



Status and perspectives of the GANIL Campaign

AGATA Week October 2016



*Charged particles
detectors for Coulomx and
nucleon transfer*

*Neutron and charged
particles detected in
NEDA/DIAMANT*

*Separated and tagged
by their decay in the
VAMOS GFM*

*Recoils identification by the
VAMOS magnetic spectrometer*

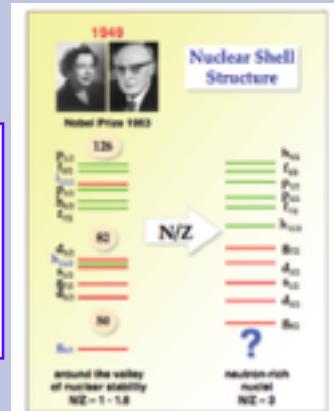
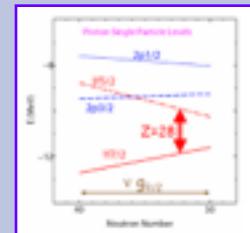
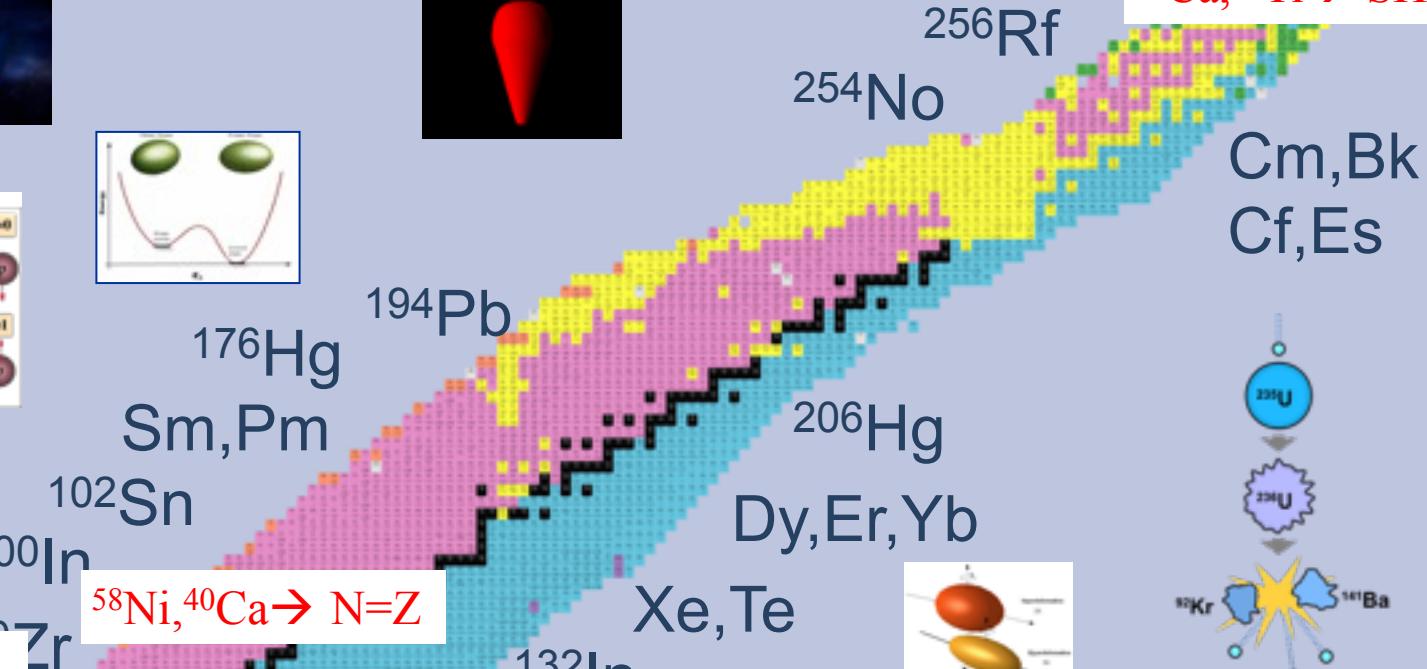
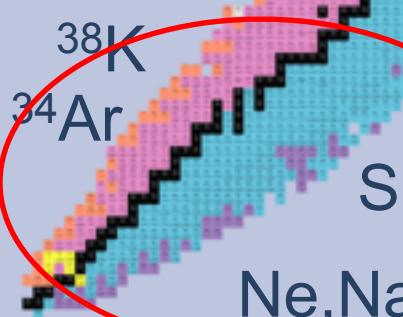
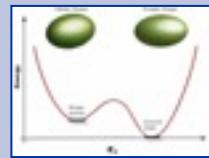
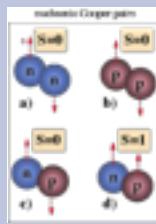
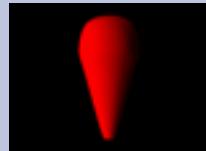
*Post-accelerated RIB
from SPIRAL1*

Fusion-evaporation

*M multinucleon Transfer
and fusion-fission*

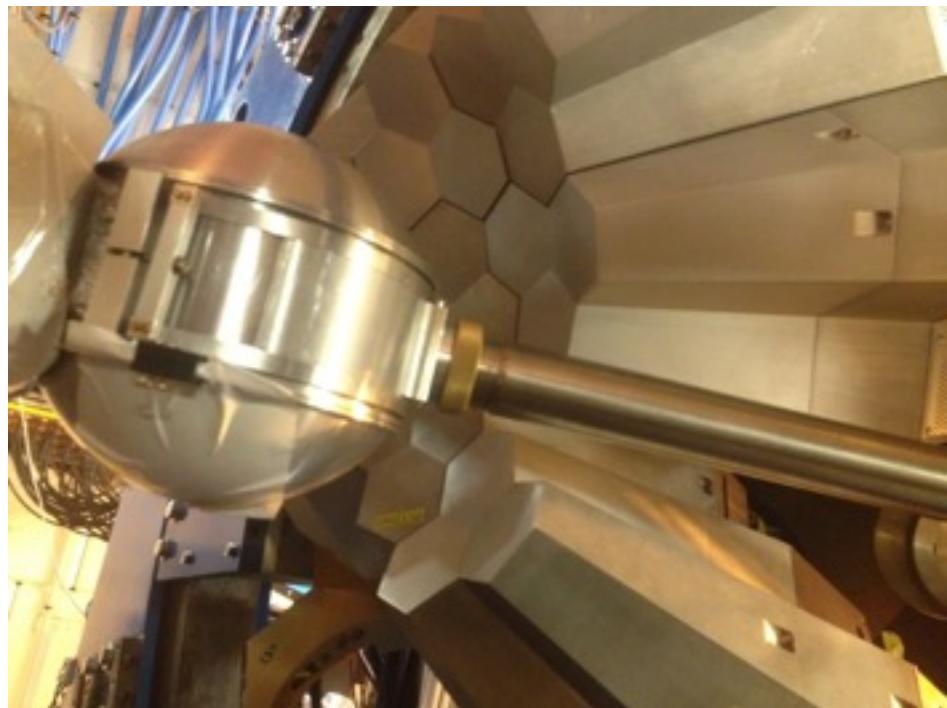
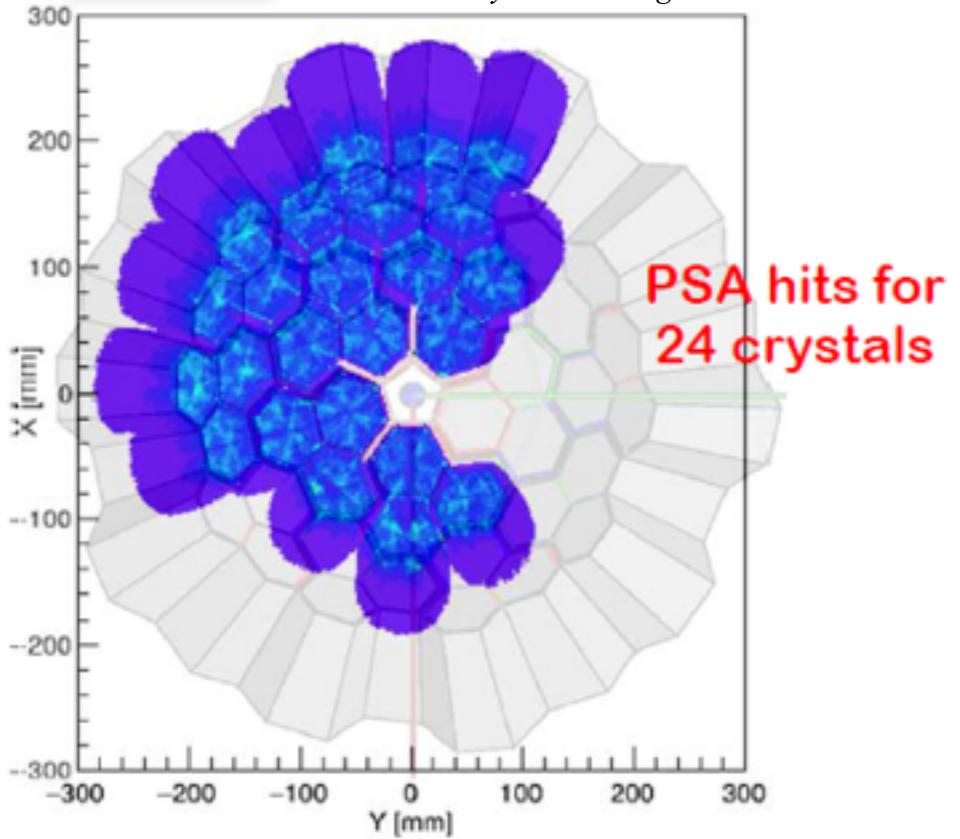
The physics case of AGATA@GANIL is the in-beam γ -ray spectroscopy of exotic nuclei populated by heavy-ions collisions at the Coulomb Barrier

Physics cases for the AGATA campaign in GANIL

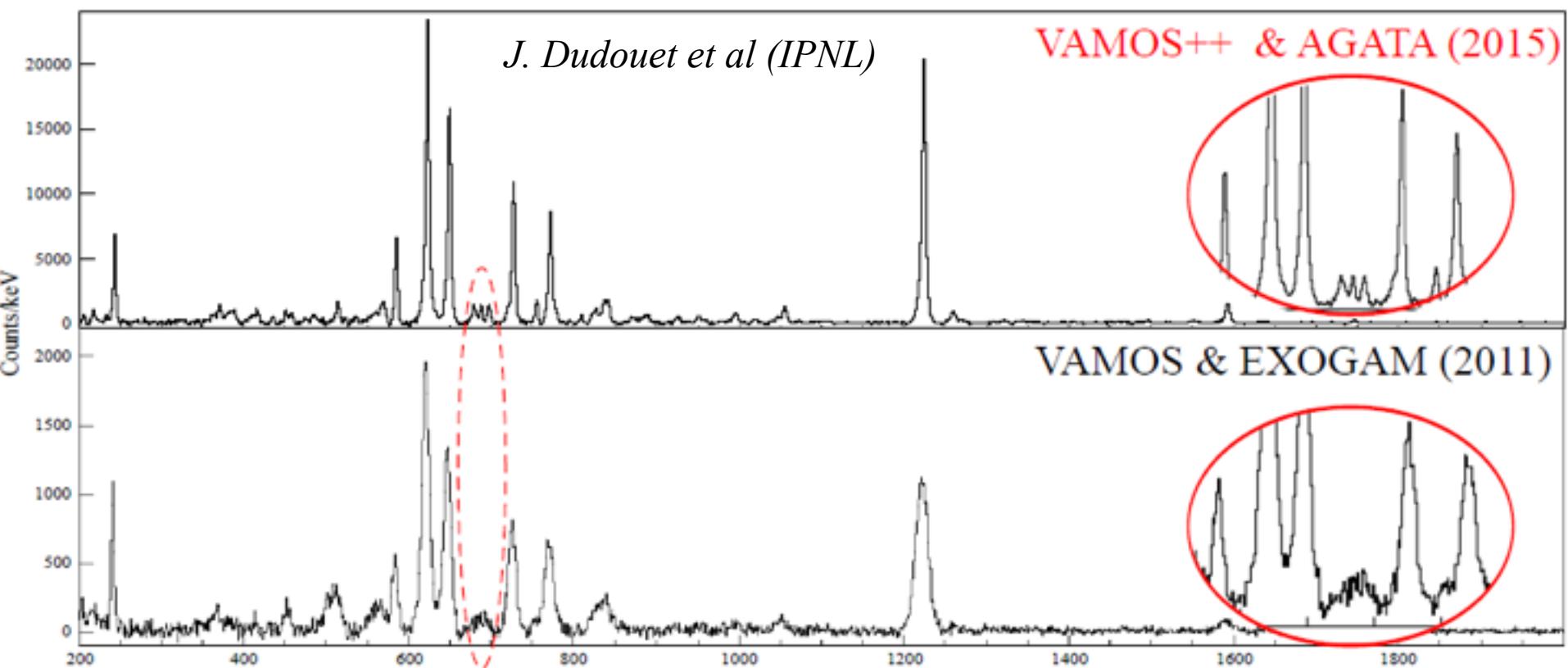
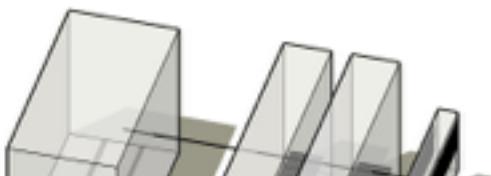
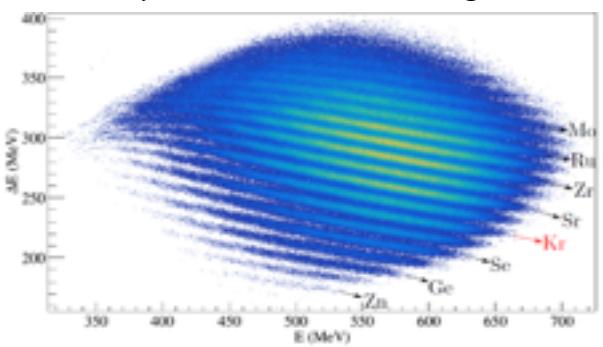




Courtesy C. Michelagnoli



AGATA@GANIL – April 2015



2016 run preparation



à 3 more clusters : ADC3, ATC9 and ATC10

Extension of the LN2 Autofill (GANIL – Irfu - INFN)

PT100 readout upgrade (Irfu – GANIL - INFN)

Detectors preparation (IKP-GANIL-Irfu)

à Mechanical Alignment check (STFC- GANIL)

à GGP – DIGOPT12 installation (IFIC-INFN-CSNSM-GANIL)

à Data storage, workstation farm, RCC upgrade (CSNSM-IPNO - GANIL)

à ATCA reliability (CSNSM)

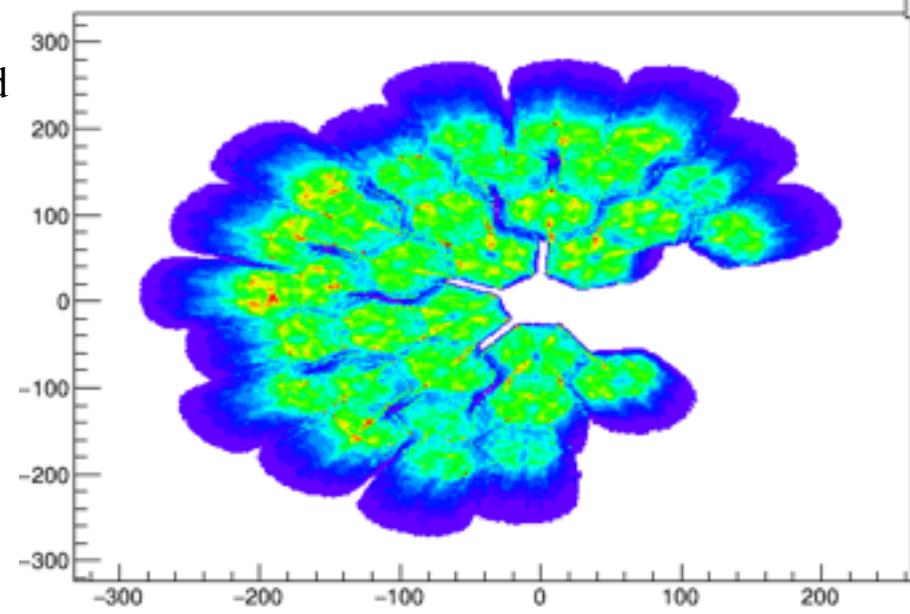
à Data analysis infrastructure (CSNSM – IPNO - IPNL)

à Extensive campaign of Sources measurement



- ❑ 10 Triple Clusters and 1 Double Cluster
- ❑ up to 32 channels operational with phase1 (ATCA) and advanced phase 1 (GGP) electronic chains + 1 spare (1184 hpGe Channels)
- ❑ DAQ infrastructure is running smoothly (~ disks ...)
- ❑ Detectors Infrastructure are perfectly running

→ This is a great success of the AGATA collaboration





2016 run

C. Fransen et al. : Evolution of the shell structure in the region of neutron-rich Ti isotopes

I. Celikovic et al. : Evolution of collectivity around N=40: lifetime measurements in $^{73,75}\text{Ga}$

A. Navin et al : $i_{13/2}$ single particle state in ^{133}Sn and high spin in ^{108}Zr

C. Michelagnoli et al . : The lifetime of the 7.786 MeV state in ^{23}Mg as a probe for classical novae models

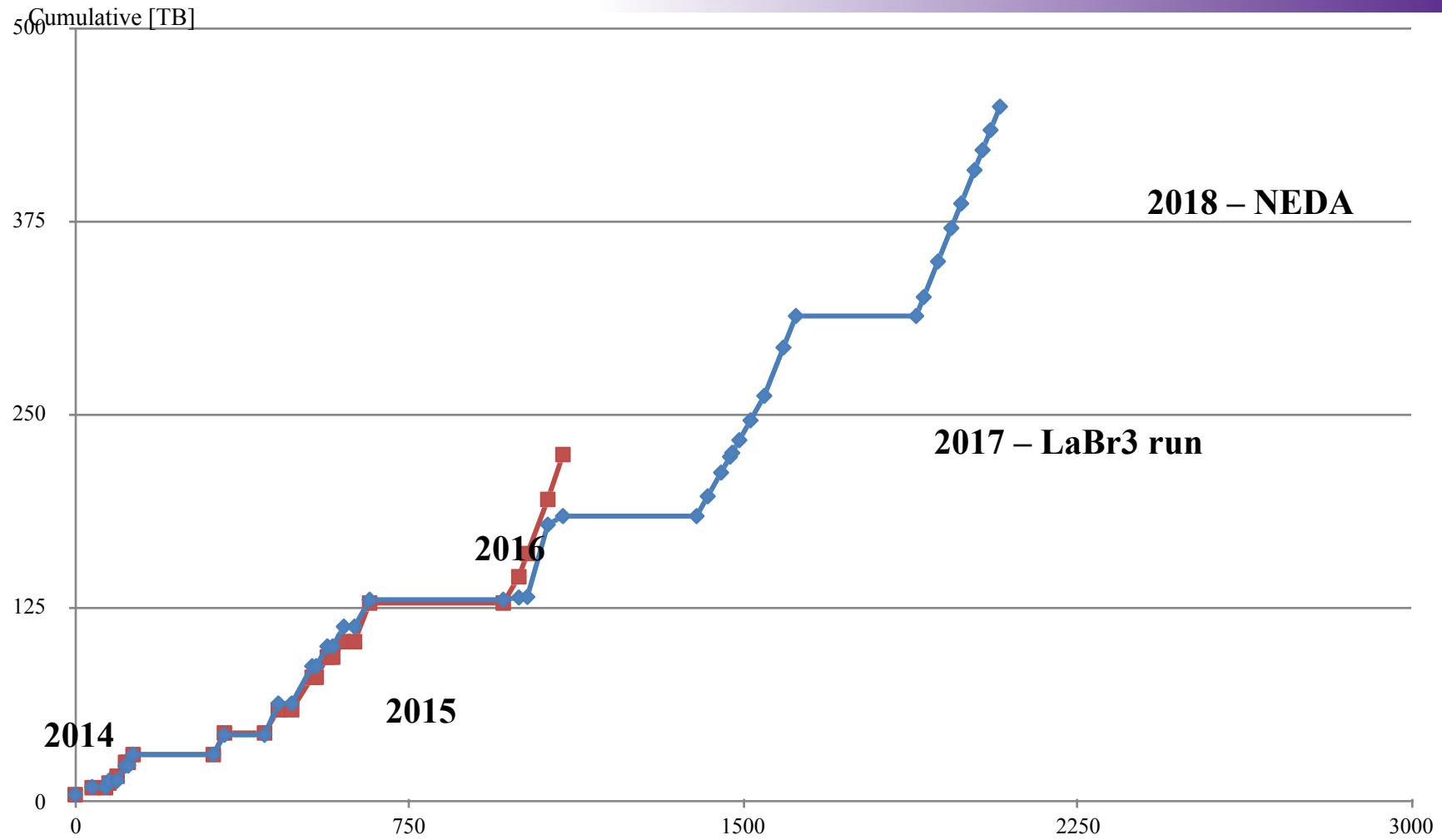
- ✓ 29 capsules running (limited by the availability of FEBEE)
- ✓ Cr/Ti Plunger **target** issues which has limited the beam intensity

- ✓ 29 caps running (ATC7 out ; see Herbert's report)
- ✓ ^{76}Ge , Plunger **target** issues which has limited the beam intensity

- ✓ 32 caps running
- ✓ Some issues with the 2nd arm
- ✓ Delayed gamma with EXOGAM at the focal plane

- ✓ 31 caps running (1 GGP channel out)
- ✓ Additionnal DSSD in the chamber
- ✓ **Target** integrity (^3He)

All 2015-2016 data have been transferred to GRID Tiers'1
in CC-Lyon and CNAF-Bologna



The GANIL Campaign organization

The AGATA campaign at GANIL has been extend to end of 2019

Each GANIL PAC has a “PrePac” workshop with a specific call : ***AGATA Collaboration Meeting***

- 1st PAC in 2014 : VAMOS (10 experiments approved)
- 2nd PAC in 2015 : VAMOS || NEDA (10 experiments approved)
- 3rd PAC in 2016 : NEDA (6 experiments approved)

E724	M.A. Bentley	20	1	1	18		B
E725	B. Cederwall	36	1	1	30	4	A
E727	B. Fornal	22	2	3	15	2	A
E730	J.J. Valiente-Dobon E. Clément	32	1	1	30		A
E731	A. Boso	20	1	1	18		A
E735	M. Palacz	23	1	1	21		B

- 4th PAC late 2017 : to be defined between MUGAST and/or VAMOS GFM

Experiments to be run in 2019 ...

→ Inputs are how SPIRAL1 upgrade and when SPIRAL2 start



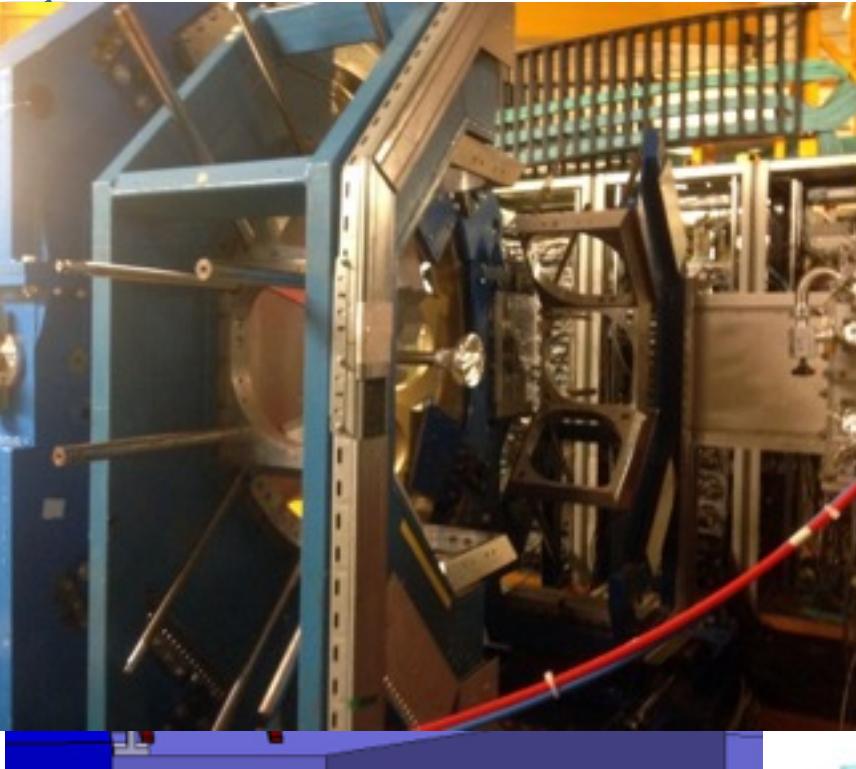
The backlog

					UT	UT cumul
Autumn 2016 -Winter 2017 - LaBr3 Mounting						
DSSD-AGATA	Run1_2017 e693	Jungclauss	20	1,5	21,5	21,5
AGATA-FATIMA	Run1_2017 e705	Regan	16	1,5	17,5	39
VAMOS-AGATA-FATIMA	Run1_2017 e673	John	25	1,5	26,5	65,5
VAMOS-AGATA-FATIMA	Run1_2017 e706	Korten	31	1,5	32,5	98
VAMOS-AGATA-PARIS	Run1_2017 e676	Leoni	43	1,5	44,5	142,5
AGATA-DIAMANT-PARIS	e709	Bednarczyk	28	1,5	29,5	172
LaBr3 Dismounting						
VAMOS-2ndArm-Gamma	e667	Schmitt	30	1,5	31,5	31,5
VAMOS-AGATA	Run2_2017 e711	Doncel	5	1,5	6,5	38
VAMOS-AGATA-Compact	Run2_2017 e674	Lemasson	25	1,5	26,5	64,5
NWALL installation in 2nd half of 2017						
AGATA-NEDA-DIAMANT	Run1_2018 e699	Lenzi	17	1,5	18,5	18,5
AGATA-NEDA-DIAMANT	Run1_2018 e703	Nyberg	32	1,5	33,5	52
AGATA-NEDA-DIAMANT	Run2_2018 e725	Cederwall	36	1,5	37,5	37,5
AGATA-NEDA-DIAMANT	Run2_2018 e731	Boso	20	1,5	21,5	59
AGATA-NEDA-DIAMANT	Run2_2018 e730	Clement	32	1,5	33,5	92,5
AGATA-NEDA-DIAMANT-PARIS	Run2_2018 e727	Fornal	22	1,5	23,5	116
AGATA-NEDA-FATIMA	Run1_2019 B	Palacz	23	1,5	24,5	24,5
AGATA-NEDA-DIAMANT-DSSD	Run1_2019 B	Bentley	20	1,5	21,5	46

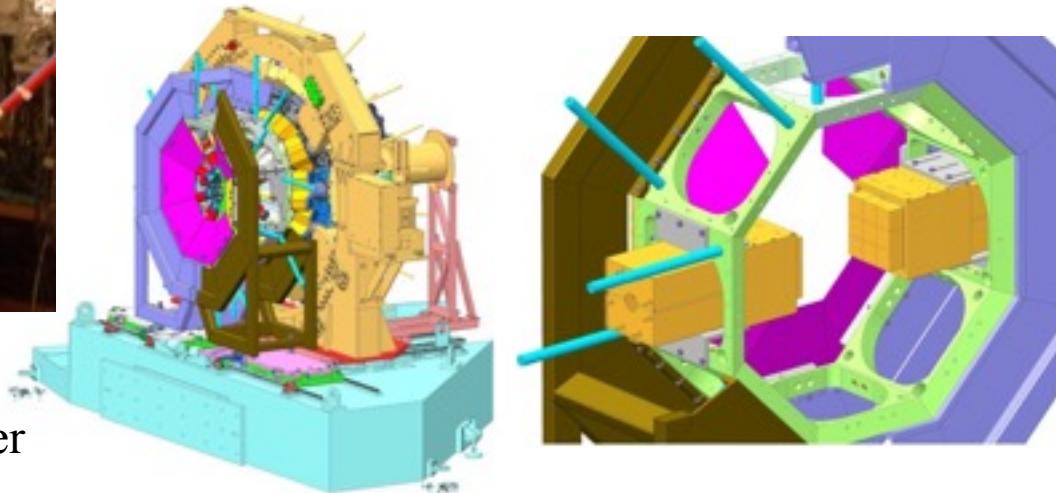
2017 run *LaBr₃* campaign – VAMOS backlog

At least ATC11 to be installed in the system

FATIMA-PARIS detectors coupled to AGATA and VAMOS (4 experiments)



- Mechanical integration
- Electronic coupling
- Detailed simulations to evaluate the impact on AGATA performances'
- Magnetic shielding



Starting the integration in the cave in October
Be ready by March 2017

Courtesy I. Burrows

Winter to-do list/wishes

- ✓DAQ services upgrade
- ✓Cleaning the cabling in the DAQ box and around the array

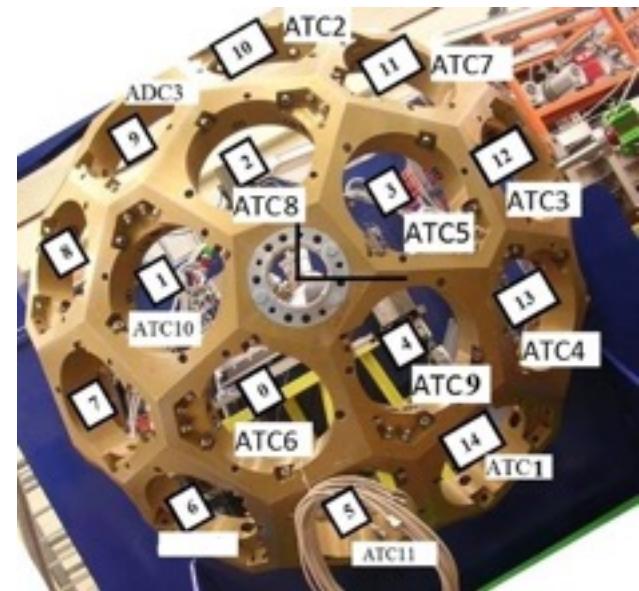
Oct- FATIMA/PARIS preparation (Mechanics, FEBEE, DAQ)

Nov- ATC1 refurbishment (cryostat, exchange of capsules for annhiling)
ATC11 installation

Installing the remaining produced GGP channels
Some more goodies for the ATCA

Narval/Dcod, GEC, trigger soft, new Trigger Processor

Preparation to the data taking

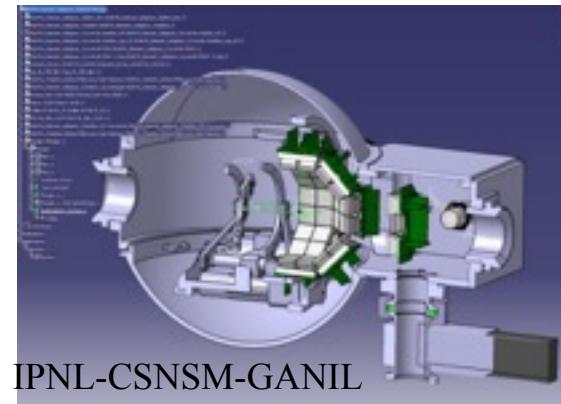
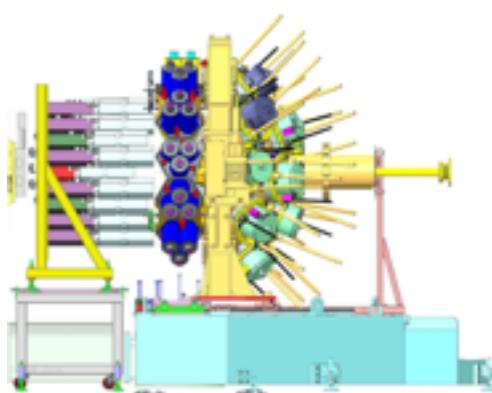
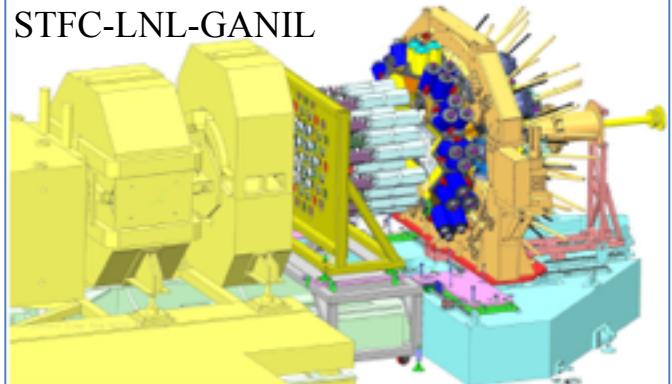


Analysis workshop organized in GANIL next 17th -21st of October

2018 run *NEDA campaign*

8 experiments approved using AGATA+NEDA (+DIAMANT) (+LaBr3) (+plunger)

STFC-LNL-GANIL



Design phase for the mechanical integration (STFC-IPNL-GANIL)

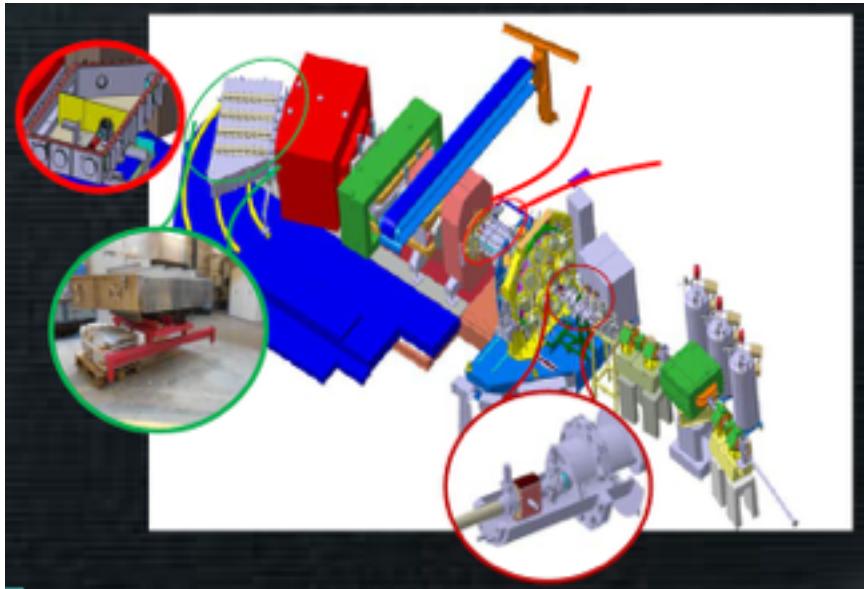
Electronic Development in progress (NEDA collaboration)

Detailed planning for the 2017 installation and 2018 to be clarified when GANIL schedule is clarified

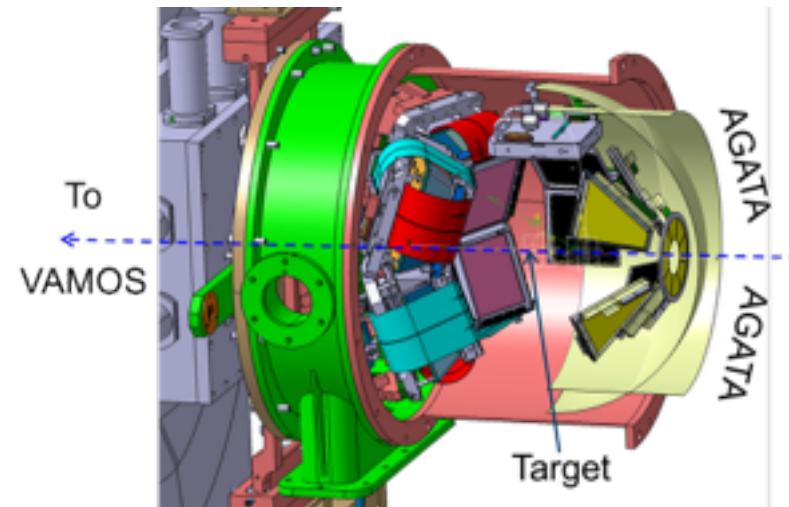
- J. Nyberg et al. : Studies of excited states in $^{102,103}\text{Sn}$ to deduce two-body neutron interactions, single-particle energies and N=Z=50 core excitations
- S. Lenzi et al. : Effects of Isospin Symmetry Breaking in the A=63 mirror nuclei
- M. Bentley et al. : Prompt gamma/proton spectroscopy in ^{65}As – isospin symmetry at the limits of proton-binding
- B. Cederwall et al. : Search for isoscalar pairing in the N=Z nucleus ^{88}Ru
- B. Fornal et al. : Gamma decay from near-threshold states in ^{14}C : a probe of clusterization phenomena in open quantum systems
- E. Clément et al : Shell evolution of neutron-deficient Xe isotopes: Octupole and Quadrupole Correlations above ^{100}Sn
- A. Boso et al : Isospin Symmetry Breaking and Shape Coexistence in Mirror Nuclei ^{71}Kr - ^{71}Br
- M. Palacz et al : Purity of the $g_{9/2}$ configuration based on lifetime measurements and energies of excited states in ^{94}Pd

2019-(2020) run MUGAST-GFM

VAMOS in GFM for prompt spectroscopy of Heavy Elements



Nucleons transfer spectroscopy using SPIRAL1 ISOL beams



4th PAC late 2017 : to be defined between MUGAST and/or VAMOS GFM
Experiments to be run in 2019 → Inputs are how and when SPIRAL1 upgrade and SPIRAL2 start

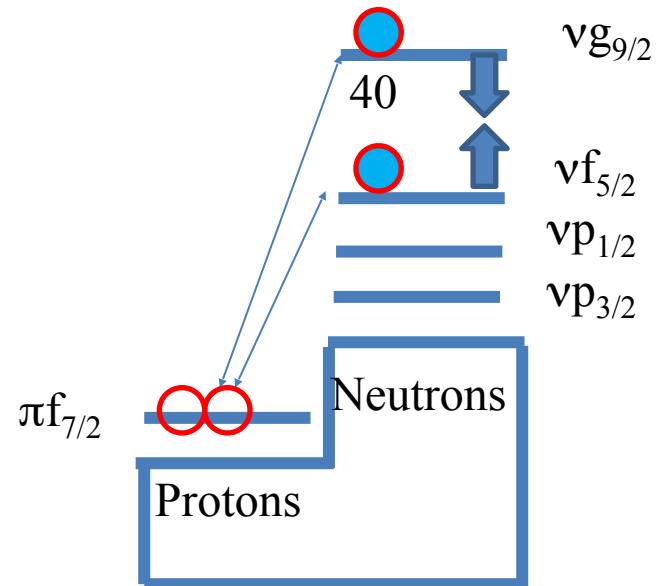
- 10 LoI using the Gaz-filled mode of VAMOS
- 16 LoI using Post-accelerated beams from SPIRAL1

Physics Campaign

Interplay of the monopole terms of the interaction with multipole terms, like pairing and quadrupole, which determines the different phenomena we observe

Motivation:

understanding the development and the trend of deformation in the third island of inversion.



LPNS interaction

interplay of the monopole terms of the interaction with multipole terms, like pairing and quadrupole, which determines the different phenomena we observe

Motivation:

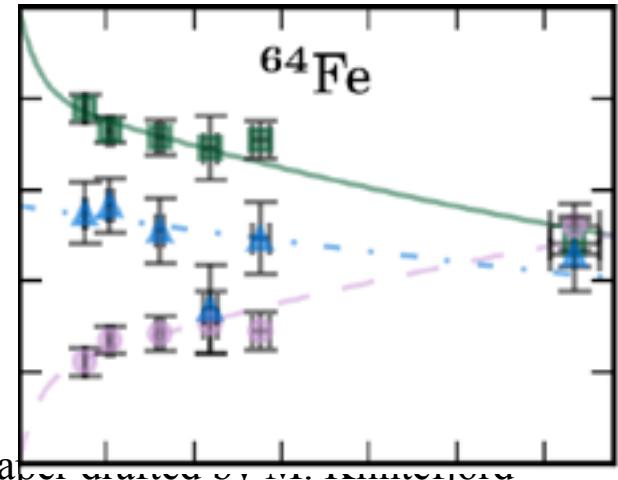
understanding the development and the trend of deformation in the third island of inversion.



Measurement of lifetimes in $^{62,64}\text{Fe}$, $^{61,63}\text{Co}$ and ^{59}Mn

2015 Data.

Lifetimes of the 4^+ states in $^{62,64}\text{Fe}$ and the $11/2^-$ in $^{61,63}\text{Co}$ and ^{59}Mn



E.Clément
and J. Ljungvall

interplay of the monopole terms of the interaction with multipole terms, like pairing and quadrupole, which determines the different phenomena we observe

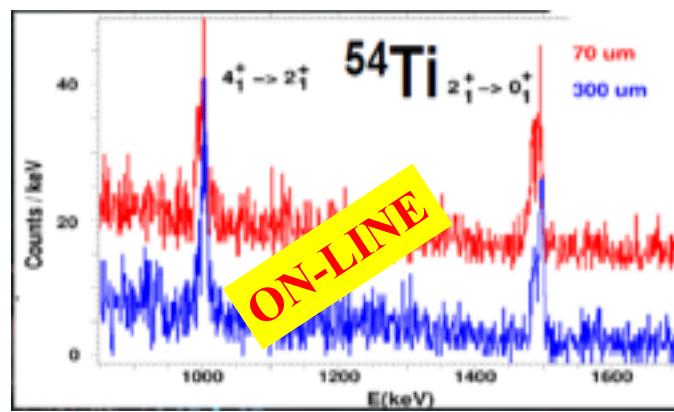
Motivation:

understanding the development and the trend of deformation in the third island of inversion.



Lifetimes in ^{56}Ti and ^{55}V
Ch. Fransen et al.

Shape evolution: subshell closures and development of deformation
2016 Data



interplay of the monopole terms of the interaction with multipole terms, like pairing and quadrupole, which determines the different phenomena we observe

Motivation:

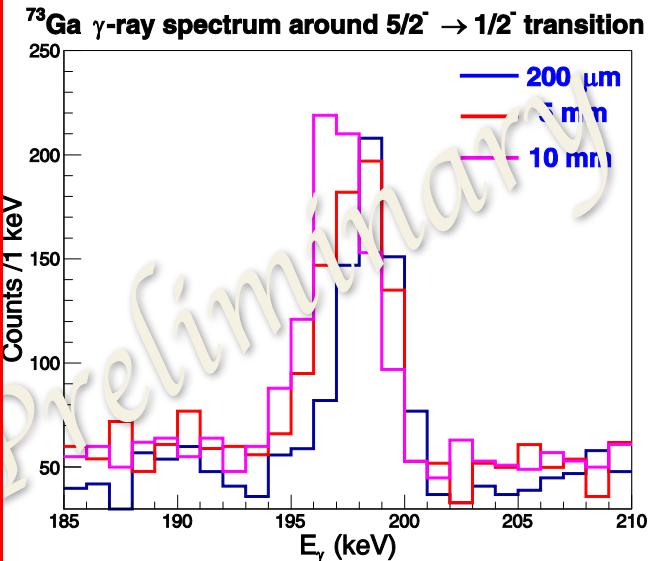
understanding the development and the trend of deformation in the third island of inversion.



E.Clément

Lifetime of the $5/2^-$ state in Ga decaying to a “degenerate” g.s
2016 Data

I. Celikovic, C. Michelagnoli et al.



Spectroscopy in the $^{68-78}\text{Ni}$ region

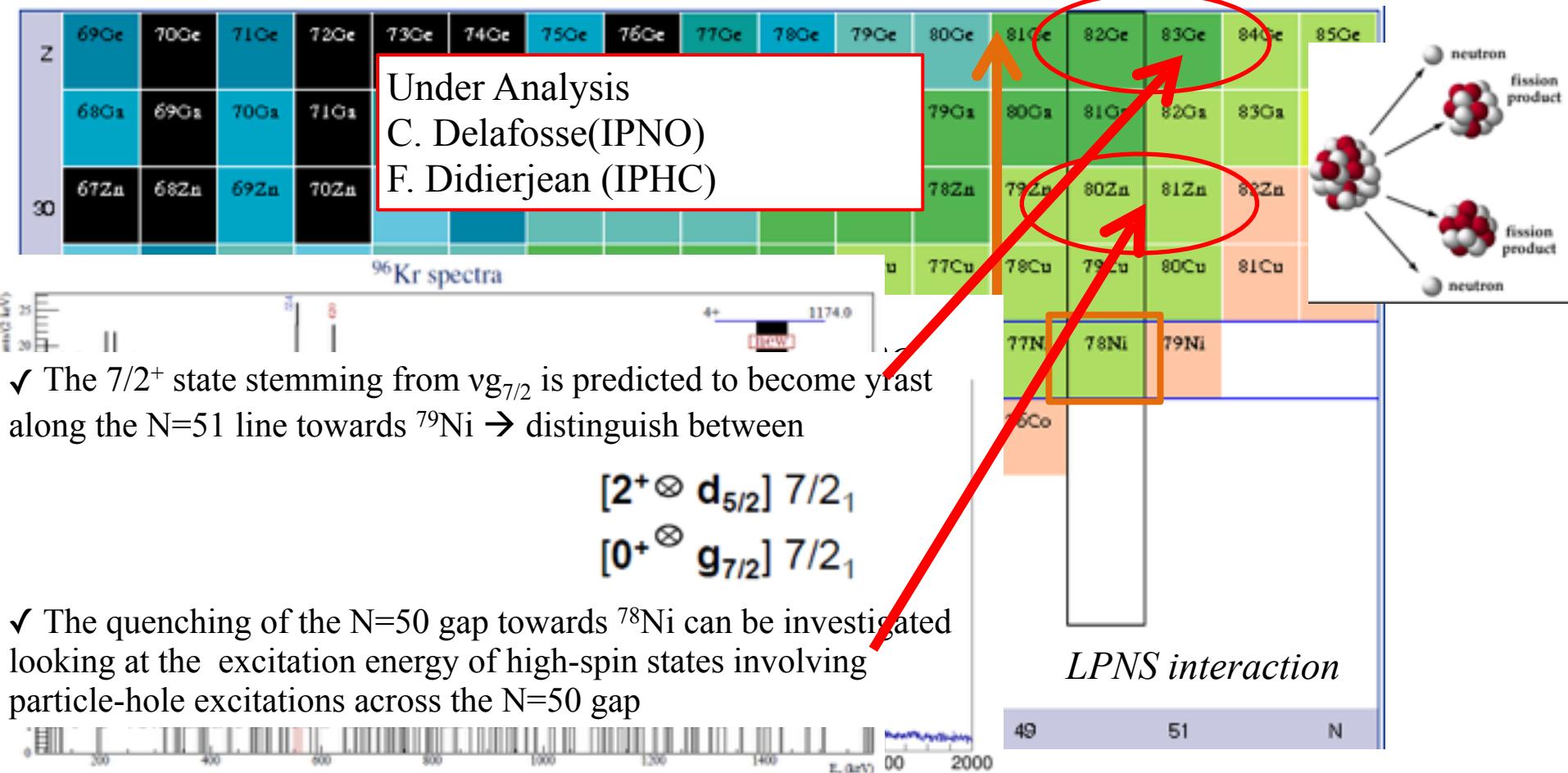
Motivation:

Understanding the single-particle evolution above N = 50
towards ^{78}Ni

Shape transition at N=60

J. Dudouet (IPNL) *in Preparation*

^{96}Kr

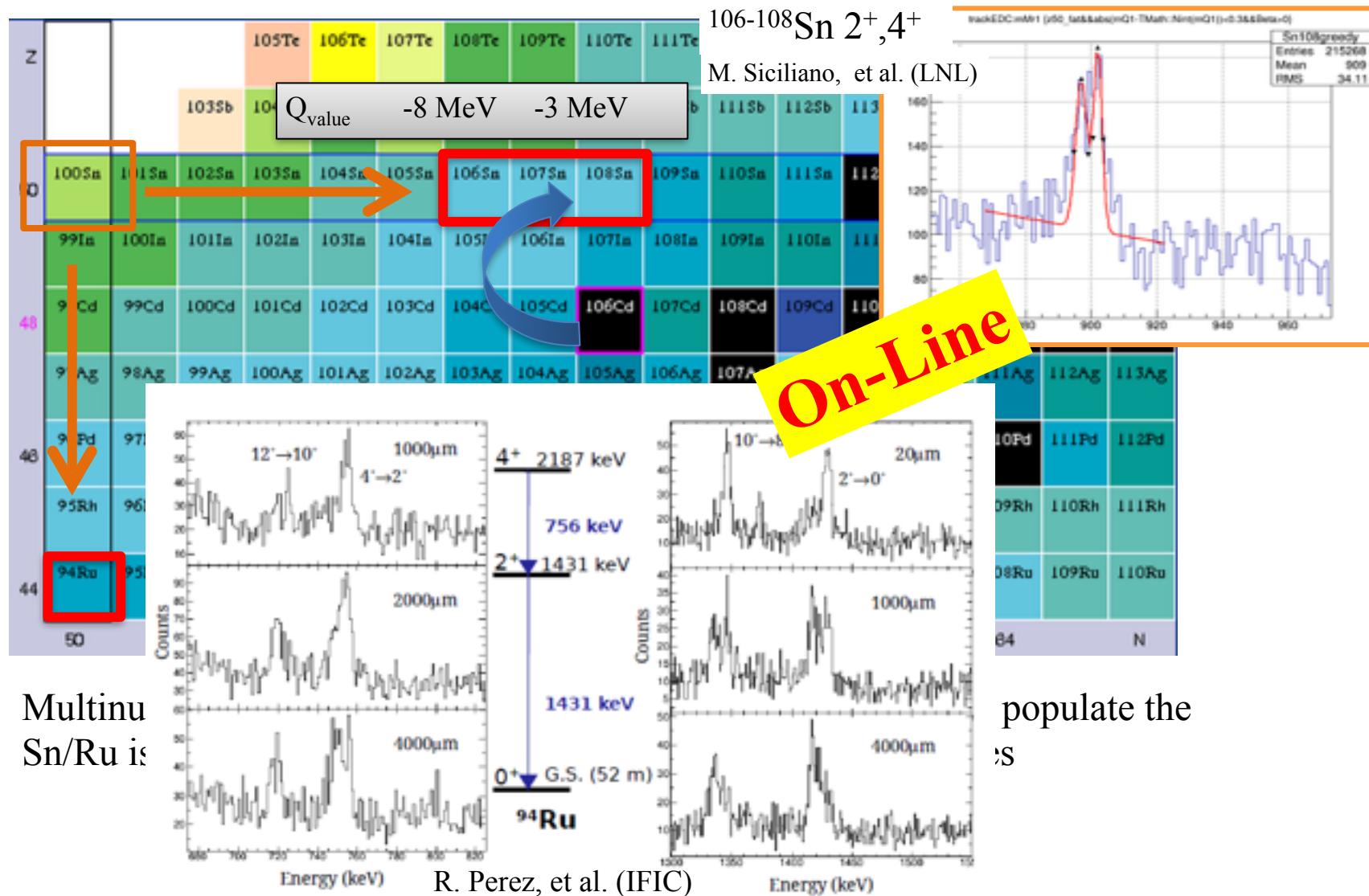


- ✓ The $7/2^+$ state stemming from $\nu g_{7/2}$ is predicted to become yrast along the N=51 line towards $^{79}\text{Ni} \rightarrow$ distinguish between

$$\begin{aligned} & [2^+ \otimes d_{5/2}] 7/2_1 \\ & [0^+ \otimes g_{7/2}] 7/2_1 \end{aligned}$$

- ✓ The quenching of the N=50 gap towards ^{78}Ni can be investigated looking at the excitation energy of high-spin states involving particle-hole excitations across the N=50 gap

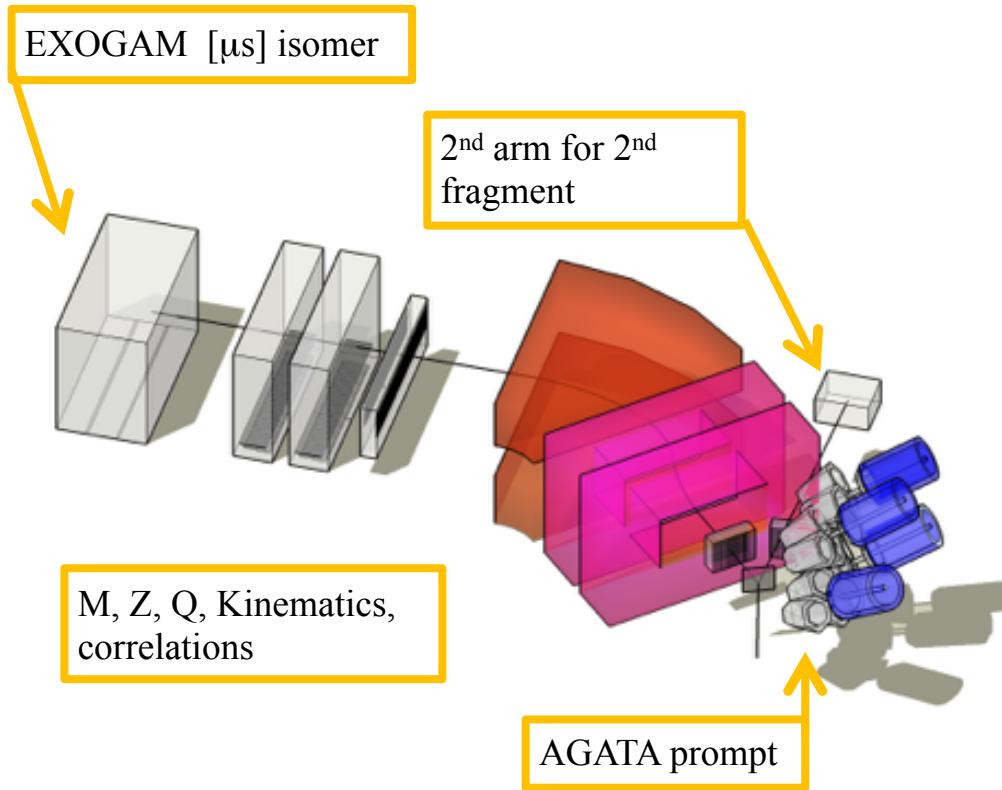
Lifetetime measurement in the ^{100}Sn region



Spectroscopy of fission fragments

A. Navin, M. Rejmund et al.
(GANIL)

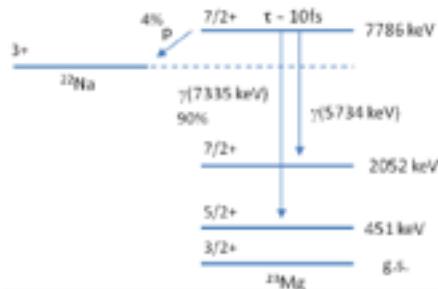
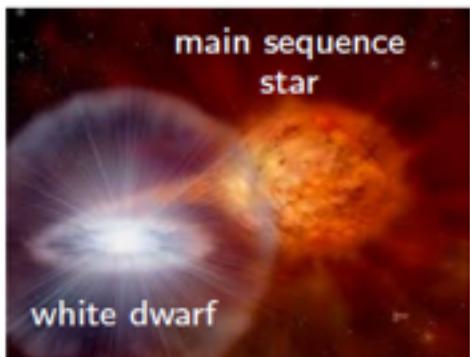
High-spin and isospin spectroscopy :Structure of nuclei around ^{132}Sn



Explosive H-burning: new benchmark for classical novae

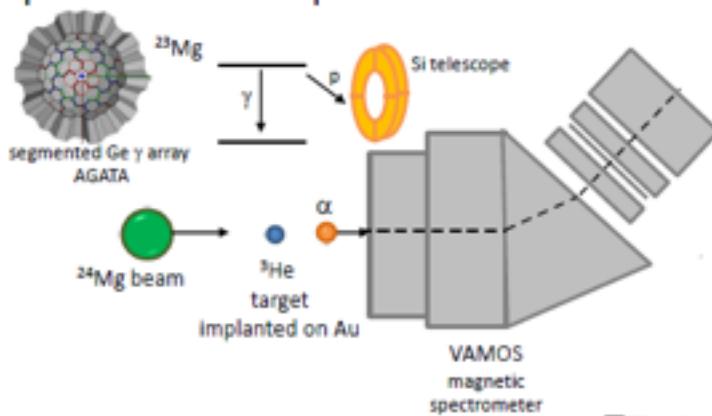
^{22}Na = main *ONe-novae* tracer: $^{22}\text{Na}(\text{p},\gamma)^{23}\text{Mg}$, a key reaction
Ambiguity on $\Gamma = \hbar/\tau(7.78 \text{ MeV } ^{23}\text{Mg}) \Rightarrow 30\%$ uncertainty on cross-section

A. Sallaska et al. PRL105(2010)152501



High-sensitivity τ measurement:
benchmark for astrophysical models.

Experimental setup:

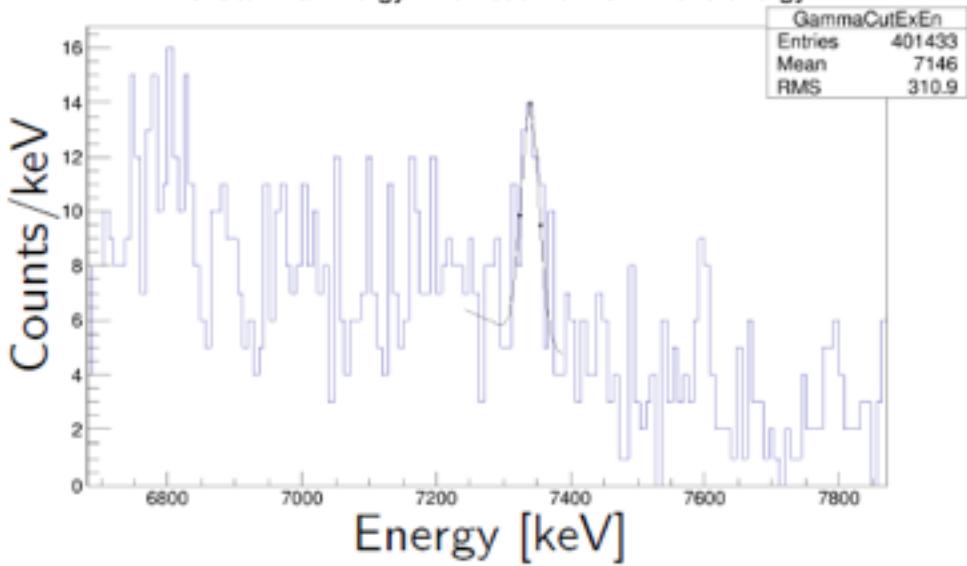


$^{3}\text{He}(^{24}\text{Mg},\alpha)^{23}\text{Mg}(7.78 \text{ MeV})$
excit. function measurement
performed at ALTO, Orsay, Dec. 2015

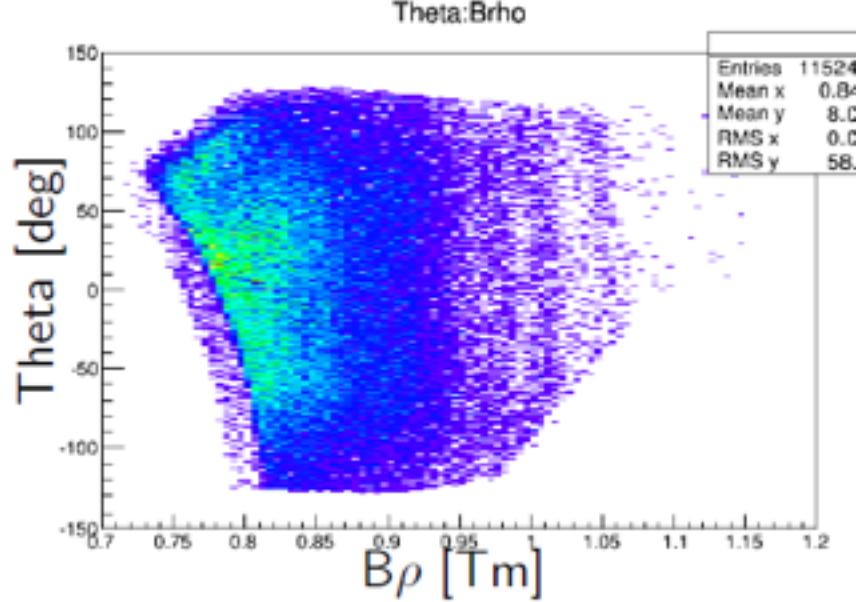
- “continuous DSAM” lifetime measurement with AGATA
- Si telescope → proton branching ratio
- magnetic spectrometer VAMOS → kinematics reconstruction

E710, July 2016, C. Michelagnoli, F. de Oliveira

DC Gamma Energy when cut 7.8 MeV in exc energy



Theta:Brho



tracked γ ray spectrum

gated in ^{23}Mg excitation energy

(from α s in VAMOS, 1/10 of acceptance – near line)

kinematics plot

(online)

Conclusion

- ❑ The AGATA collaboration is operating up to 32 capsules in the array at GANIL
- ❑ The second AGATA run at GANIL is now completed
- ❑ The physics program of AGATA at GANIL is rich, ambitious and broad
- ❑ First results from the 2015 run are released

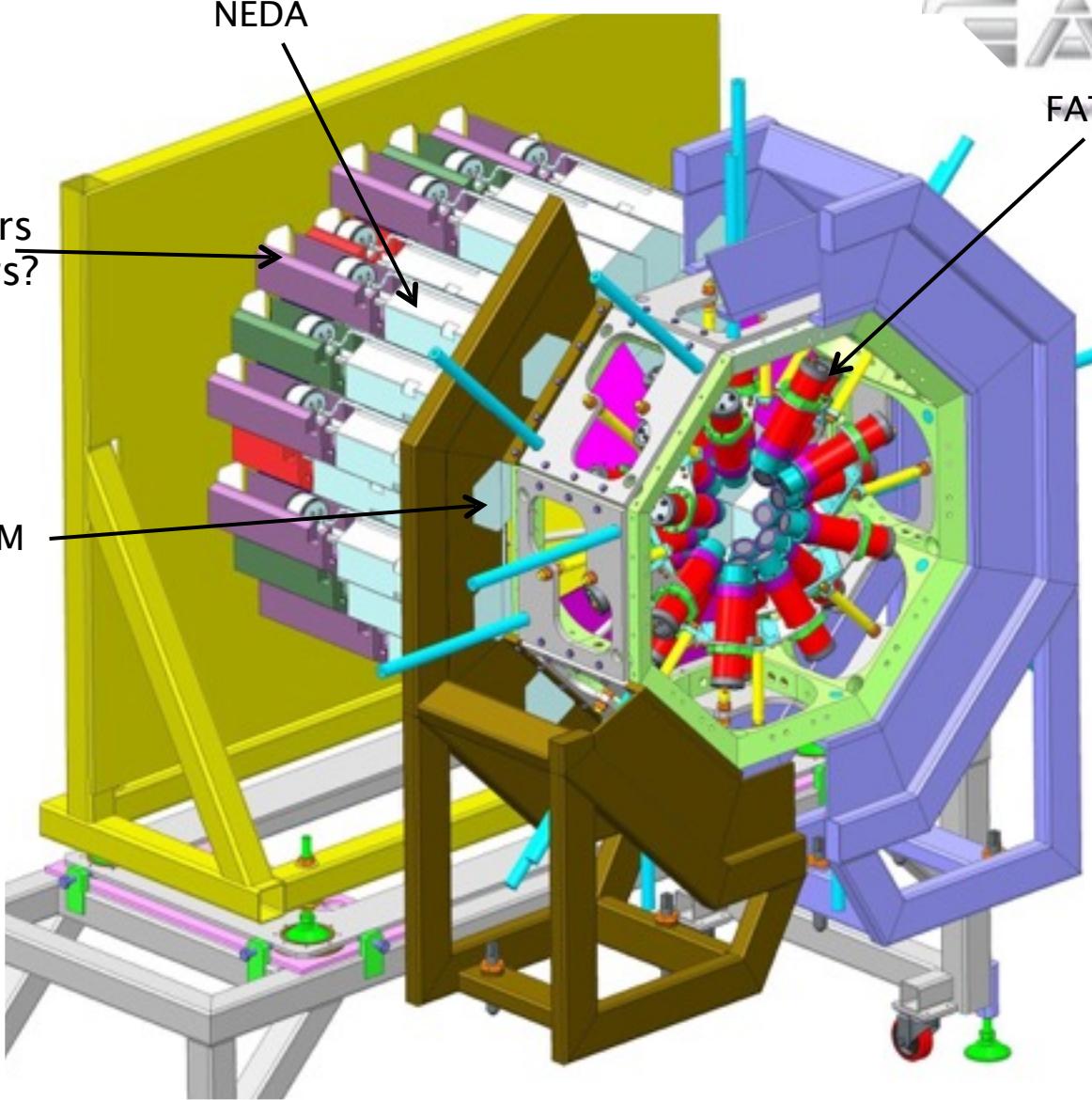
- ❑ The AGATA campaign will keep us busy until 2019 (at least)
- ❑ 2017 : LaBr₃ campaign
- ❑ 2018 : AGATA-NEDA campaign

THANKS TO ALL THE AGATA COLLABORATORS

Removable spacers
on outer detectors?

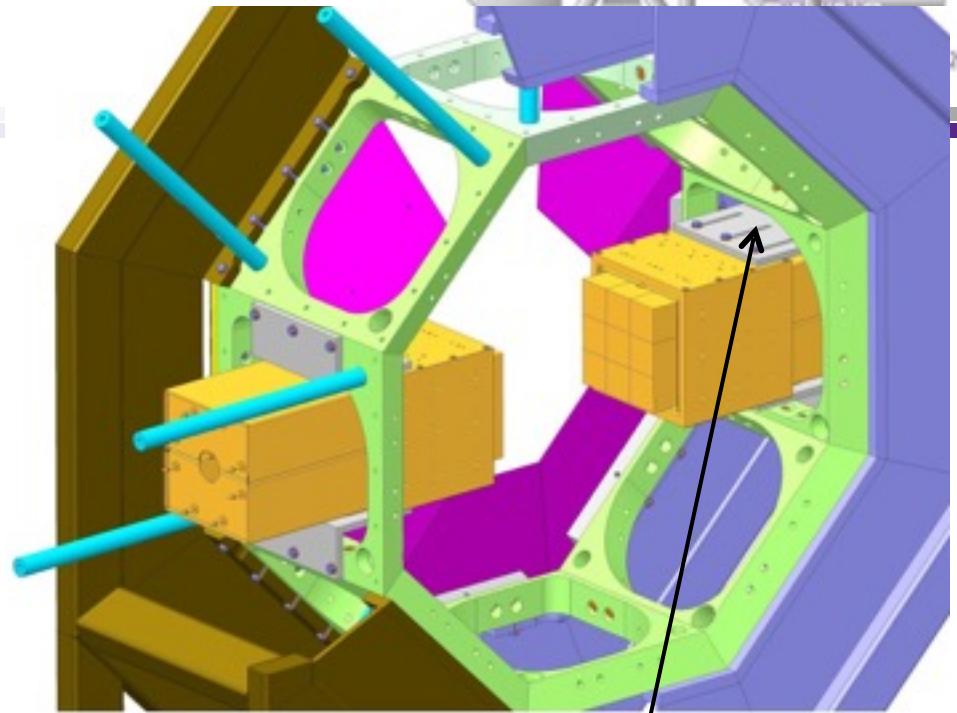
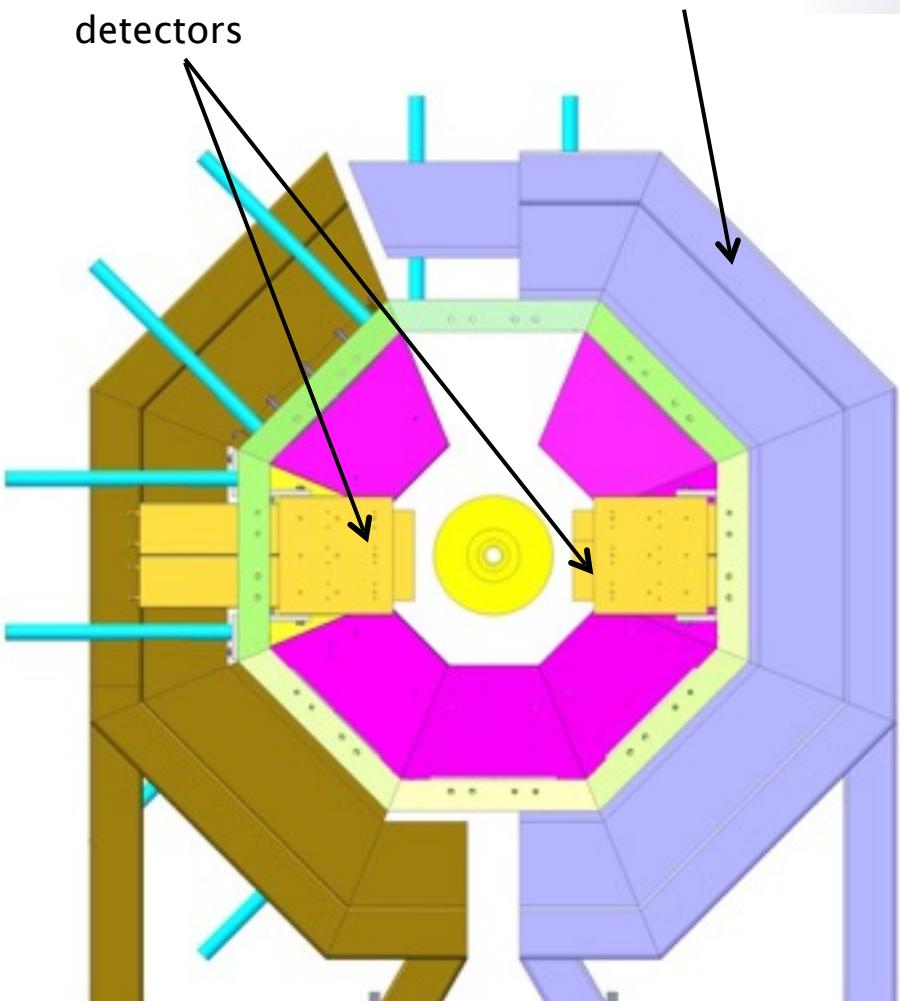
NEDA

Clash with EXOGAM
support structure



PARIS
detectors

Existing EXOGAM
structure



Simple 'L' shaped brackets to
allow detector faces to target
distance to be varied between
15 & 23cm

PARIS