Dipartimento di Fisica e Astronomia Galileo Galilei

INFN
Istituto Nazionale di Fisica Nucleare

Università degli Studi di Padova

Daniele Mengoni

Dipartimento di Fisica e Astronomia "G. Galilei" Università di Padova
and INFN Padova

GRIT project status

GCM, 15 ottobre 2024, GANIL

GRIT

Outlook

- Generality
  - Physics
  - Tech status: Detectors, Mechanics, FE and BE Electronics, DAQ
- Organization
- Perspectives

The GRIT array

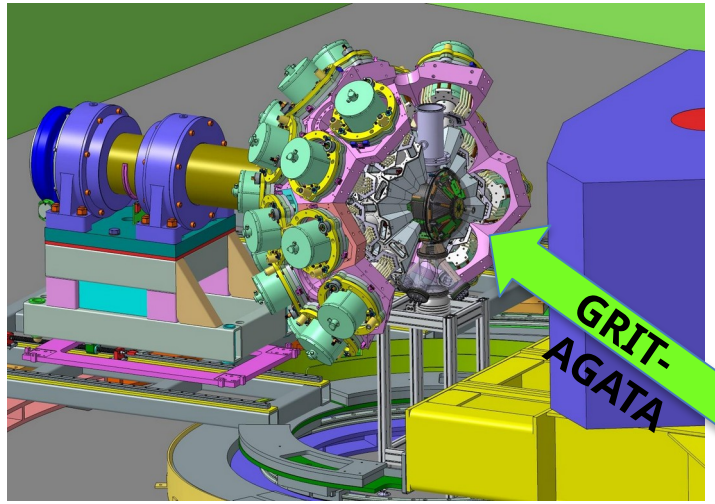
4π Silicon array fully integrable in AGATA & PARIS

DETECTORS

- High efficiency for particles
- High granularity (strip pitch < 0.8 mm)

Layers of Silicon

- 500 um DSSD pitch < 0.8 mm
- 1.5 mm DSSD pitch ~10mm



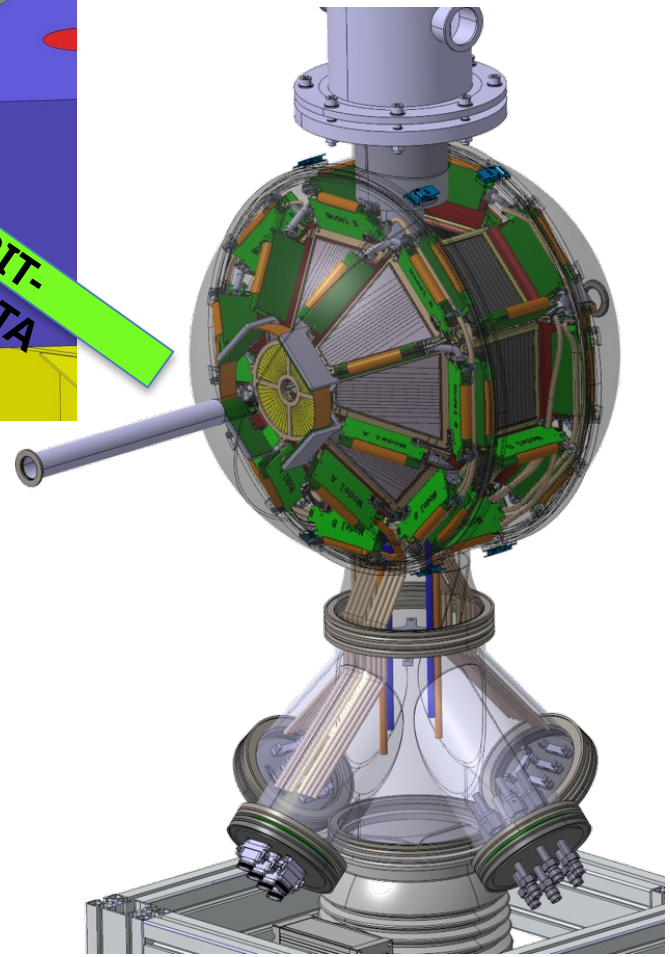
ELECTRONICS

- Large dynamical range
- PID using Pulse Shape Analysis techniques

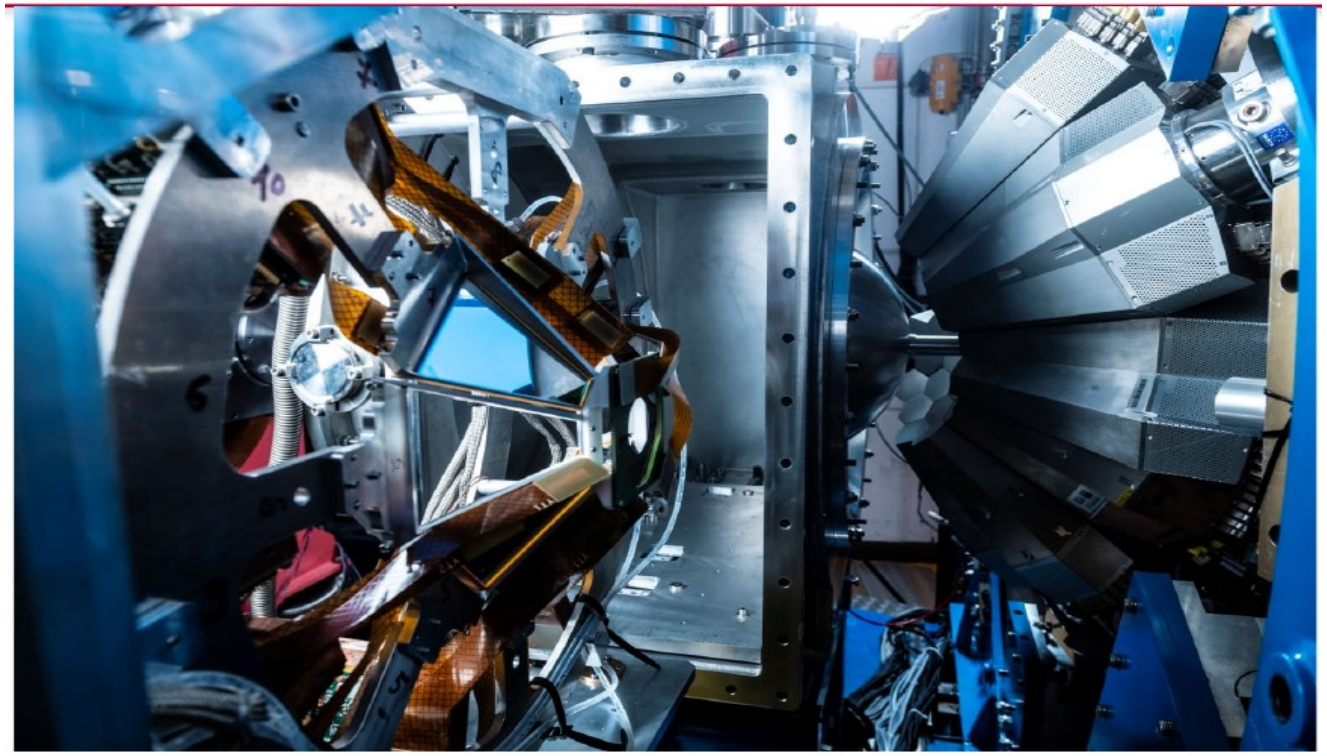
New Integrated Digital electronics designed by IJCLab, LPC Caen, INFN

MECHANICS

- Integration into **AGATA** (**radius=23 cm**)
- transparency to gamma-rays
- high compacity
- Special targets : cryogenic, tritium, windowless



Physics: some numbers



Assié et al., NIMA 1014 (2021) 165743

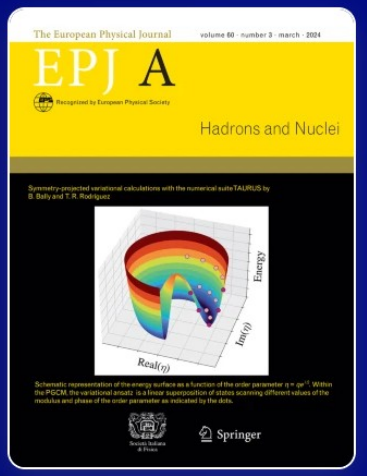
- 2019-2021 (SPIRAL1), 2023- (LISE): astro, structure reaction and clustering:
  - I Zanon, Phys. Rev. Lett. 131, 262501 (2023),
  - V. Girard-Alcindor et al Phys. Rev. C 105 (2022) 051301
  - D.Brugnara et al., submitted
  - C.Paxman et al., submitted
  - J.Sanchez et al., in preparation
- Education: 5 PhD thesis 1 Master thesis Pd 3 more PhD for the LISE campaign
- Tech: cryo target and high-intensity beam

Home › The European Physical Journal A › Article

Advances in nuclear structure via charged particle reactions with AGATA

Regular Article – Experimental Physics | Open access | Published: 26 May 2023

Volume 59, article number 117, (2023) Cite this article



- Comparison with worldwide exp setups
- Excellent resolving power of the combined setup, including gamma-ray tracking and particle detection (transfer/Coulex)
- https://doi.org/10.1140/epja/s10050-023-01026-3

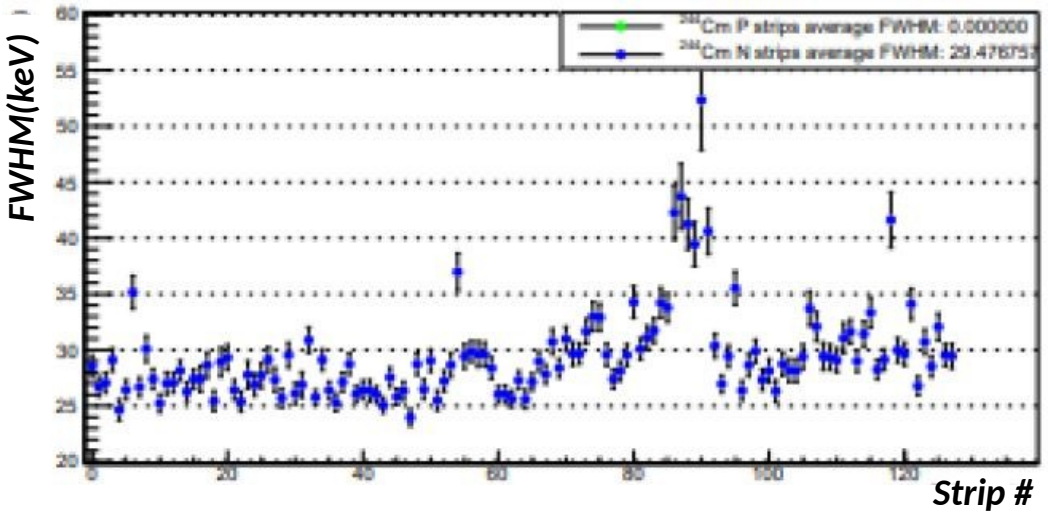
,,, and Long range plan 2024

NuPECC

Technical status

GRIT Detectors status

TTT11 3595-3 test results



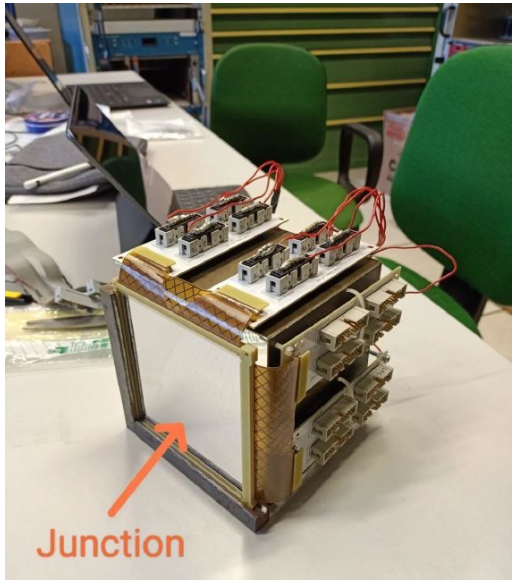
Detector	Code	Ordered	Received	Tested	To purchase
Thin trap.	FFF2	17	17	8(+4?)	2 spares
Thin square	TTT11	7	7	6	0+1 spare
Thick trap. 2nd stage	MMM4	15	13	12	1+3 spares
Thick trap. 3rd stage	MMM4	0	0	0	0
Thick square	TTT16	2	2	0	4+2 spares

Prototype of the annular detector being procured

- Tests on LNL Bench (all channels)

Thin Square and Trapez.

- Received thick square
- Test by end of 2024 early ‘25
- >80% of dets received

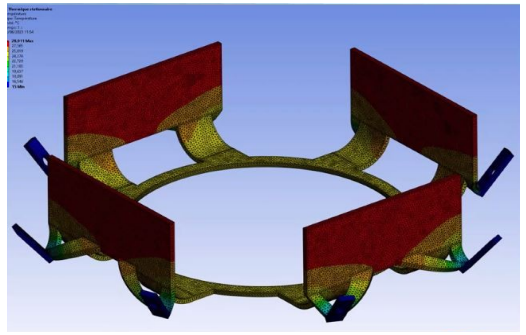


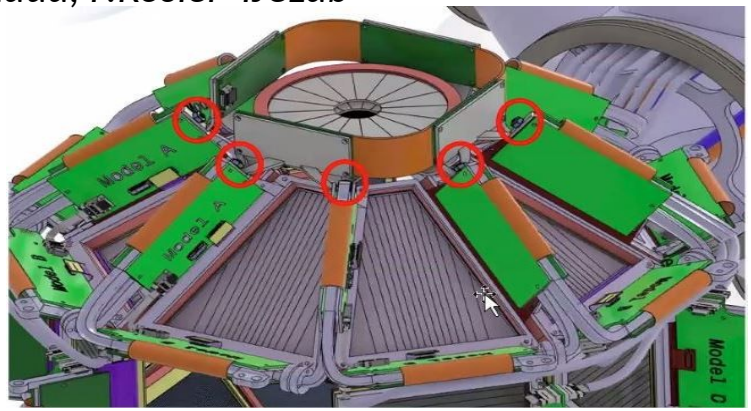
J. Duenas et al., https://doi.org/10.3390/s23125384
J. Duenas et al., https://doi.org/10.3390/s24082622

GRIT Mechanics

Y.Peinaud, P.Rosier IJCLab

- Initial plan:
  - ✓ Mockup of trapezoid cooling blocks 1 Annular
- Problem of galvanic corrosion identified





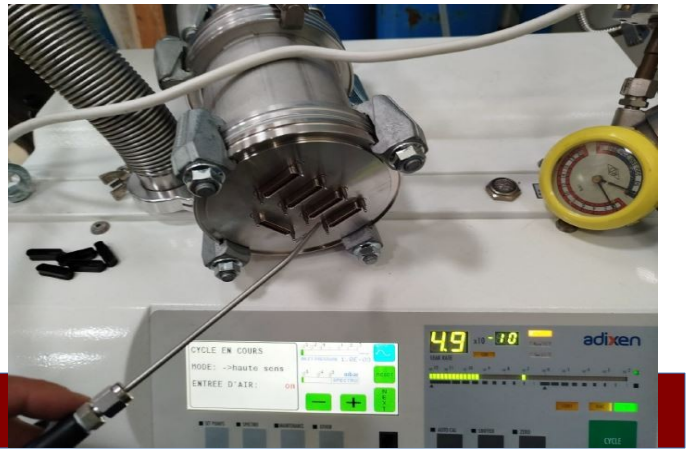
2024 Budget for mechanics is used to purchase new cooling blocks in Ti

Constraints	Validation	Person in charge	Parameters	Units	Titanium TiCp	Copper Cu	Aluminium AlSi10Mg	Stainless Steel 316L
Agata transparency	Geant4 simulation	Simone	Density	kg/m3	4500	8900	2700	7900
FEB cooling efficiency	Ansys thermal simulation and test	Yann and Philippe	Thermal coef	W/m.k	16	400	200	15
Cooling block corrosion	Test with water @ ijclab	Yann	Galvanic couple vs Stainless Steel (pipes, chiller)	mV	0	320	840	0
Price	quotations	Management Board	Material powder, treatment, post treatment	k€	1,4	1,5	1	1,4

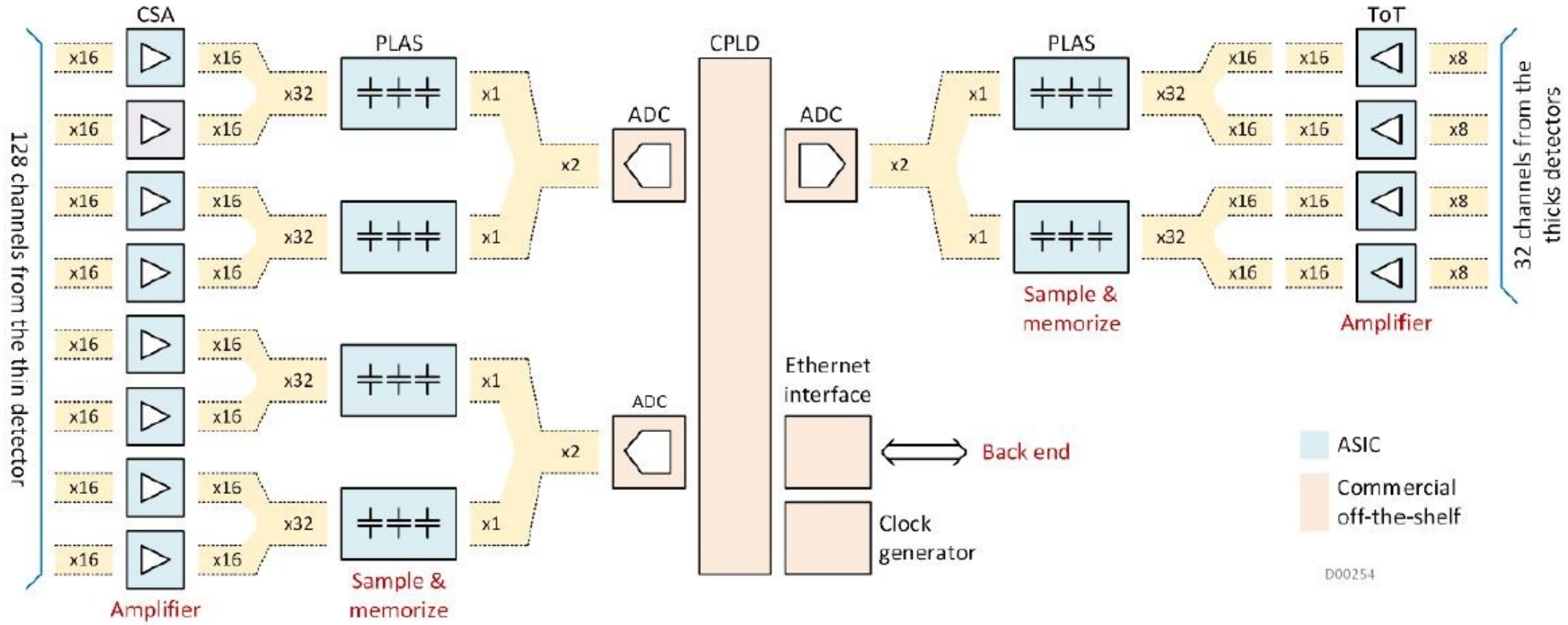
- Outgassing tests at IJCLab (also for integration of the ATRACT cryo target)
  - ✓ 30cm of AXON cable
  - ✓ Front-end boards of MUST2
  - ✓ Trapezoid detector packaging
  - ✓ Gap Pad BERGQUIST® TGP HC5000

Reception and leak test of the 4 GRIT feedthrough flanges from AXON

→ **OK**



GRIT Front-end Electronics



GRIT Electronics: external review

Report on electronics for the GRIT project.

10th-11th April 2024. Orsay IJCLAB

David Baudin (CEA/IRFU/SACLAY),

Ian Lazarus (STFC/DARESBURY),

E. Delagnes (CEA/IRFU/SACLAY)

The review focused on the following points:

- Is the approach correct/sound ?

- Is the technology appropriate ?

- Is the proposed timeline feasible ?

- Has risk analysis been made ?

- Is man power (Full Time Equivalent) sufficient ?

- Are cost estimates realistic ?

- 20 pages report prepared by the MB (C.Soulet)
- ½ day oral presentations
- Report from the reviewer issued end of May

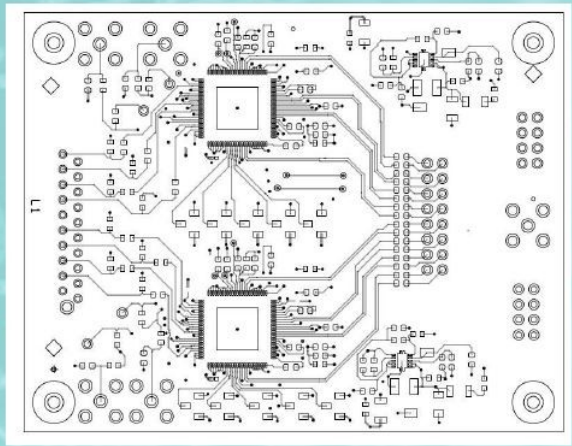
preamp ASIC for the first layer - status

Reviewers recommended to make use of existing preamp chip or develop a simplified and more compact version of TOT in AMS

- 2 solutions being tested
  - ✓ MCC2SA from LPC
  - ✓ Stripped-down Milano preamp

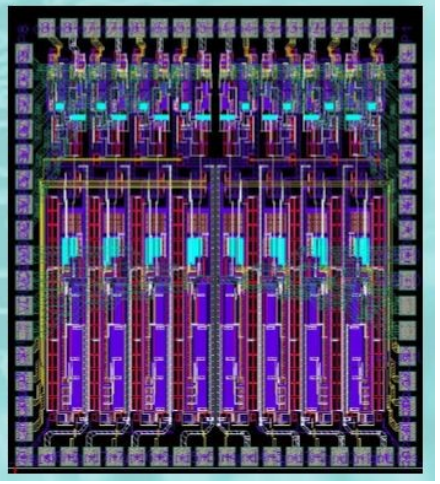
MCC2SA evaluation

- Simple test board with 2 ASICs
- 8 channels
- Differential outputs on flat cable
- Simple power scheme: +5V
- ARDUINO-based I2C communication
- Will be tested with available detectors
- In-beam test to study PSA capabilities (end of November – first week of December)



Stripped-down Milano Preamp for first layer

- 8-channel prototype
- 5 mm^2
- 10 keV or better RESOLUTION FWHM
- 50 mW/channel power dissipation
- Differential output stage
- QFN64 package
- Dual +/- 2.5V power supply
- No need for external feedback resistor
- Tape-out July 24, expected by Nov. 24
- Switchable polarity



In beam test early next year

S.Capra, INFN MIlano

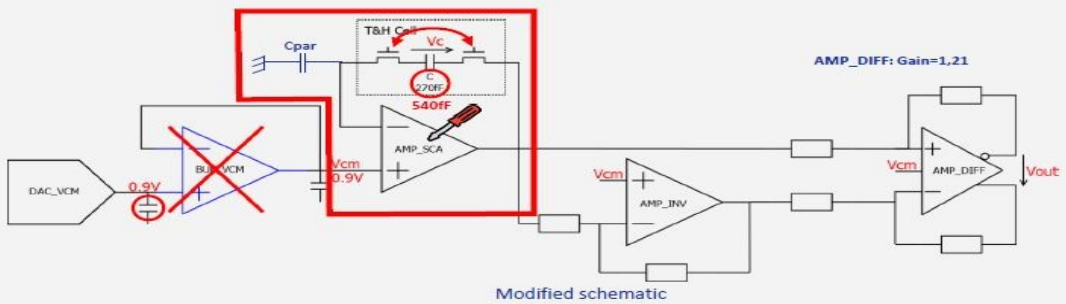
PLAS V3 design - status

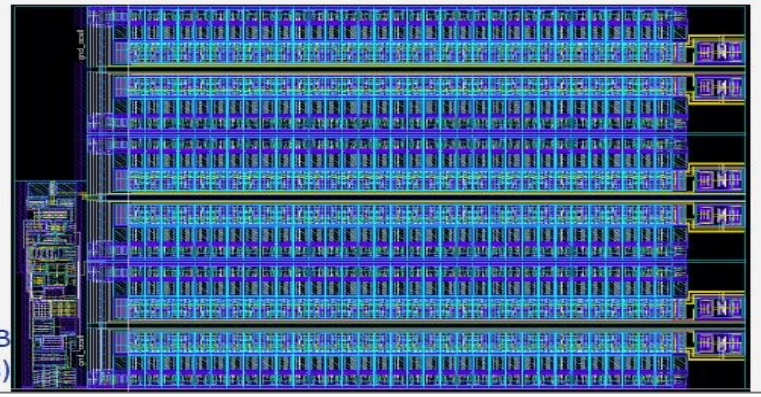
Required upgrade of technology TSI 0.18um → XFAB 0.18

"heavy workload" (reviewers)

S.Drouet – LPC Caen

Simulation of the noise on the reading stage (only blocs into the red part) with XFAB, and Comparaison to the noise obtained with the optimization made on TSI technology





Preliminary Layout with XFAB (AMP_SCA+192 memory cells)

		fullscale Range	Noise	SNR	DC ENOB
Original Schematic (PLAS_v2)	Schematic	1,2 V	624 μV_{RMS}	56,6 dBFS	9,1 bits
Modified Schematic (on TSI)	Schematic	1,2 V	233 μV_{RMS}	65,2 dBFS	10,5 bits
New Design on XFAB	Schematic	1,2 V	223 μV_{RMS}	65,6 dBFS	10,6 bits
	Layout (extracted with RC parasitics)	1,2 V	237 μV_{RMS}	65,1 dBFS	10,5 bits

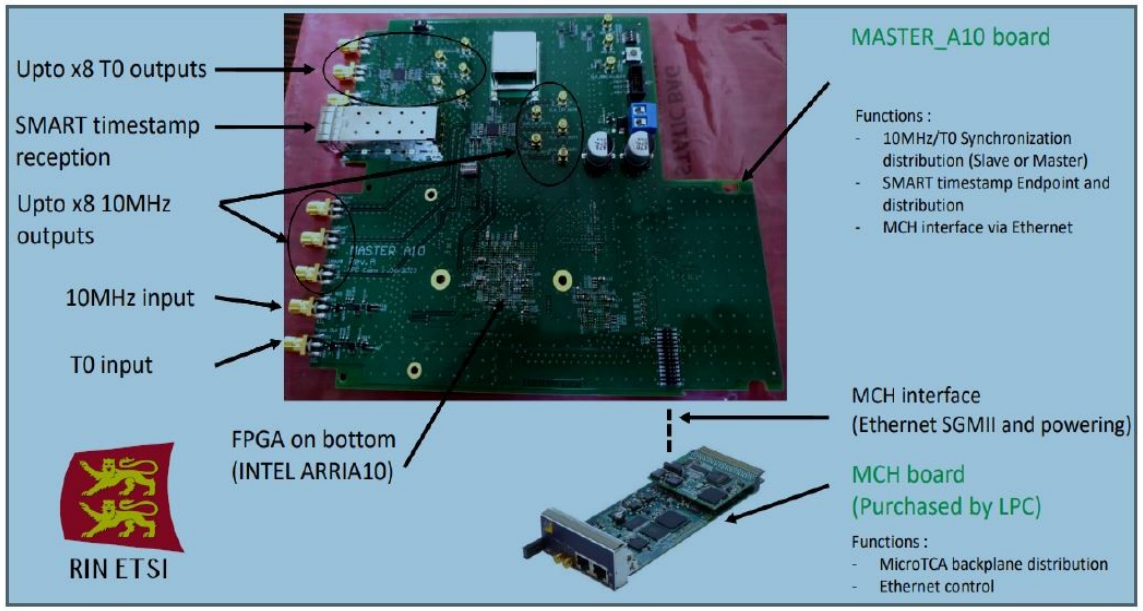
- Debug of the existing design
- Revision of the input stage
- Assessment of the performance
- XFAB → proprietary toolkit

GRIT Backend activities

(A.Matta)

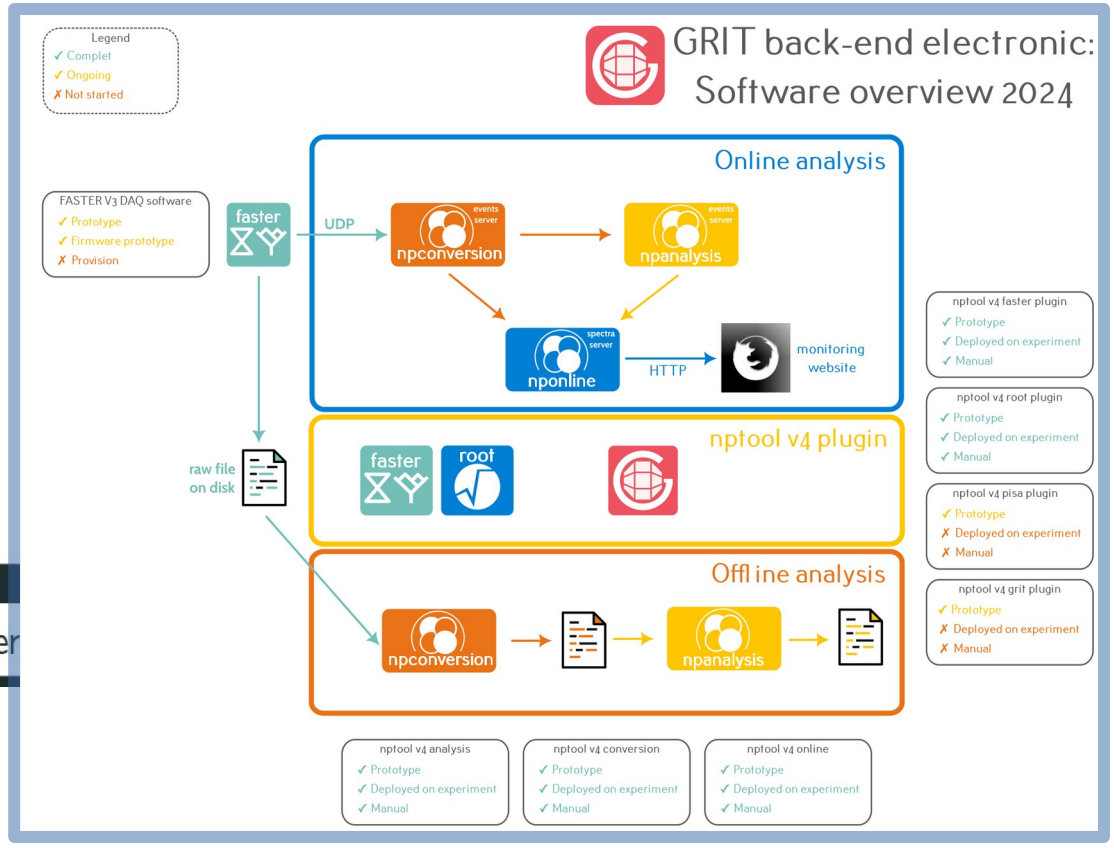
FASTER/SMART coupling: GRIT&AGATA working together

MASTER A10 (**F. Ingouf**, G. Wittwer, GANIL & D. Etasse, B. Carniol, LPC Caen)



Board to Board test done. Waiting for SMART to be finalised to test further

- FASTER V3
- Analysis ONLINE OFFLINE:
- NPTOOL V4



Collaboration

GRIT MoU renewal

Memorandum of Understanding
For the GRIT array
Granularity, Resolution, Identification, Transparency
2020 - 2024

Preamble

The GRIT international collaboration is aiming to build and operate a new detector, GRIT, conceived for optimal study of reactions using low and intermediate energy radioactive ion beams. The device consists in a new type of compact, highly segmented Silicon array, optimized for integration in gamma detector arrays such as AGATA, EXOGAM2, GALILEO, and PARIS. It is also meant to offer state-of-the art particle identification for improved reaction channel separation hence physical background reduction. Native integration of special targets such as the Orsay Helium cryogenic target or the pure and windowless hydrogen target production system CHYMENE, is also

- Financial status
- New collaboration structure
- Status report of each WG was produced
- New workplan under elaboration

GRIT Collaboration structure

Collaboration:

IJCLab, LPC Caen, INFN (Padova, Milano, Firenze), Surrey U., Valencia U., Santiago de Compla U., Huelva U., GANIL

Spokesperson : D. Beaumel (IJCLAb)
co-Spokesperson: D. Mengoni (INFN/Padova)
Technical coordinator : C.Soulet (IJCLab)

Steering committee

Y. Blumenfeld (IJCLab)
W. Catford (U. of Surrey)
G. De Angelis (LNL)
G. De France (Ganil)
A. Gadea (IFIC/Valencia)
S. Leoni (INFN-Milano) CHAIR
N.Le Neindre (LPC)
A.Pullia (INFN-Milano)

Management Board

SP , co-SP, TC
+ Working Group Leaders

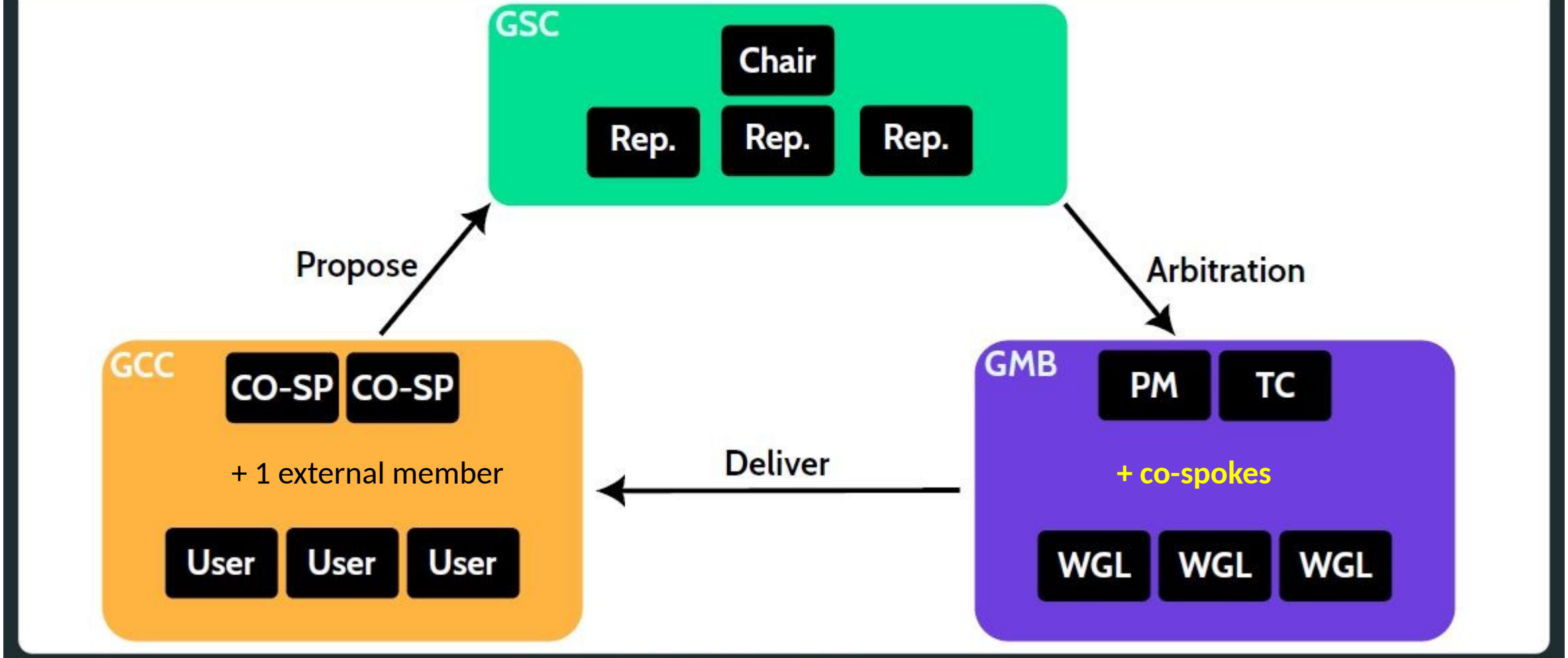
Working Groups

1. Mechanics
Ph. Rosier (IJCLab)
2. Detectors
F. Galtarossa (Padova)
3. FE Electronics
S.Capra (Milano)
4. DAQ/backend
A.Matta (LPC Caen)
5. Simulations
S.Bottoni (Milano)
6. Special targets
A.Gottardo (Legnaro)
7. MUGAST
M.Assié (IJCLab)

Scientific coordinator at GANIL : M.Assié (IJCLab)

GRIT construction phase organisation

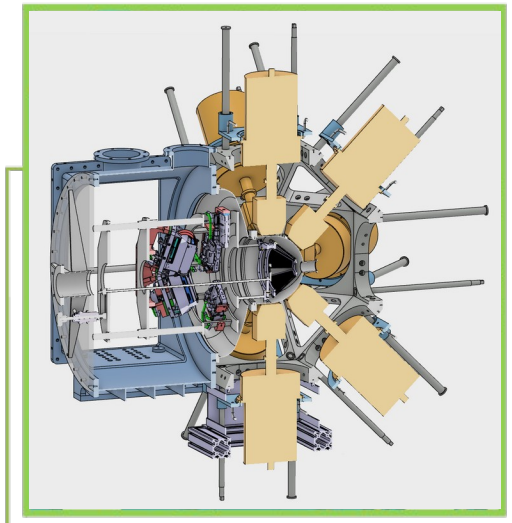
General layout



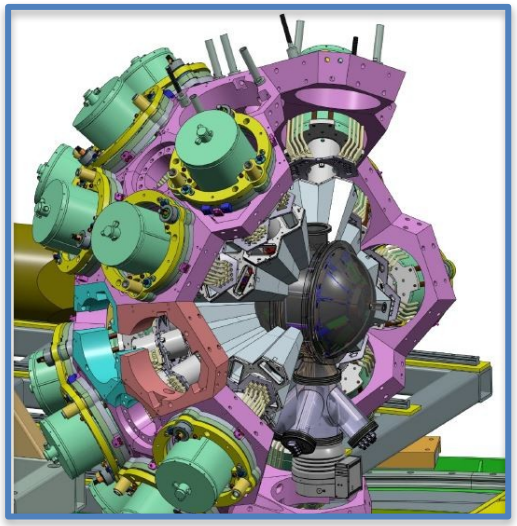
Perspectives: GANIL and beyond

MUGAST / GRIT – Timelines

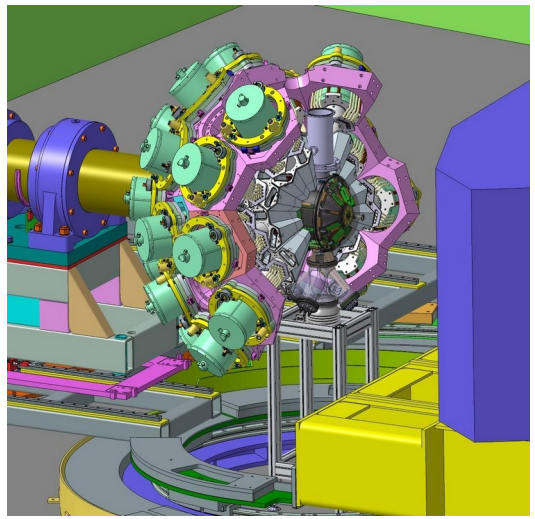
MUGAST-
AGATA-VAMOS
@GANIL



MUGAST-
EXOGAM-LISE
@GANIL



MUGAST/GRITPh0
AGATA-VAMOS
@GANIL



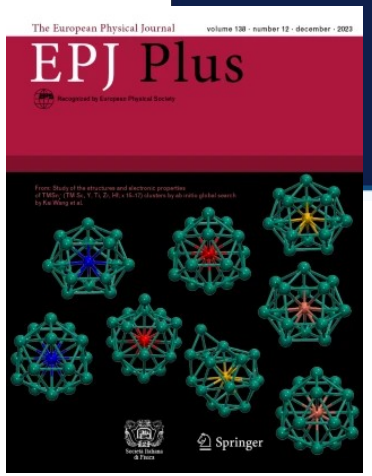
GRIT+AGATA
@SPES ?

2019-2021 | **2023-2027** | **2028** | **2029-2030** | **2031 -**

Today

GRIT Phase0 Commiss.

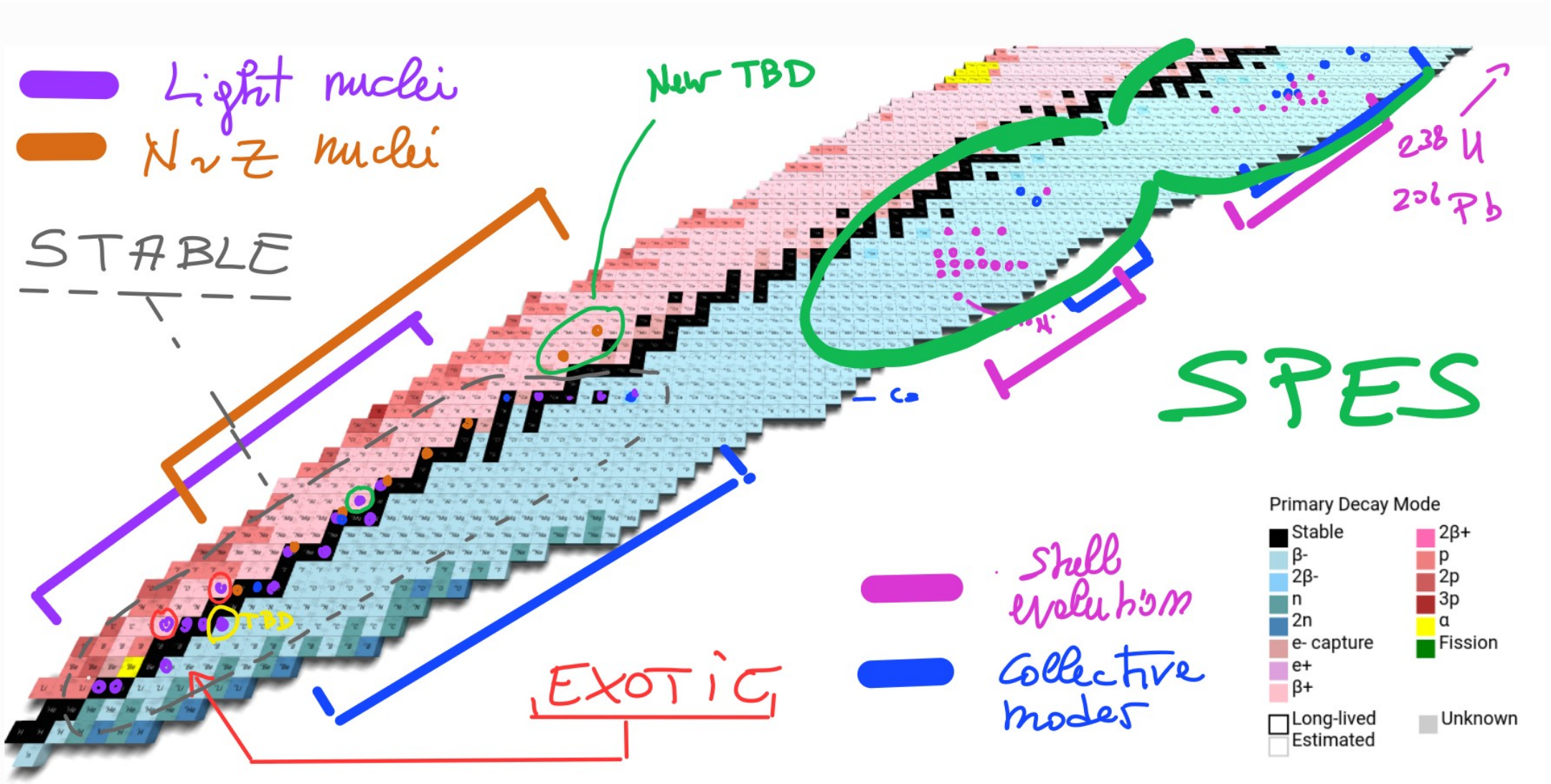
INFN Physics MID-TERM Plan



Eur. Phys. J. Plus 138, 709 (2023),
https://doi.org/10.1140/epjp/s13360-023-04249-x
https://agenda.infn.it/event/28738/

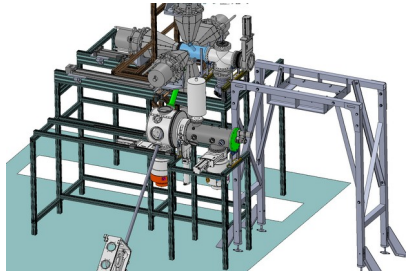
Mid-term plan initiatives @ INFN LNL

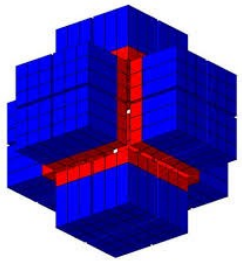
https://web.infn.it/nucphys-plan-italy/



Instrumentation

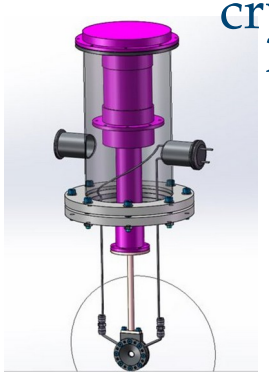
β-decay
station



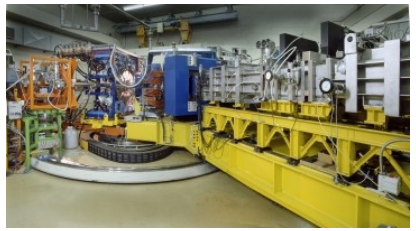


PARIS
γ-rays

CTADIR
cryogenic
target

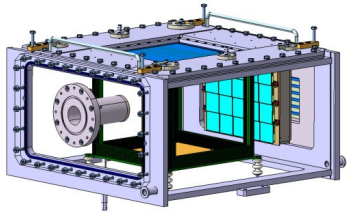


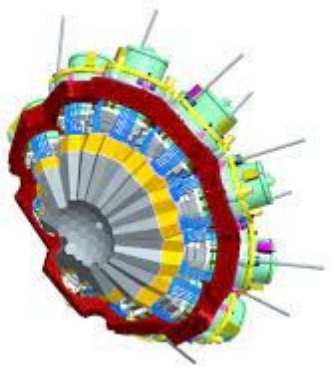
PRISMA
heavy ions



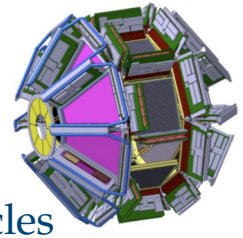
Forefront
contemporary nuclear structure
needs ground-breaking integrated
systems

ACTIVE TARGETS

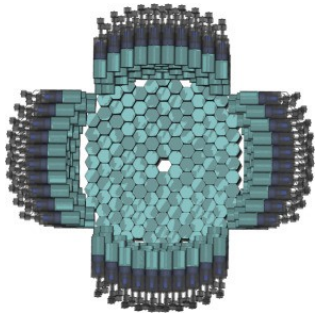




AGATA
γ-rays

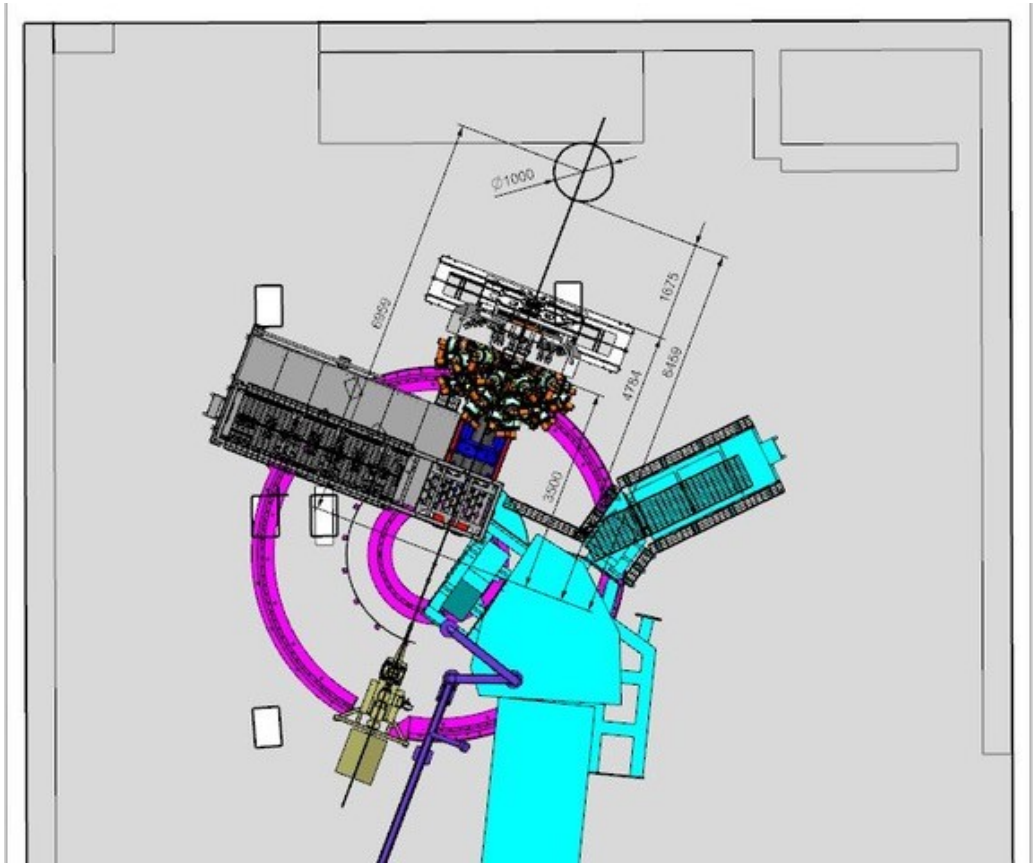


GRIT
charged particles



NEDA
neutrons

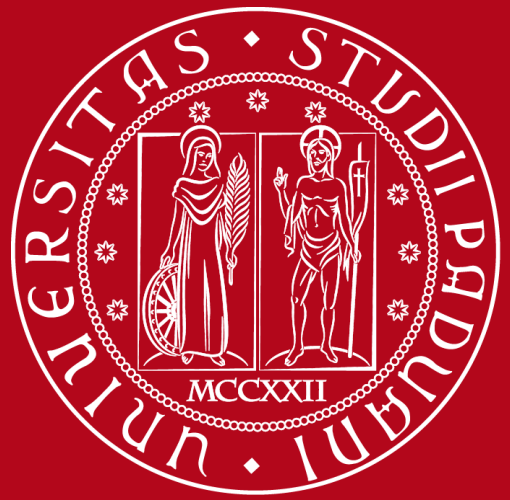
Possible LNL configuration with AGATA



- “zero-degree” configuration plausible
- New reaction chamber compatible with AGATA 2pi,
- ZDD probably needed,
- cryo target compatibility

Conclusions

- Detectors: all prototypes developed, ~80% procured
- Mechanics: design FINAL GRIT chamber being finalized at IJCLab , compliant with AGATA and new cryo targets.
- External review on the electronics to orient the FEE: ASIC Plas_vXX challenging planning success oriented, ASICs preamplifiers opmitized
- BEE, DAQ ongoing
- Renewal/Extension MoU ongoing
- Planning in evolution: given the present timeline and the recommendation of the ASC, it seems timely to commission the array an have a first campaign @GANIL.



UNIVERSITÀ
DEGLI STUDI
DI PADOVA