- In the present configuration of the V2495:
  - up to 64 cores – all the material available to go to 128 cores
  - Selectable trigger output (TTL/NIM)
  - Dedicated scaler for individual channels
  - Possibility to enable/disable channels
  - Selection of the rising/falling edge of individual signals
  - Adjustable delay and width of the output
  - Selectable individual inspection
- To be done:
  - Fold conditions and output

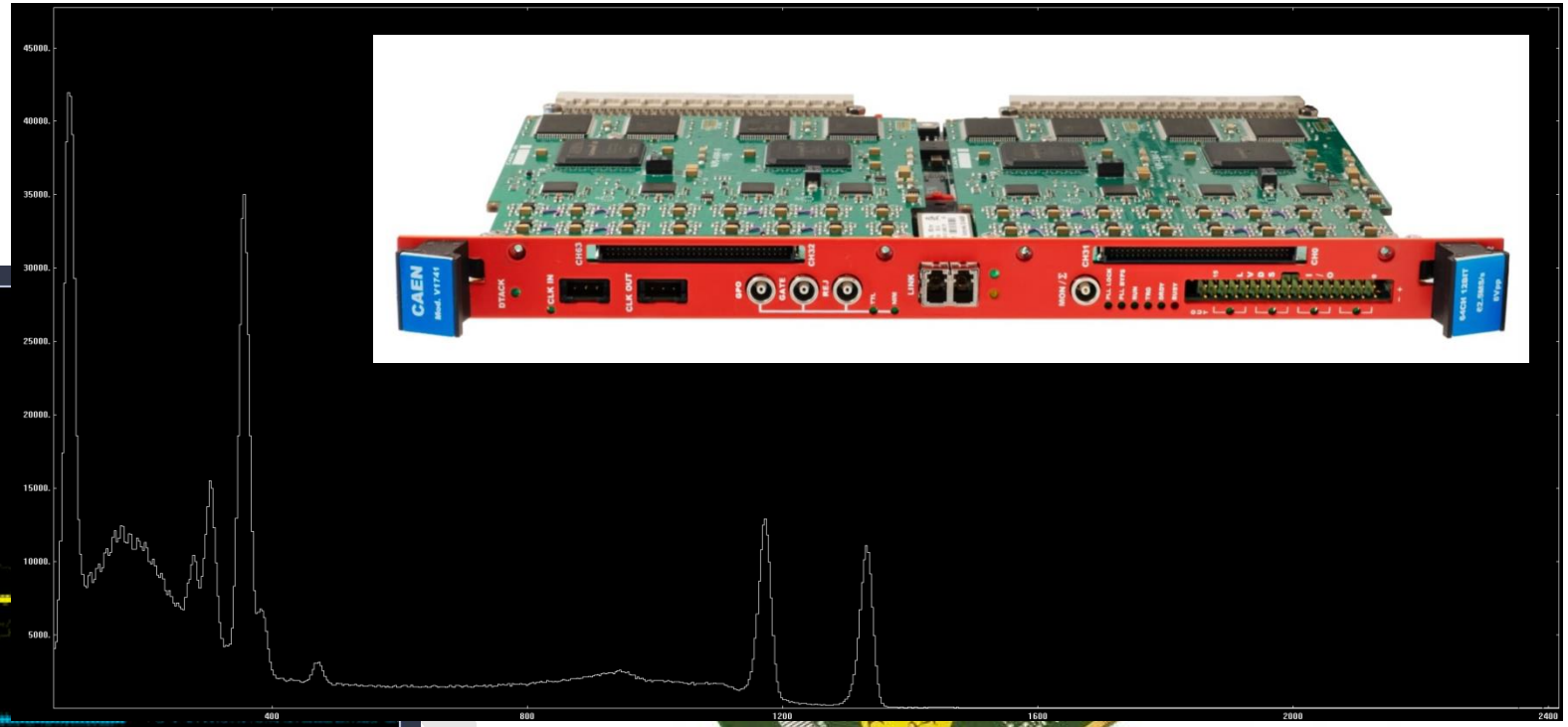


ONLINE FEEDBACK ON THE GAMMA-OR

DigiOpt-12 have two analog outputs:

- LVDS Output (pin connector) → V2495
- Bipolar TFA output (SMA) → V1741





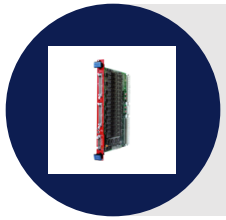
Limited resolution of the TFA output (23 keV on the ^{60}Co) but sufficient to set a threshold

AVAILABLE COMMERCIAL ELECTRONICS

CAEN DIGITIZERS

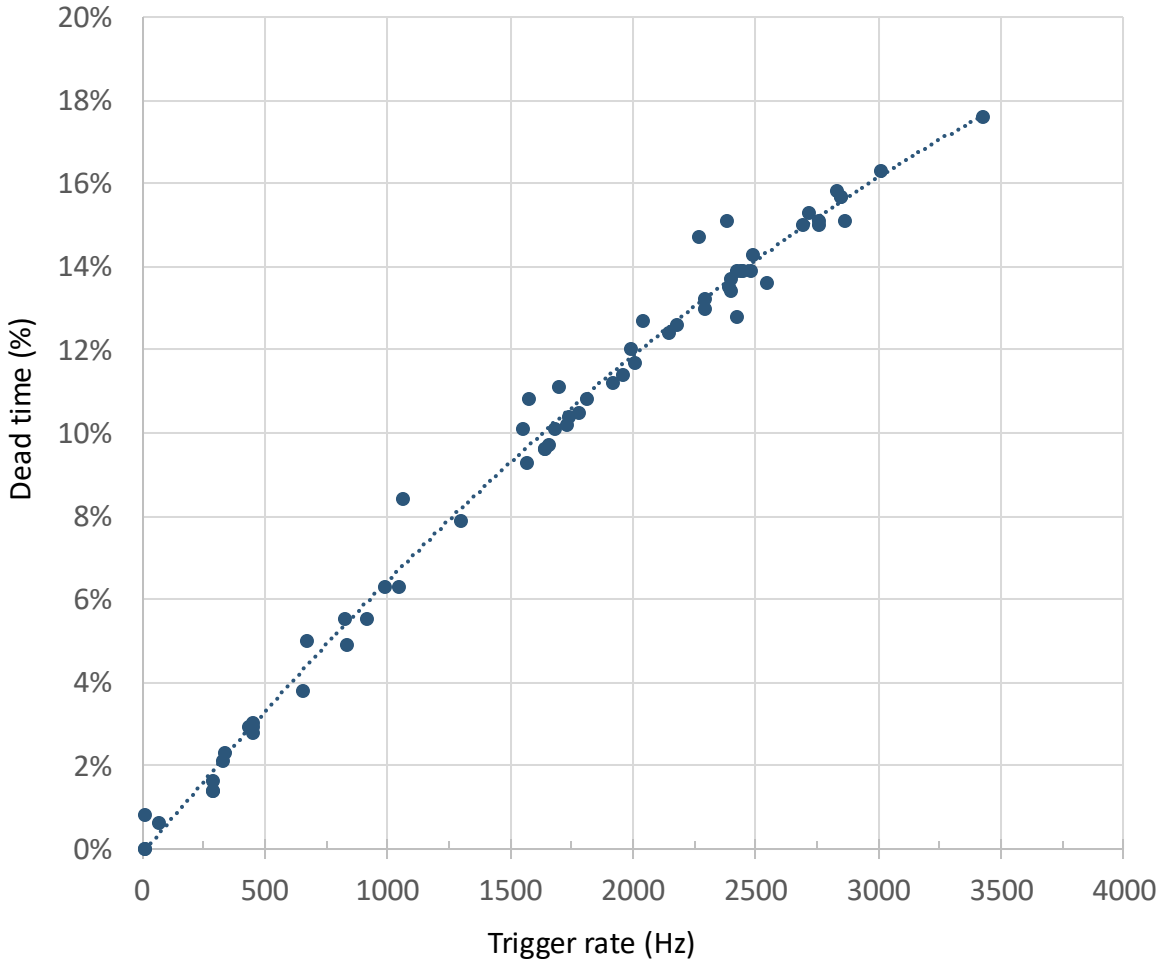
- 6 V2740 (64 channels – 125 MSPS – Diff.)
- 5 V1725 (16 channels – 250 MSPS – S.E.)
- 2 V1730 (16 channels – 500 MSPS – S.E.)
- → 432 available channels.
- All integrated in XDAQ data stream (ADF)
- Possibility to validate the trigger using fold signal from AGATA (gamma-OR)
- Possibility to send trigger signal to AGATA using the AGAVA (**adding some dead time**)

- VME-USB high-speed readout using the Wiener (reduced dead time compared to previous solution)
- 5 ADC V785 (32 channels)
- 3 TDC V775 (32 channels)
- Modified TDC V785 with extended range
- Inclusion of scaler in the chain to better monitor and keep track of the exp. cond.



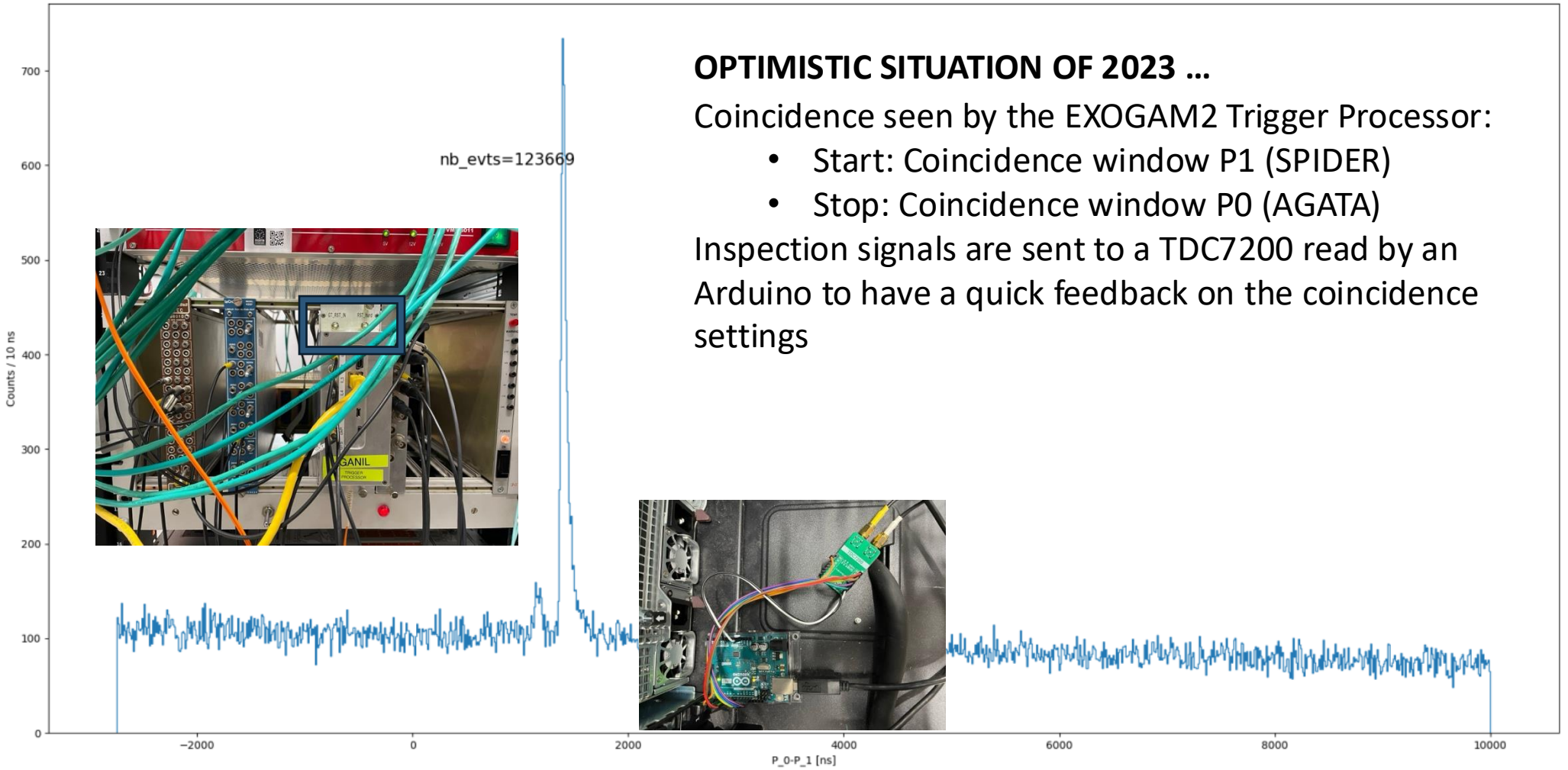
"TRADITIONAL" CHAIN

PRISMA READOUT DEAD-TIME



- Dead-time closely monitored during the experiments comparing the HW-trigger (OR-cathodes) to the readout trigger
- Dead-time reduced by up-to 50% at typical rates
- Due to detector time response better to keep the rates below 4-5 kHz to limit pile-up in the IC

COINCIDENCE VX2740 – AGATA (SPIDER-AGATA)



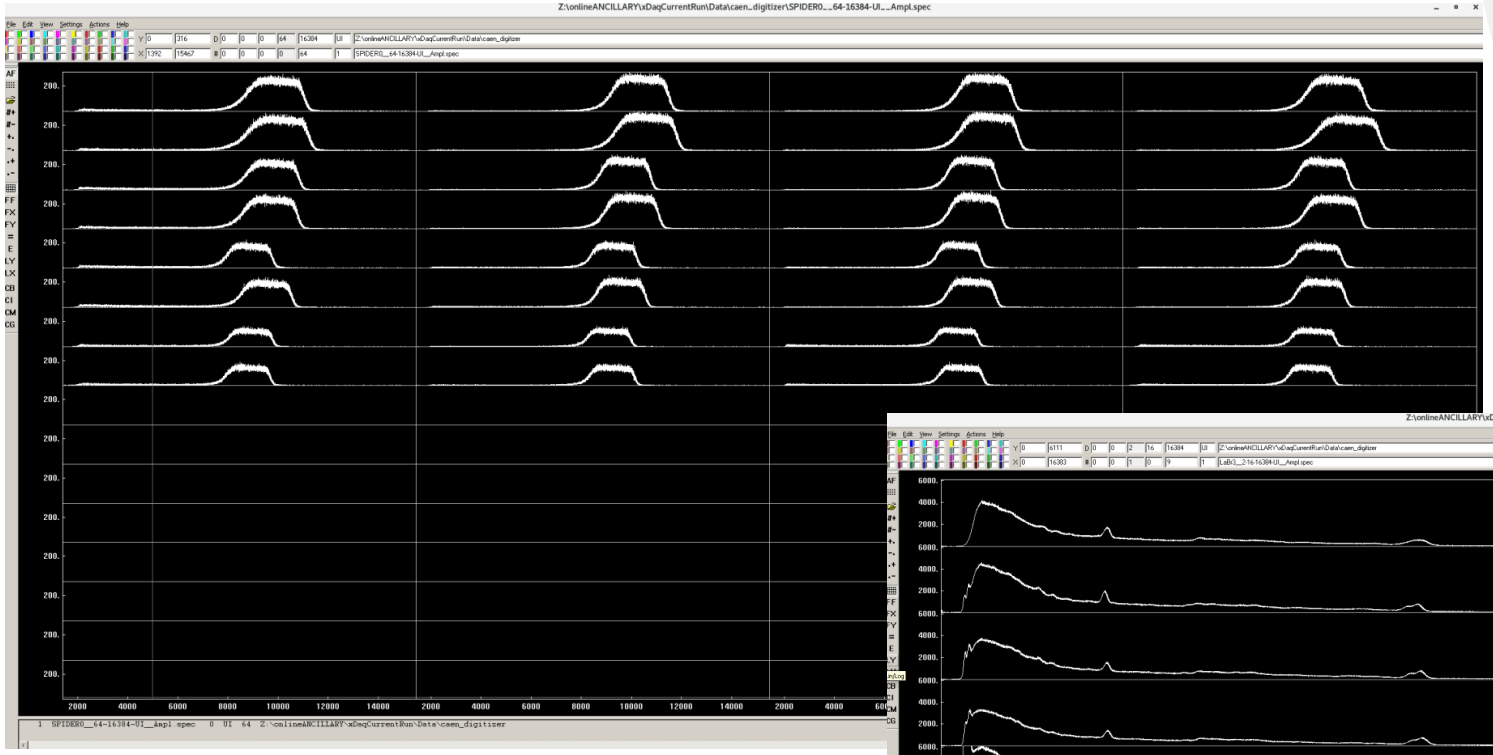
OPTIMISTIC SITUATION OF 2023 …

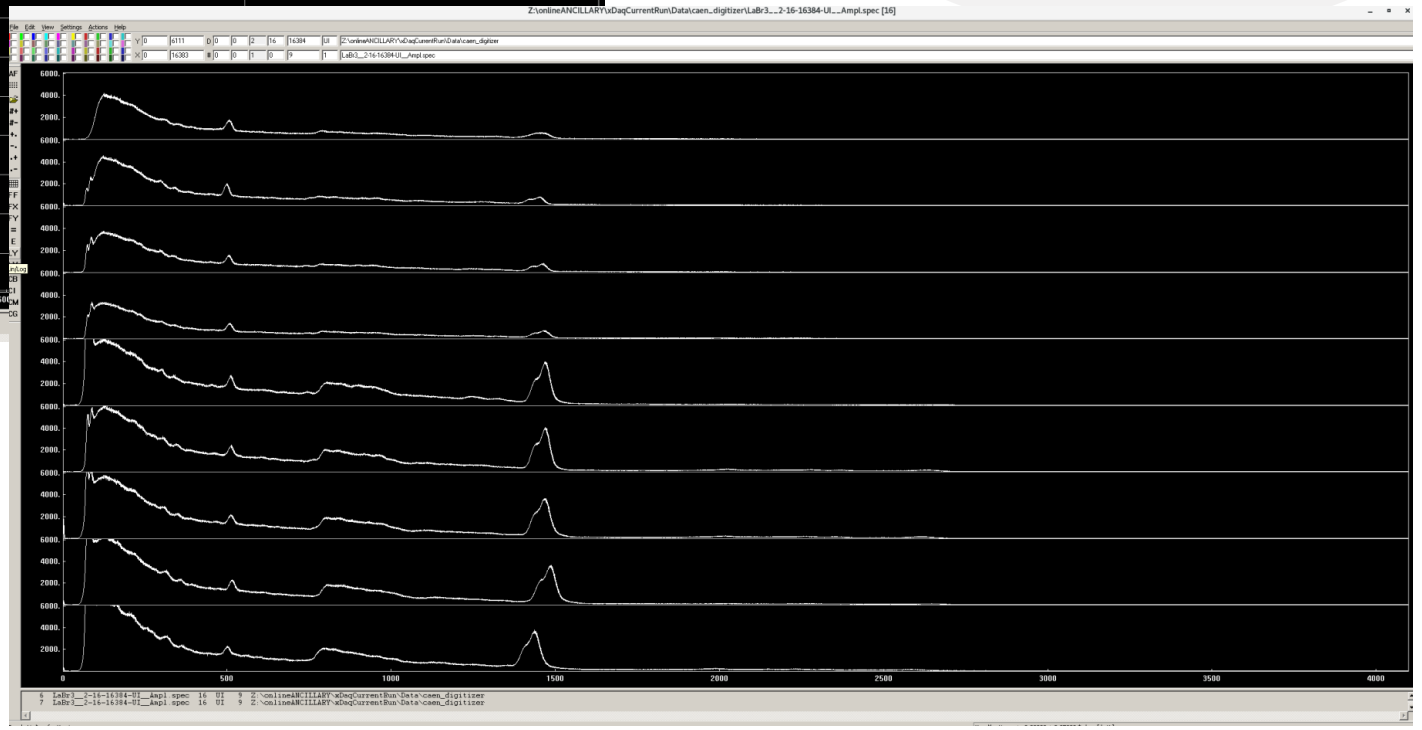
Coincidence seen by the EXOGAM2 Trigger Processor:

- Start: Coincidence window P1 (SPIDER)
- Stop: Coincidence window P0 (AGATA)

Inspection signals are sent to a TDC7200 read by an Arduino to have a quick feedback on the coincidence settings

MONITORING VIA TKT



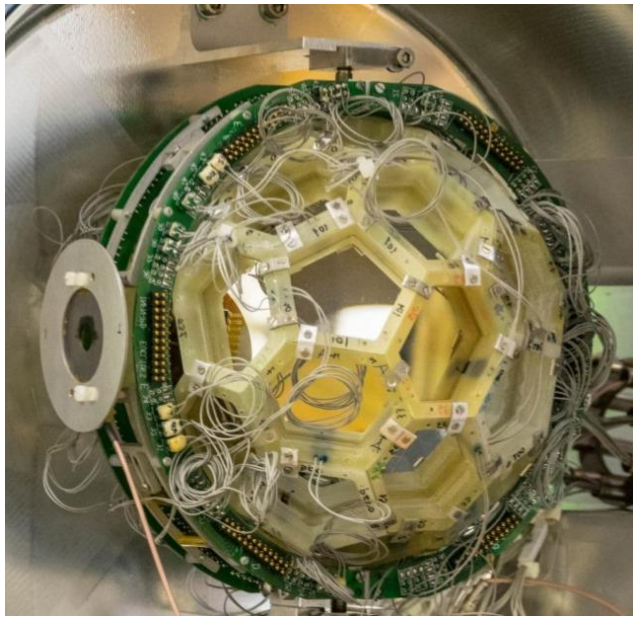


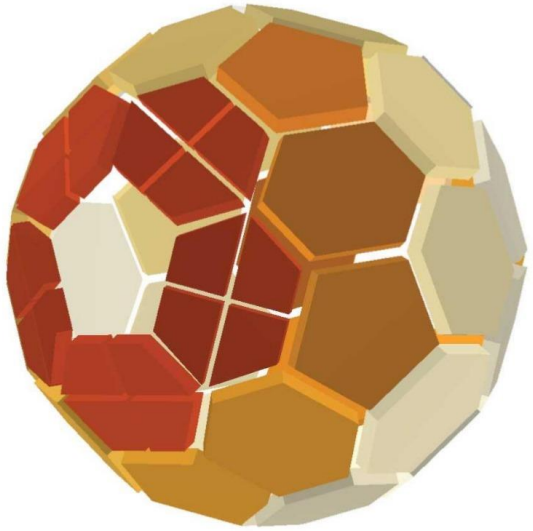
With the possibility to erase/write the spectra on command

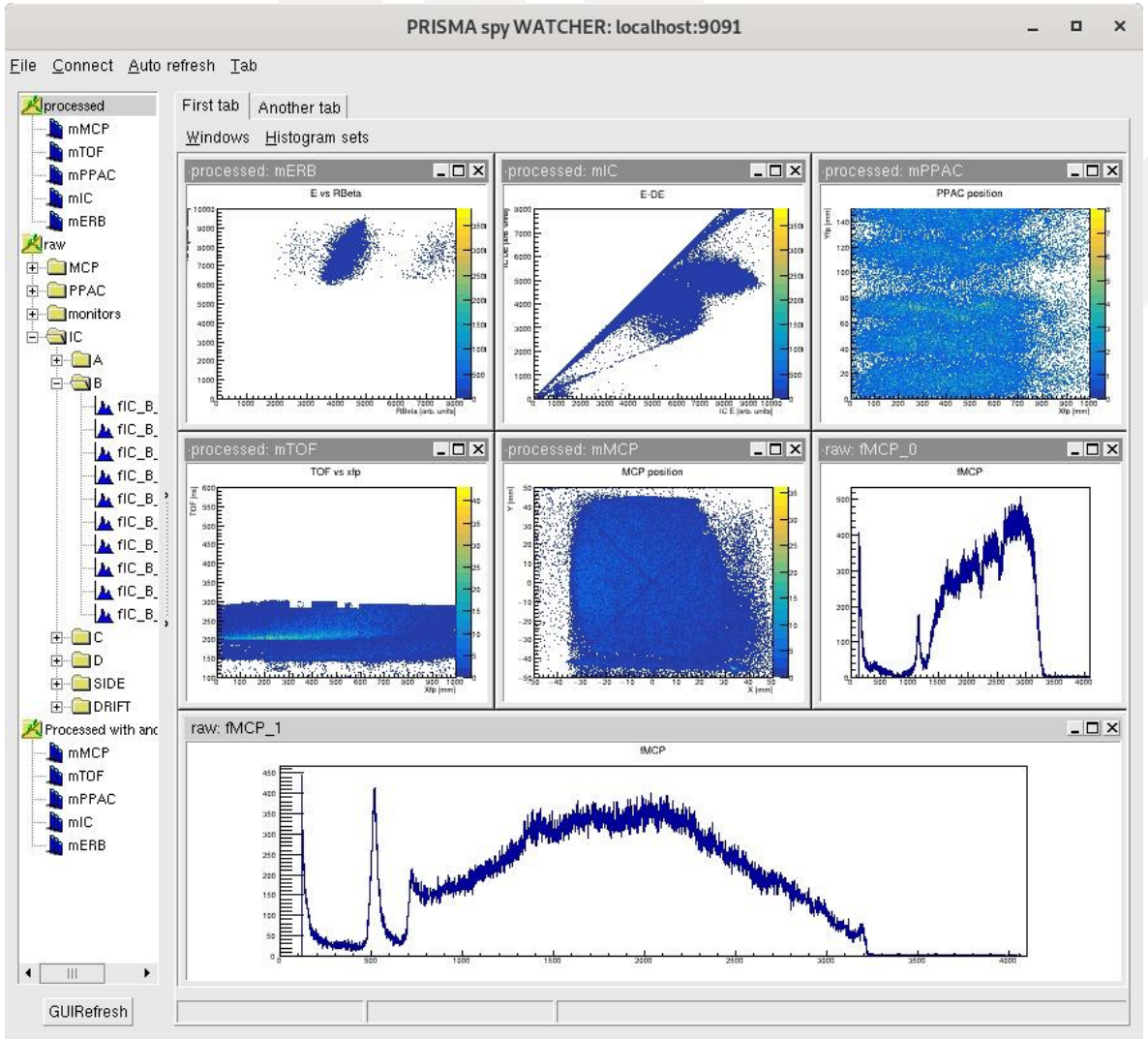
SPY MONITORING FOR ALL ANCILLARIES

Monitoring of the ancillary data quality at different level of the DAQ:

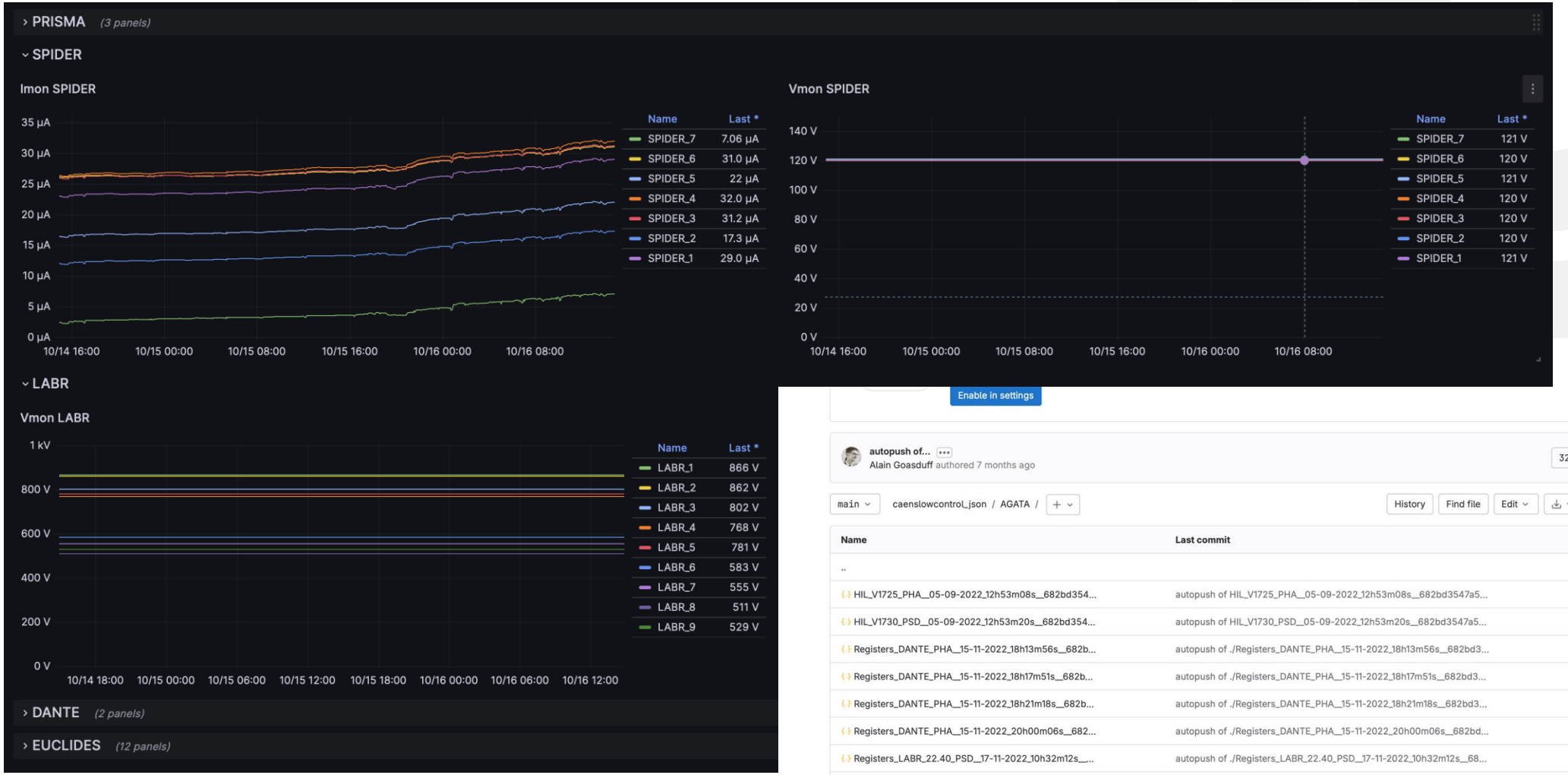
- Producer
- Event builder







MONITORING AND METADATA GENERATION



METADATA GENERATION

- Run Control has been modified (the version used at HIL):
  - Using the time range of the start/stop it can export all the requested parameters from the CARBON database
  - Output file can be regenerated in JSON/CSV/ROOT …
  - A direct export would allow to overcome the decimation of the data on the long term to keep the online data base with reasonable dimensions (at the moment ~ 100 GB)

- So …

1. What would you like to have?
2. Which format?

THE LOCAL TEAM

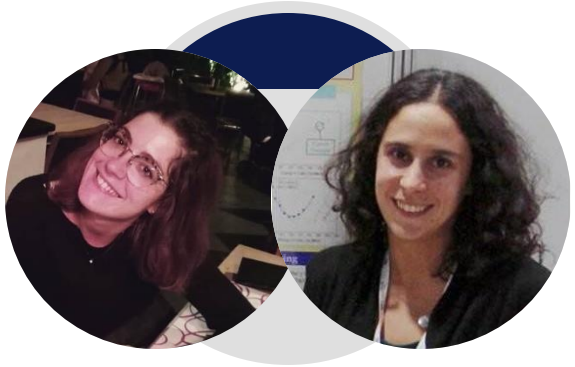
DANIELE BRUGNARA
JULGEN PELLUMAJ
EUCLIDES

MATUS BALOGH
NAOMI MARCHINI
SPIDER
S1 detectors

FRANCO GALTAROSSA
ELIA PILOTTO
PRISMA
OSCAR

KSENIIA REZYNKINA
JAIME BENITO
DANTE

MARTA POLETTINI
FILIPPO ANGELINI
PLUNGER



SARA PIGLIAPOCO
AGNESE GIAZ
LaBr3

ANDREA GOTTARDO
CTADIR

STEFANO CAPRA
TRACE

DANIELE MENGONI
Local coordinator