



AGATA at GANIL

Status Report

AGATA Week September 2017

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

$^{48}\text{Ca}, ^{50}\text{Ti} \rightarrow \text{SHE}$

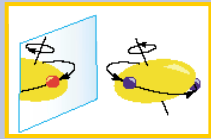
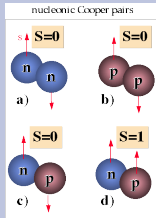
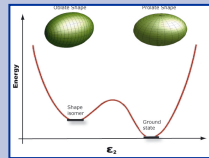
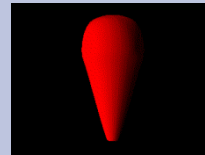
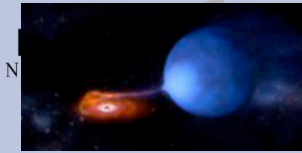


TABLEAU PÉRIODIQUE DES ÉLÉMENTS

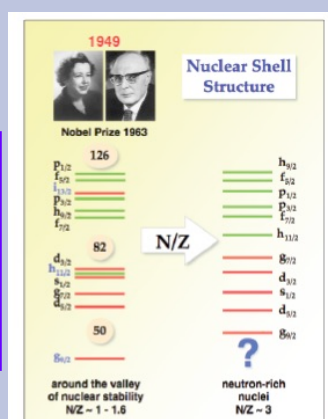
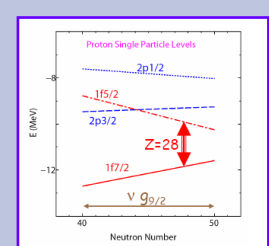
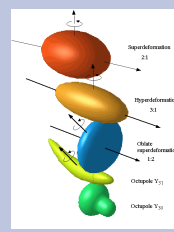
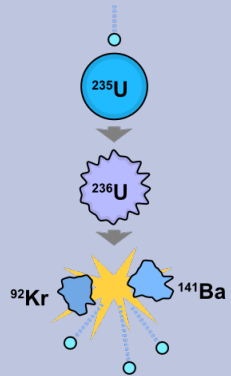
-Mangan - sur face - Fe - bio - ecr HD

$^{58}\text{Ni}, ^{40}\text{Ca} \rightarrow N=Z$

$^{238}\text{U}, ^{208}\text{Pb} \rightarrow \text{n-rich}$

SPIRAL1

Cm, Bk
Cf, Es



38K, 34Ar, 46Ti, 46,48Ca, S, Cl, Ar, K, Ne, Na

256Rf, 254No

176Hg, 194Pb

206Hg, Dy, Er, Yb

Xe, Te, Zr, Sr

78Ni, 80Zn, 68Ni, Fe, Co, Cu

102Sn

100In

Sm, Pm

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

γ decay from near-threshold states in ^{14}C

Prompt γ /proton spectroscopy in ^{65}As .

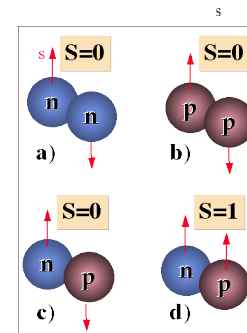
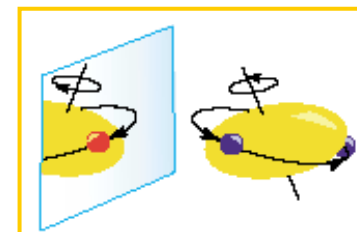
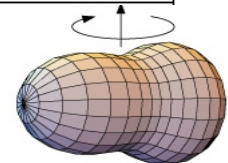
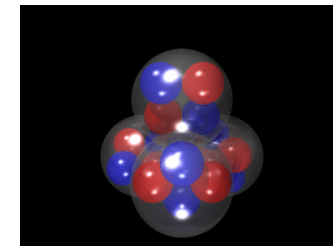
Isospin Symmetry Breaking in the $A=63,71$ mirror nuclei

Search for isoscalar pairing in the $N=Z$ nucleus ^{88}Ru

Purity of the $g_{9/2}$ configuration in ^{94}Pd

Studies of excited states in $^{102,103}\text{Sn}$

Octupole shape in ^{112}Xe



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

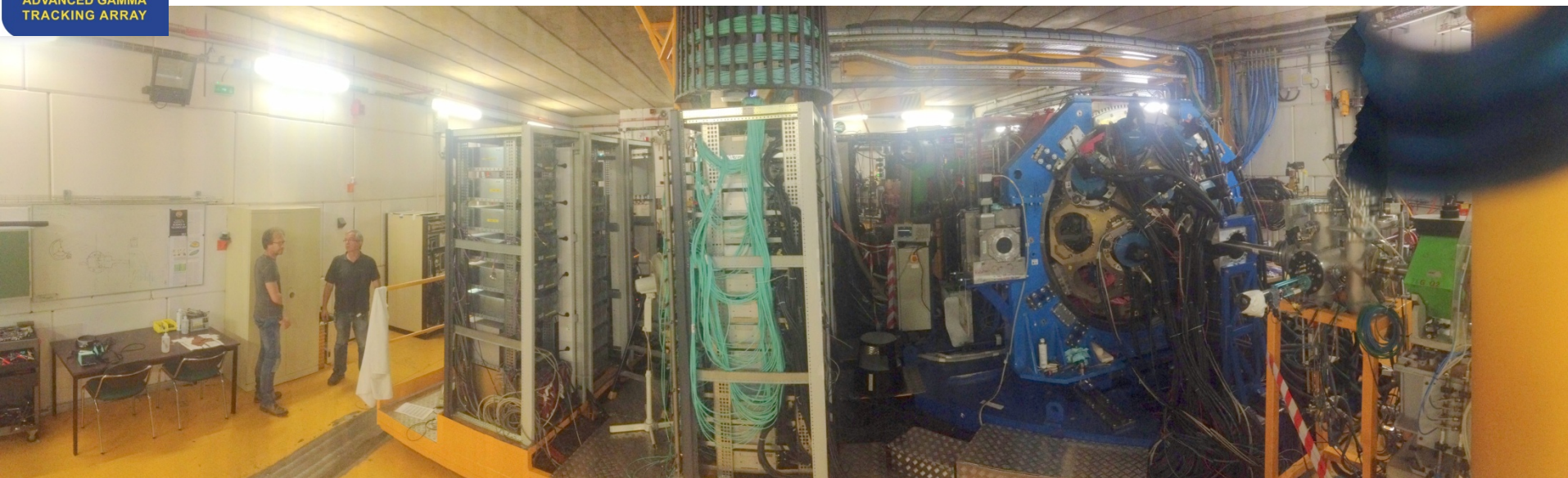
Each GANIL PAC has a “PrePac” workshop with a specific call : **AGATA Collaboration Meeting**

- ✓ 1st PAC in 2014 : VAMOS (10 experiments approved)
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- ✓ 3rd PAC in 2016 : NEDA (6 experiments approved)
- ✓ 4th PAC November 2017. Submission deadline is the 21st of September. Should have been sent to the different GANIL Scientific Coordinators on the 7th of September. GANIL management has decided to fully open the call without coordination with the campaign managers.

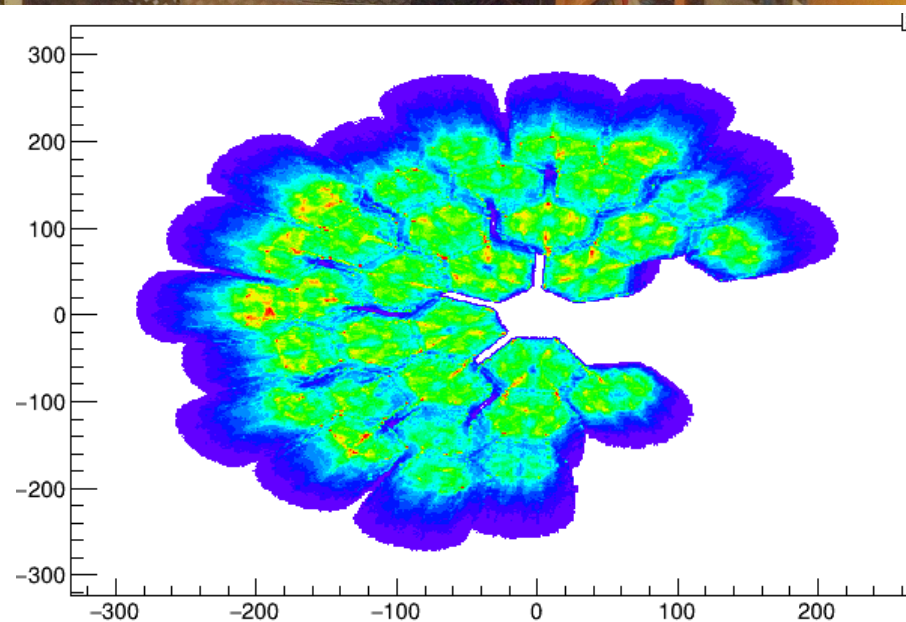
708 UT have been already approved
447 UT have been performed over 15 experiments producing 626 To of data on GRID

3 scientific papers published

- ✓ M. Klintefjord et al , *Measurement of lifetimes in $^{62}, ^{64}\text{Fe}$, $^{61}, ^{63}\text{Co}$, and ^{59}Mn ,* Phys.Rev. C 95, 024312 (2017)
- ✓ J. Dudouet et al. $^{96}_{36}\text{Kr}_{60}$ -- *Low-Z boundary of the island of deformation at $N=60$,* J. Dudouet et al. Phys. Rev. Lett. 118, 162501 (2017)
- ✓ E. Clément, et al, *Conceptual design of the AGATA array at GANIL*, NIMA 855, 21 May 2017, Pages 1-12



- ❑ 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 was running smoothly
- ❑ Detectors Infrastructure were perfectly running



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 capsules running (ATC7 out)

✓ ^{76}Ge , Plunger **target** issues which has limited the beam intensity

✓ 32 capsules running

✓ Issues with the 2nd arm

✓ Delayed gamma with EXOGAM at the focal plane

✓ 31 capsules running (1 GGP channel)

✓ Additional DSSD in the chamber

✓ **Target** integrity (^3He)

- ✓ DAQ services upgrade (network, software, disks)
 - ✓ Re-cabling of the DAQ box and the detectors
 - FATIMA/PARIS integration (Mechanics, FEBEE, DAQ)
 - ATC1 refurbishment (swap of capsules for annealing ; 1 failed)
 - ATC11 and ATC13 deliveries
 - ATC3 at the lab after a beginning of warming up due to a vacuum problem. Reminder: ATC3 was the first installed in November 2014. Then ATC4 with dewar problem.
- In 2017, 38 detectors (12 ATC and 1 ADC) are in GANIL.
35(3) have run

Installation of the remaining produced advanced phase 1 channels
35 channels (24 ATCA+11 GGP) channels are running with 1 full GGP channel spare

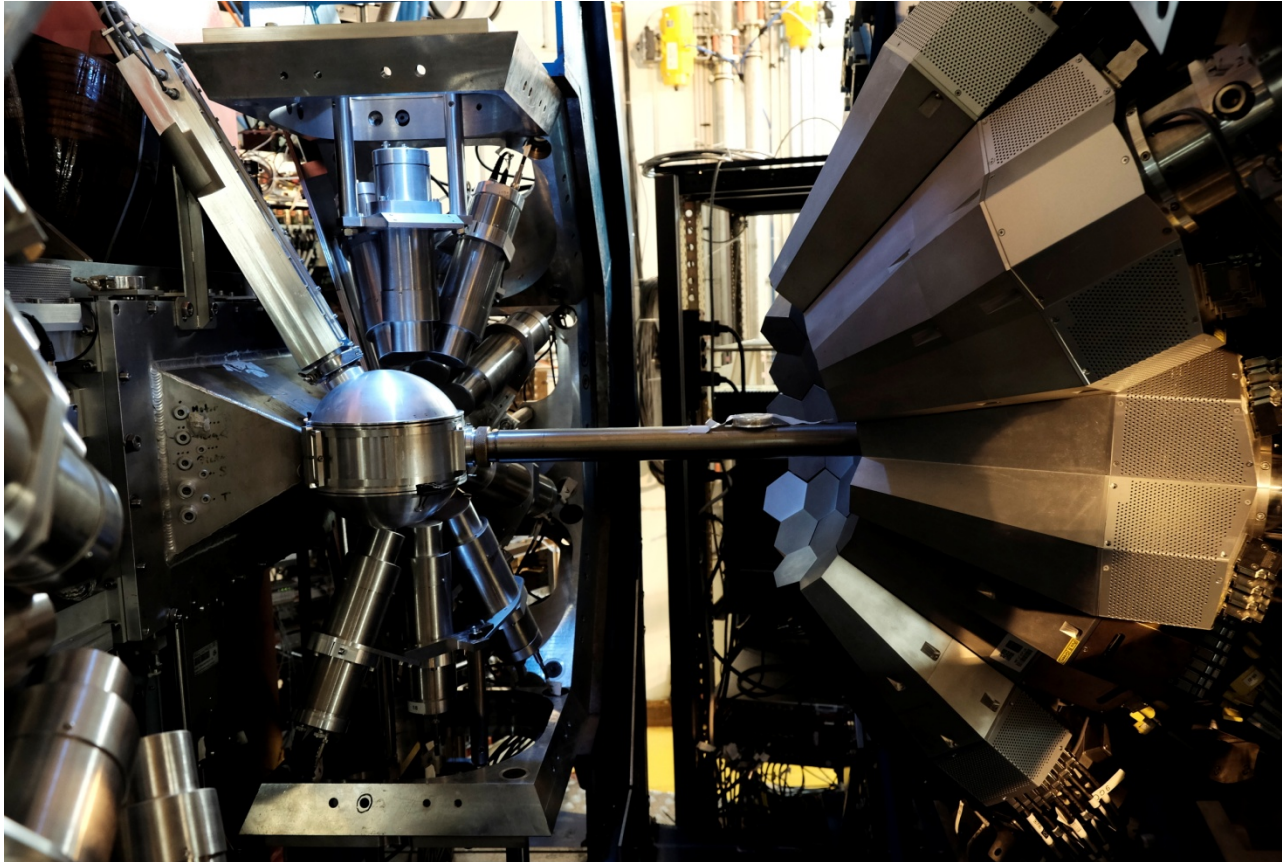
7 GGP from GALILEO installed on the 20th of March and swapped with non-working AGATA channels

→ Max available channels is 36 channels

Analysis workshop organized in GANIL last 17th -21st of October 2016. Next will be January 2018



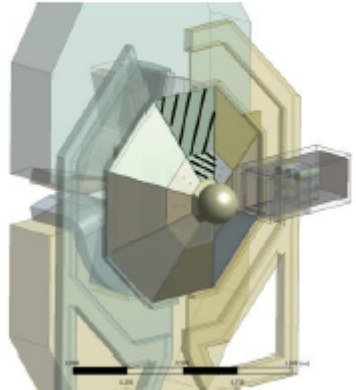
FATIMA-PARIS detectors coupled to AGATA and VAMOS (4 experiments)
DSSD detector coupled to AGATA (1 experiment)



35 detectors on-line : Single efficiency measured at 3.4(1)% in nominal position at 1.408 MeV (GEANT4 = 3.6%)

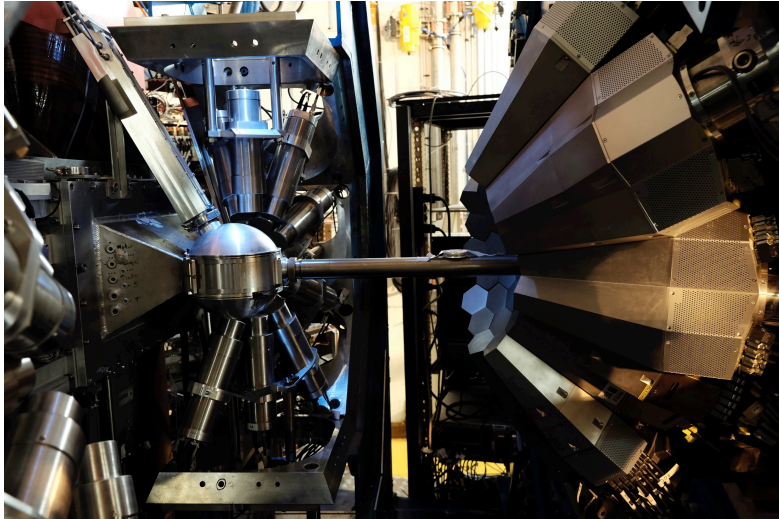
Magnetic field shields studies

On the top side, the vertical petal and its extension miss (cf black cross-hatching).



petal	Bx (mT)	By (mT)	By (mT)	Module (mT)
1	0,6	-13,9	4,6	14,7
2	-2,1	-13,6	2,6	14,0
3	-1,1	-8,9	-8,3	12,2
4	0,9	5,7	-10,9	12,3
5	3,5	15,4	-0,2	15,8
6	1,8	13,0	2,4	13,3
7	-9,3	7,8	0,1	12,1
8	-7,3	-3,5	0,8	8,1
9	1,0	-13,7	-2,3	13,9
10	5,2	-15,5	-0,7	16,4

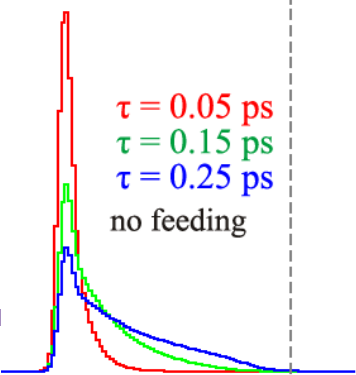
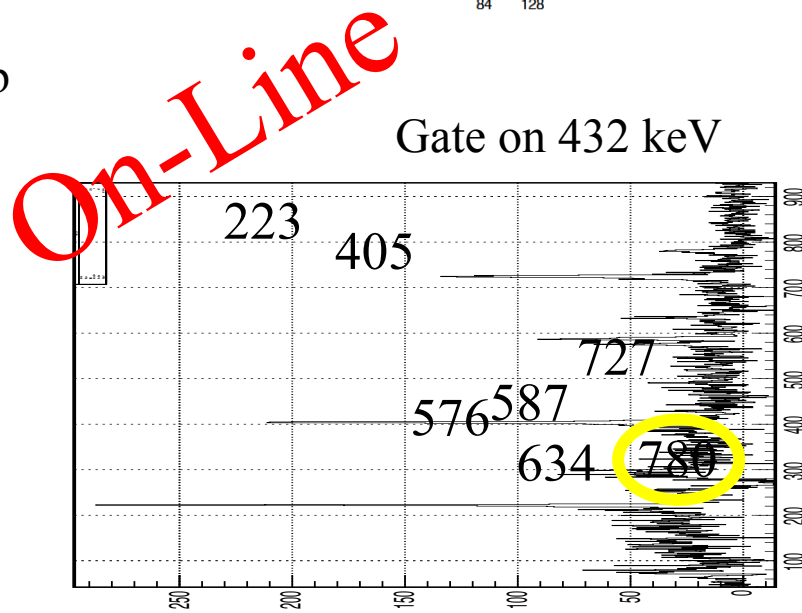
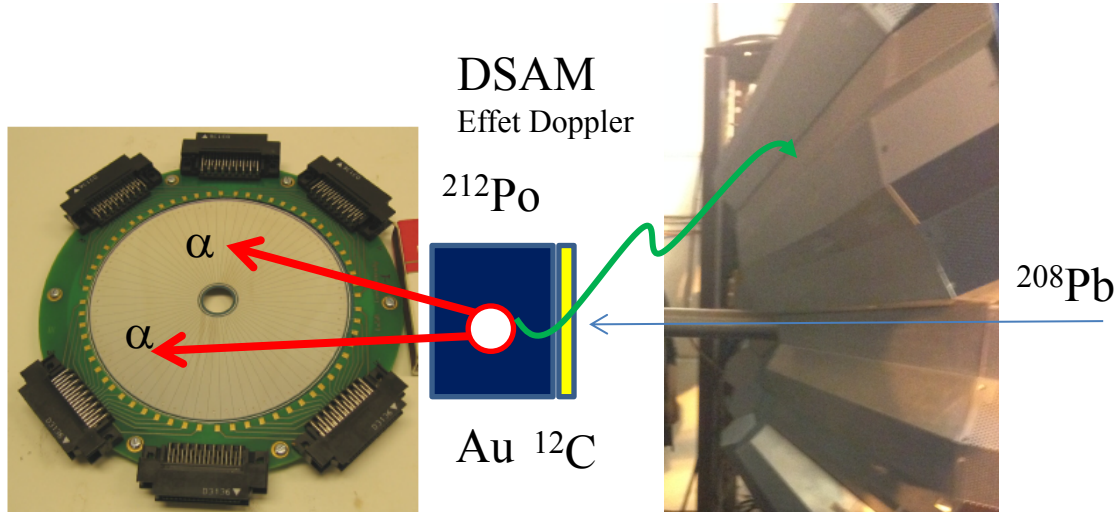
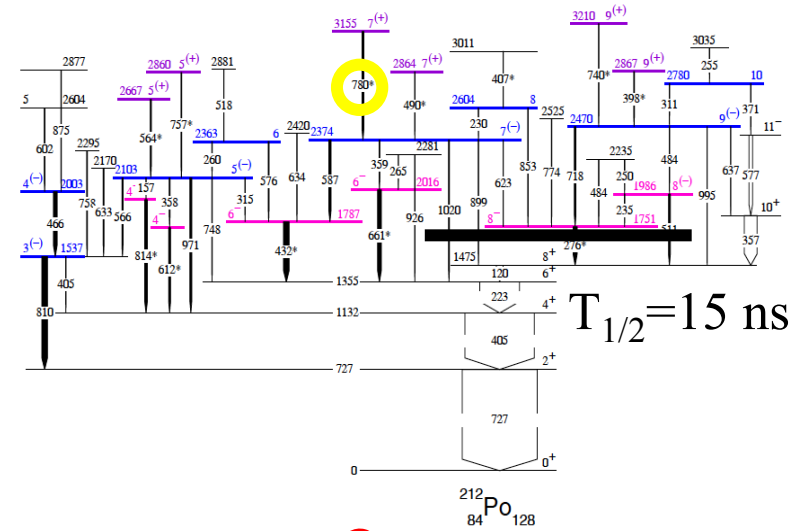
- E693 : A. Jungclaus AGATA –DSSD
- E705 : P. Regan AGATA-FATIMA
- E673 : P. John AGATA FATIMA
- E706 : W. Korten AGATA FATIMA VAMOS Plunger
- E676 : S. Leoni AGATA PARIS VAMOS Plunger



E693 : A. Jungclaus - AGATA – DSSD

4th-11th may - 35 detectors running

Search for the alpha cluster structure in heavy elements : case of ^{212}Po ($^{208}\text{Pb} + \alpha$) using the $^{12}\text{C}(^{208}\text{Pb}, ^8\text{Be})^{212}\text{Po}$ reaction. Lifetime measurement of the non-yrast states using the DSAM method

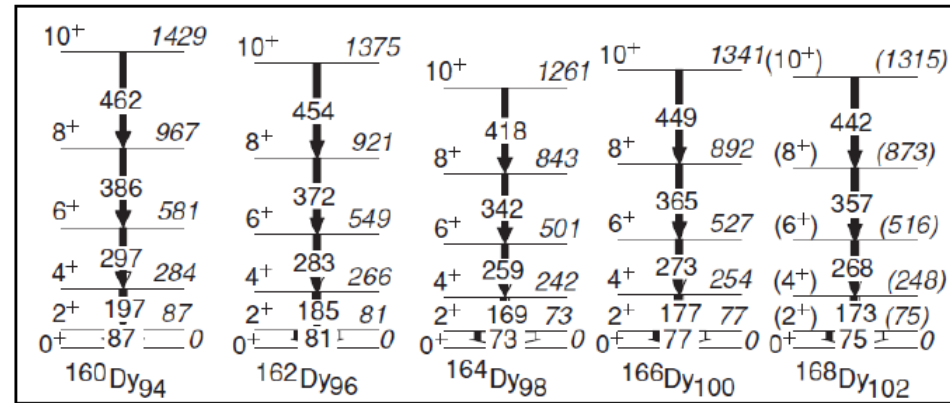
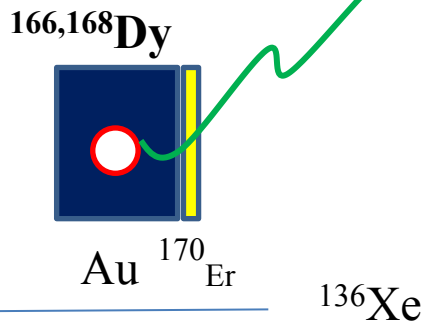


E705 : P. Regan AGATA-FATIMA - 22nd – 27th may

35 detectors running

Study of the deformation in the vicinity of ^{170}Dy by lifetime measurement using the FATIMA array using the $^{170}\text{Er}(^{136}\text{Xe}, ^{140,138}\text{Ba})^{166,168}\text{Dy}$ reaction

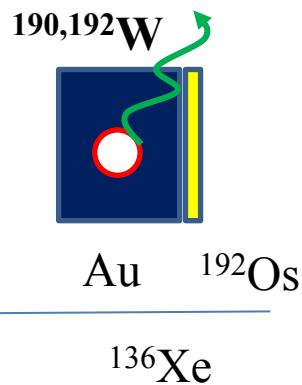
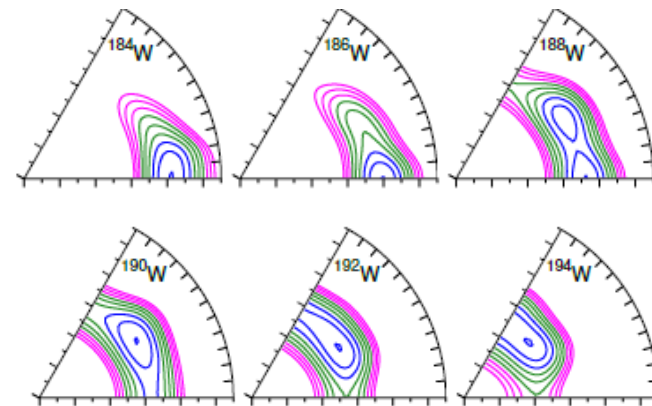
The experiment was stopped due to a failure of the Er targets



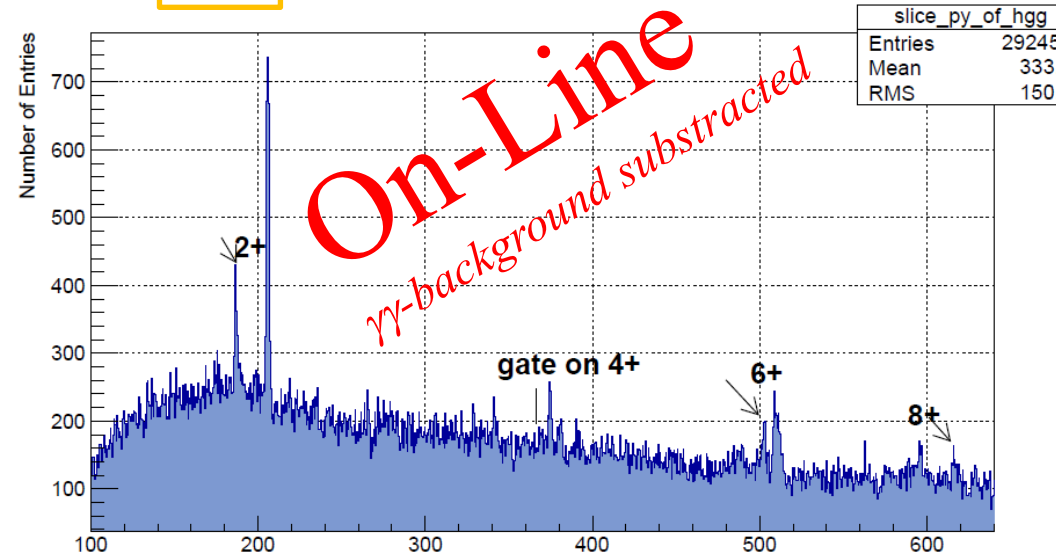
E673 : P. John AGATA FATIMA – du 27th April to 5th of June ; 35 detectors running

Investigating the shape transition in the W isotopes using by fast timing using the FATIMA array using the $^{192}\text{Os} (^{136}\text{Xe}, ^{138,136}\text{Ba})^{190,192}\text{W}$

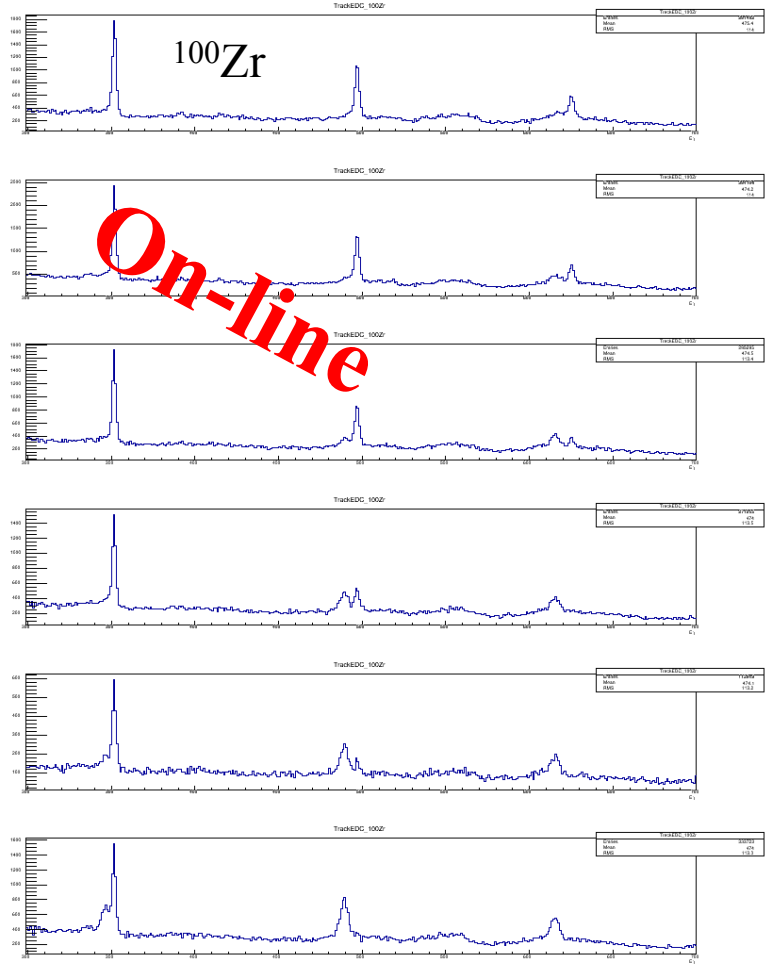
Change of the FATIMA FEBEE in the middle of the experiment to reduce the deadtime



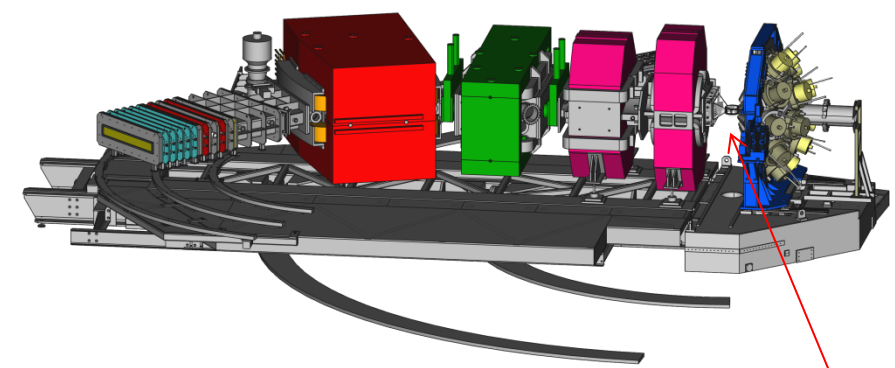
190Os in parts of the data gamma-gamma with fatima



Shape evolution in fission fragments in the $A \sim 100$ region combining AGATA-VAMOS and a plunger + FATIMA for lifetime measurements using the ${}^9\text{Be}({}^{238}\text{U}, \text{FF})$ reaction



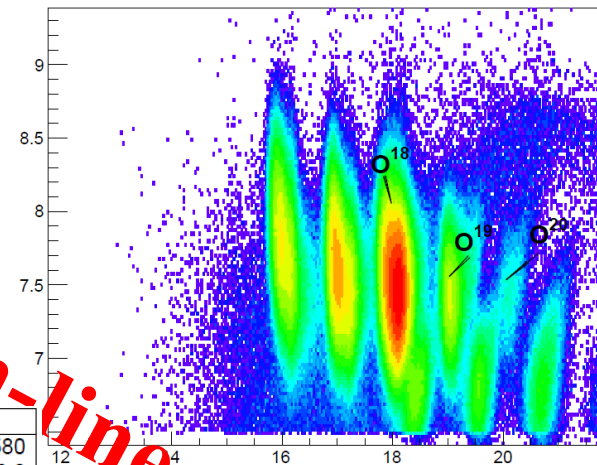
30um
 52um
 90um
 265um
 450um
 780um



+ Plunger (short lifetime $I^\pi > 4^+$)

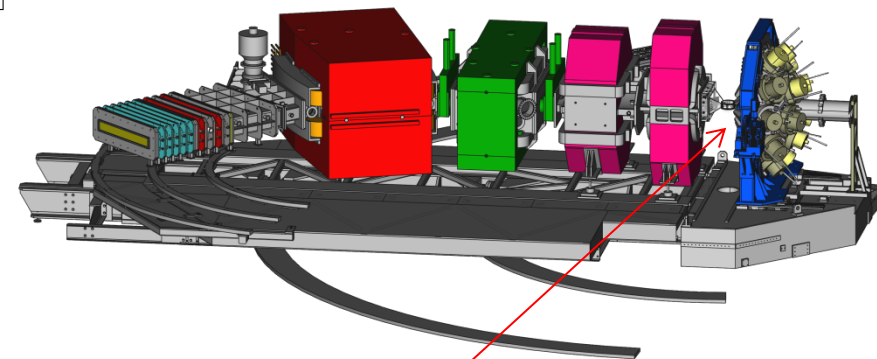
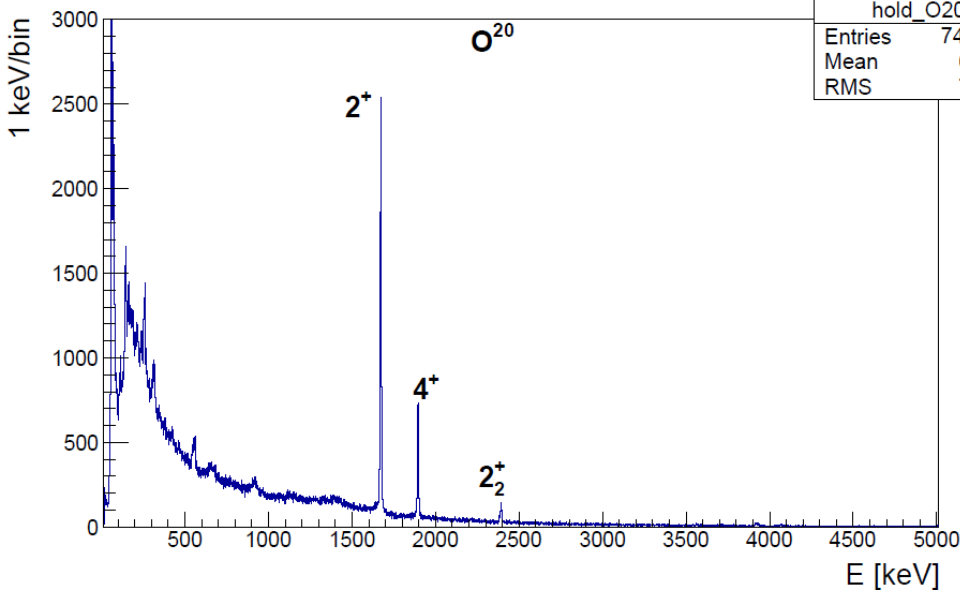
31 detectors running

Lifetime measurement in the non-yrast excited states of neutron rich C and O isotopes to probe the 3 body- contribution in the nuclear interaction using the $^{198}\text{Pt}/\text{Tl}(^{18}\text{O}, ^{16,18}\text{C}, ^{20}\text{O})$ reaction. Branching ratio using the PARIS array and ideally E2/M1 ratio will be measured



On-line

hold_O20	
Entries	748580
Mean	699.2
RMS	721.9



+ DSAM-like

A third run is scheduled between end-October and beginning of December 2017

The remaining AGATA-VAMOS experiment is by A. Lemasson et al using the ^{48}Ca target.
Experiment postponed to Due to the availability of the target.

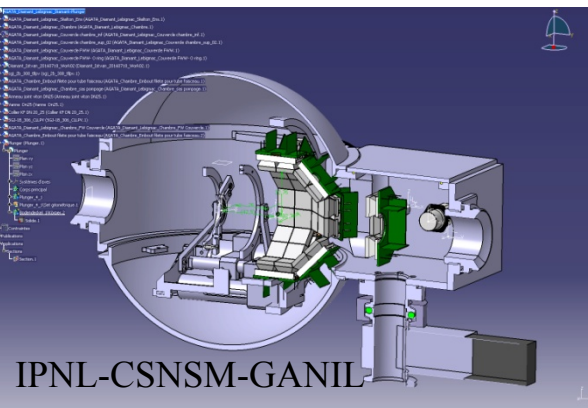
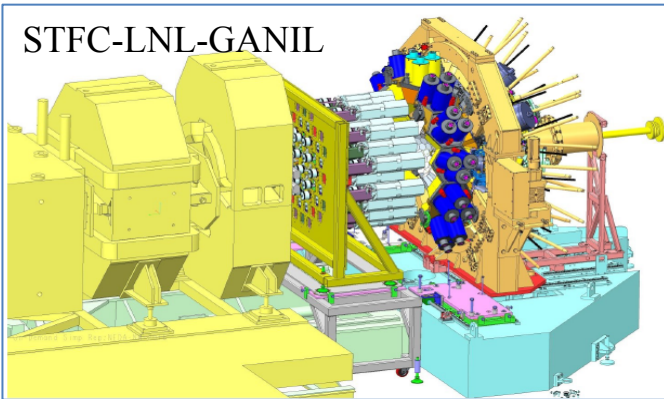
Two others fission-runs are scheduled in G1

M. Caamano (e753) U Fission Yields, without AGATA [30th of October → 5th of November]

C. Schmitt (e667) Hg Fission Yields, with AGATA [24th of November → 4th of December]

2018 run *NEDA* campaign

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



The mechanical design foresees the use of 54 self produced NEDA detectors at forward angles and 14 NWALL detectors at around 90 degrees coupled to DIAMANT, using the NUMEXO2 FEBEE

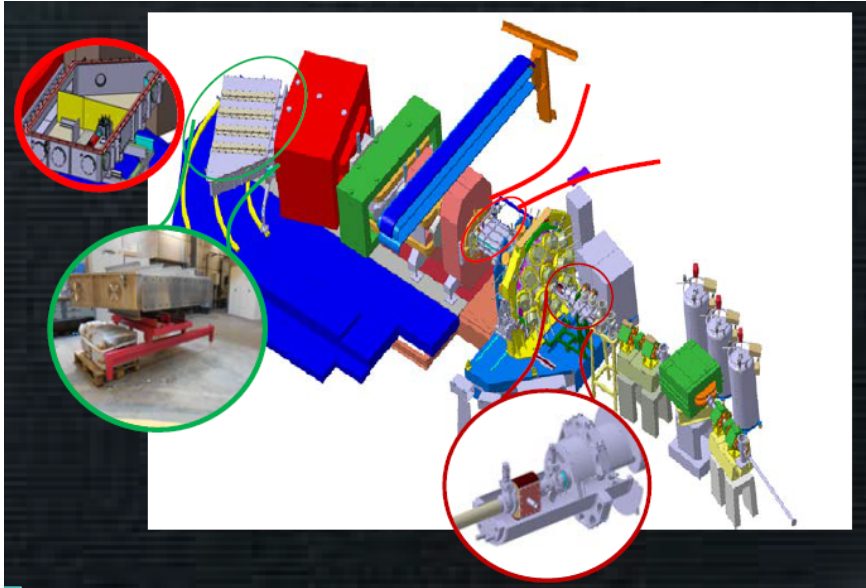


Pre-installation in G2 with an in-beam tests foreseen during run 3 → MUST be successful !!

Start of the campaign : Early 2018 – not yet known how long will be the beam time in 2018.

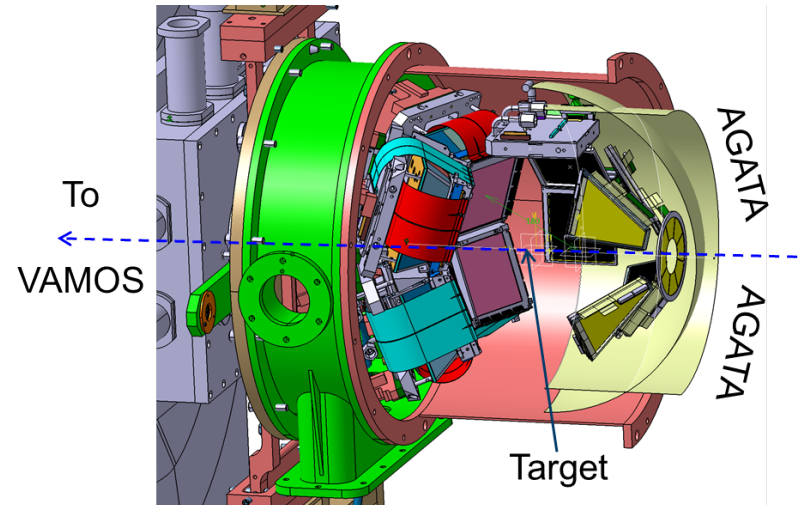
2019-(2020) run *MUGAST-GFM*

VAMOS in GFM for prompt spectroscopy of Heavy Elements



The project will be completed in 2017 and ready for commissioning.

Nucleons transfer spectroscopy using SPIRAL1 ISOL beams



The current call for proposal includes de facto these setups

- ❑ Data analysis collaboration between AGATA-Ancillaries-Spokesperson can be improved
 - * Post-experiment fast access to the Data, GRID Uploading and access users
 - * Full Replay from traces to tracking
 - * Local infrastructures (disks, CPU), svn for the software, Manual, Quality check
 - * Contact person in the collaboration ?

- ❑ Efficiencies
 - * We spent a lot of time on the source and in-beam efficiencies
 - * Most of the effects are understood but not all in particular at high rate. With 35 detectors, we often go beyond 1MHz event requests in the GTS system.
 - * Need updates of the G4 package

- ❑ Aging of the system
 - * First HP anodes with linco2 are dying
 - * More Linco2 failures after shutdown
 - * More GTS V3 mezzanine flash boot failures after shutdown
 - * >60% of the detectors need a neutron damage correction
 - * Aging of the cryostat with vacuum issues (real damage (ATC3, ATC4) or just quality of the vacuum after 4 years of uninterrupted operation (ATC8))

Some general remarks

□ Operation

- *We ran 15 experiments in ~9 months of beam time (~2 experiments/month)
- *Remaining time is spent on fixing and testing (~100% time of the local team)
- *There are 1330 electronic channels to manage (Detectors, FEBEE, DAQ, calibrations)
- *There are ~60 000 parameters to be prepared by the local team to reach the tracked.adf
- *We backed-up 313 To of data to each GRID Tiers
- *In-beam data since 2014, the campaign is approved until 2019 with an additional request for 2020 to be sent (7 years operation at GANIL).

□ Local team

- *Hongjie will stay 3 years until beginning of 2019
- *Damian will join GANIL from end of 2017 for 2 years
- *LPM
- * Guillaume Lalaire was appointed as DAQ infrastructure contact
- * Bruno Rain, Michel Tripon, Mathieu Beuzard left GANIL
- *Jean will go in retirement beginning of 2018

□ Visitor

- *Magda visited GANIL for 4 months in 2017
- * Participation during the beam time or during the preparation

Conclusion

First results from the 2015 data set have been published or presented in conferences

Four experiments have been performed in 2016 with some limitations due to the targets.

The 2017 run ran with 35 capsules taking data

AGATA was successfully coupled to VAMOS, DSSD, FATIMA and PARIS detectors

Five experiments have been performed in 2017 in three months.

Analysis are in progress and more results will come

The next campaign will be the NEDA-DIAMANT setup coupled to AGATA in 2018

Call for the next PAC and schedules beyond 2018 will be released soon

You are welcome to help

Many thanks to all AGATA collaborators!