Preparation for the AGATA campaign at GANIL

E.Clément (GANIL)

AGATA Week GSI June 2012

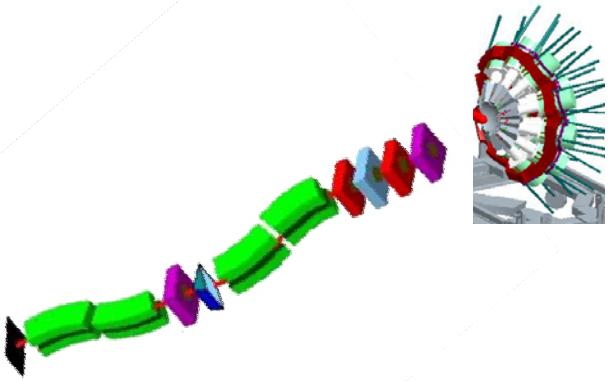
AGATA Demonstrator/1π Experimental Program

2010 → LNL
5TC

AGATA D.+PRISMA

Total Eff. ~6%

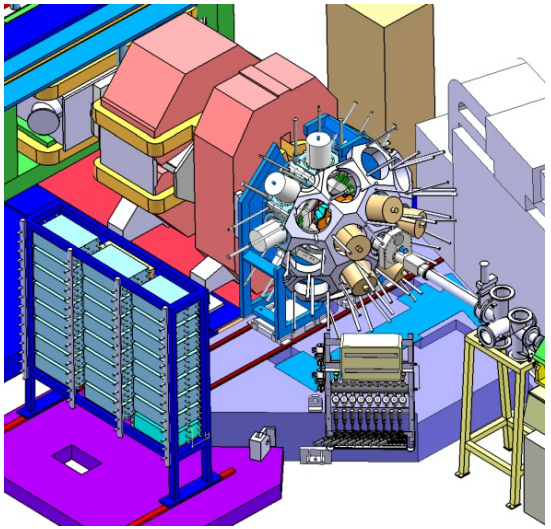
2012 → GSI/FRS
5TC+5DC



AGATA @ FRS

Total Eff. > 10%

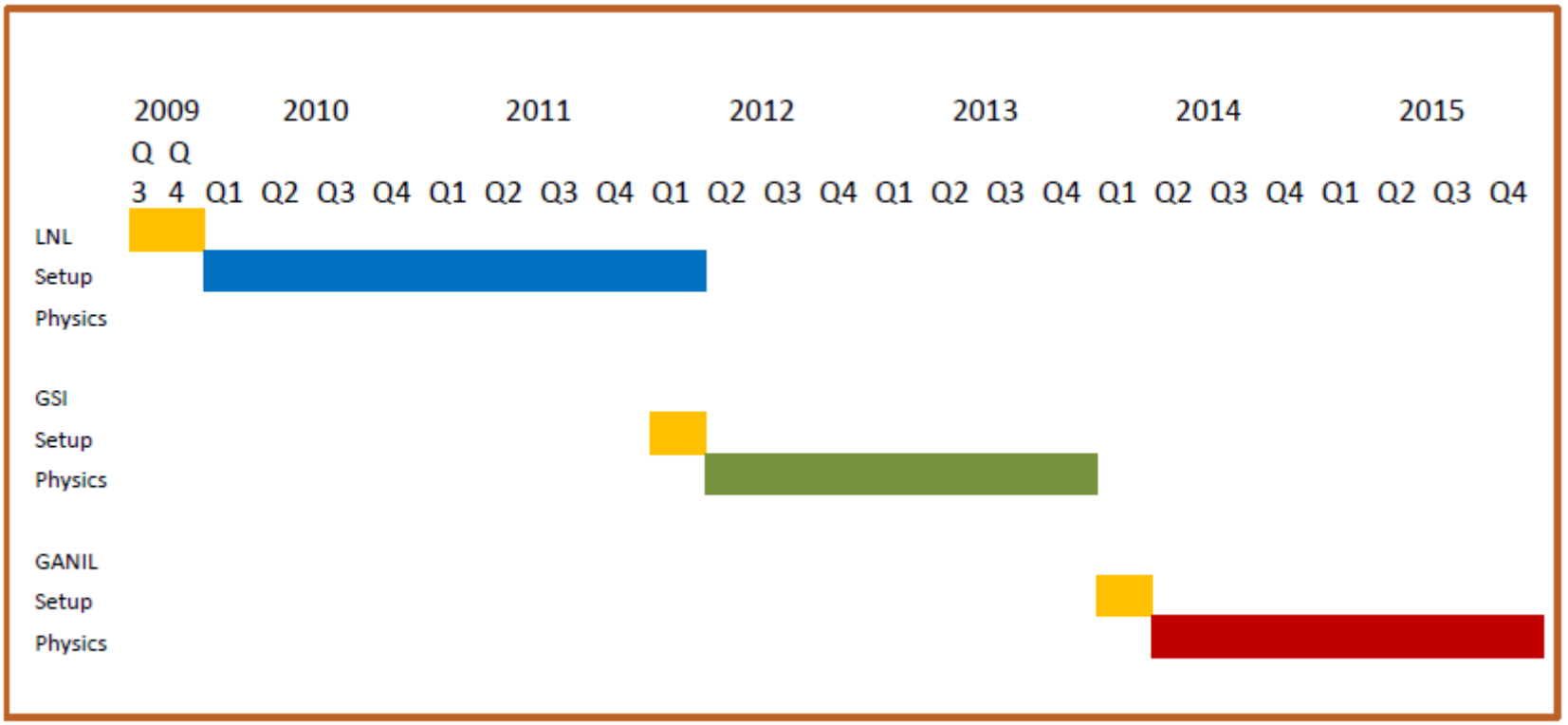
2014 → GANIL/SPIRAL2
10TC+5DC



AGATA + VAMOS + EXOGAM

Total Eff. > 20%

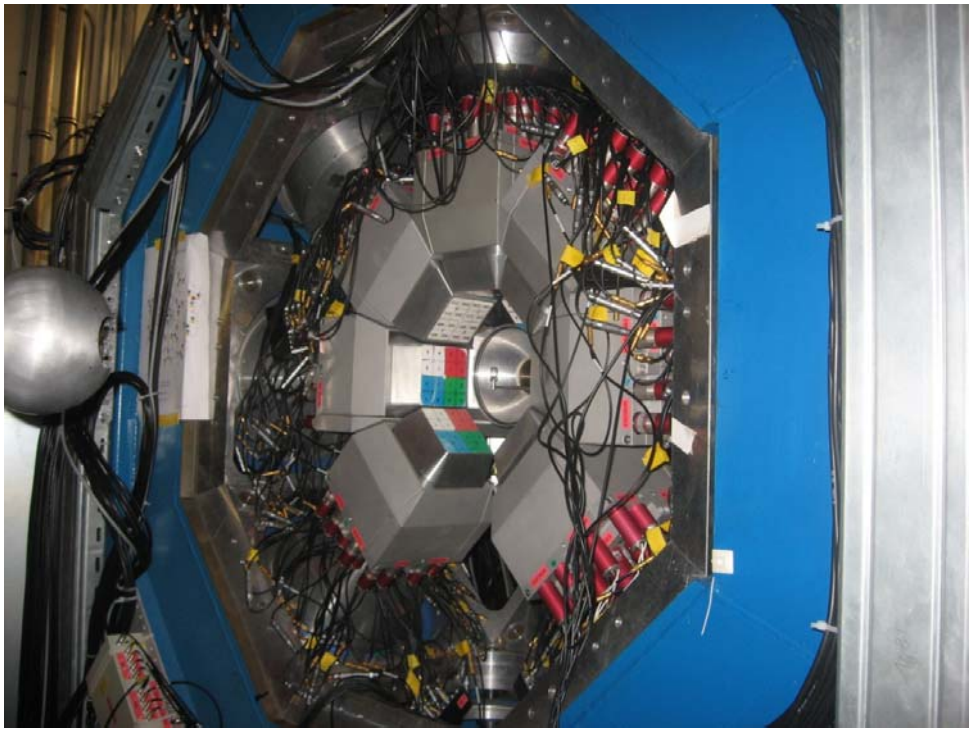
Schedule


2009
2010
2011
2012
2013
2014
2015
Q Q
3 4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
LNL
Setup
Physics
GSI
Setup
Physics
GANIL
Setup
Physics

GANIL Assets / Uniqueness

- Energy range E/A from 0.3 to 95 MeV/A
- Heavy stable beams (up to uranium)
- High intensity (~2pnA ^{238}U; 1pμA ^{36}S; 0.5pμA ^{48}Ca;…)
- Intermediate energy fragmentation
- ISOL (SPIRAL1)
- Detectors: spectrometers (SPEG, VAMOS); γ-ray arrays (EXOGAM, Château de cristal); DIAMANT; MUST2, NWall; etc.
- Future with SPIRAL2 and S3

γ-ray spectroscopy at GANIL today



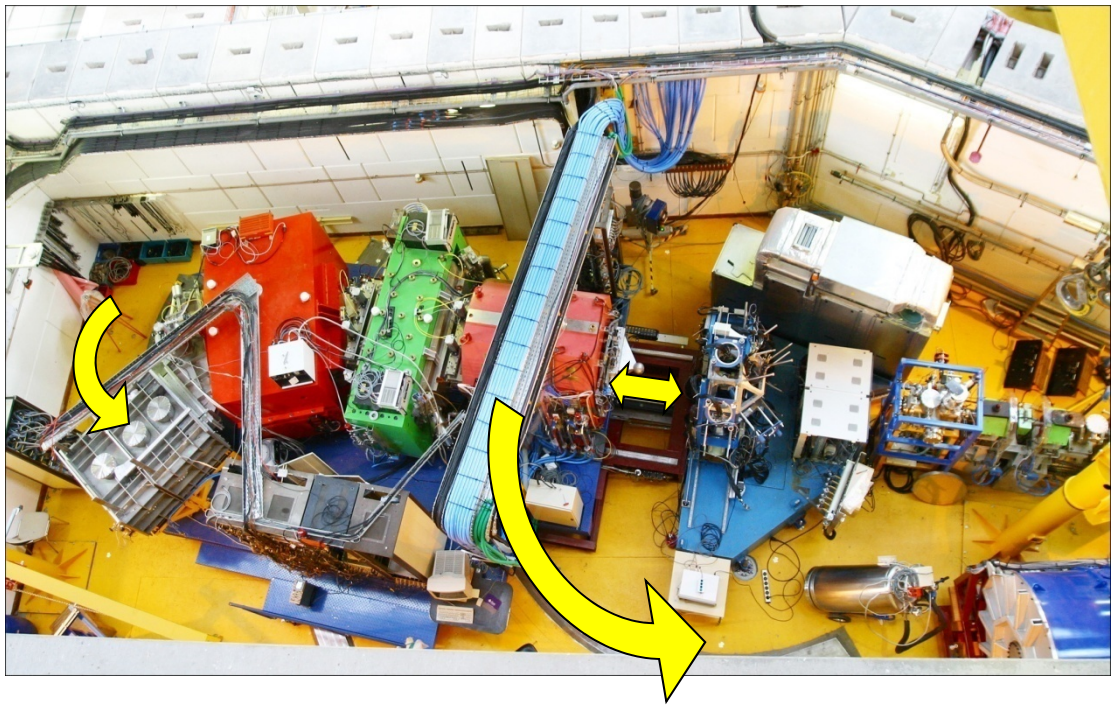
- EXOGAM is the working horse for high resolution γ-ray spectroscopy at GANIL
- 40% of experiments require EXOGAM resources
- Used in several areas: G1 (VAMOS), G2, D4 and D6 (LISE), G3 (SPEG), LIRAT
- Exploit stable beams from very low to medium energy; radioactive beams from fragmentation and SPIRAL1

EXOGAM coupled to VAMOS:
Spectroscopy of n-rich nuclei

Beam: ^{238}U @ 5.5 MeV/u, (i ~ 2pnA)
(N/Z=1.58) ~ 11% above barrier

Target : ^{48}Ca,^{70}Zn, ^{198}Pt … (1 mg/cm^2)

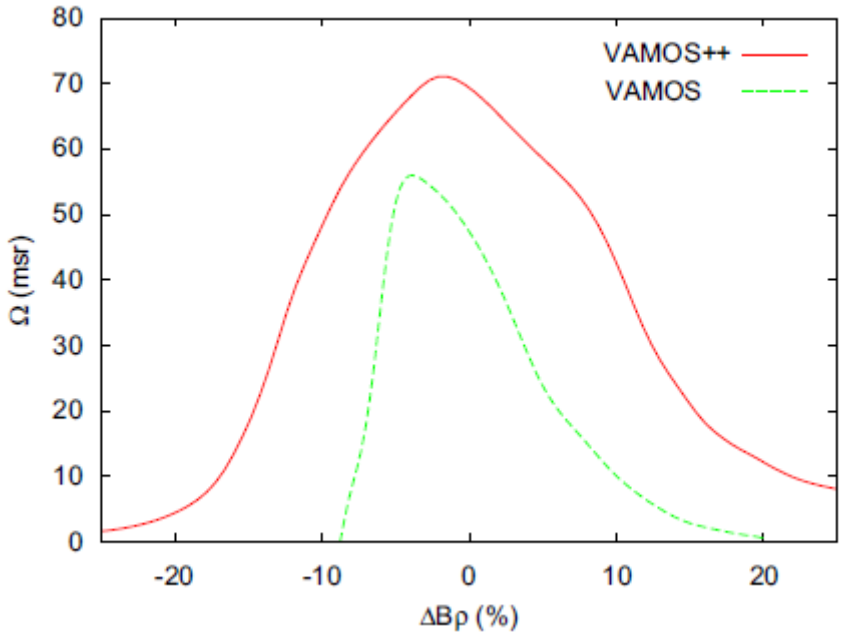
- VAMOS + EXOGAM at grazing angle (for target-like)
- Detection of targetlike residues at the focal plane



- Shell evolution toward ^{54}Ca *(M. Rejmund et al)*
- lifetime measurement with a plunger in n-rich nuclei beyond ^{68}Ni (*J Ljungvall et al; A Dijon et al, I. Celikovic et al)*
- Delayed and prompt gamma spectroscopy around ^{68}Ni *(A Dijon et al)*
- Transfer induced fission reactions *(F. Farget et al, M. Rejmund et al. A. Görgen et al.)*
- Spectroscopy of heavy element Os *(J. Valient-Dobon et al)*

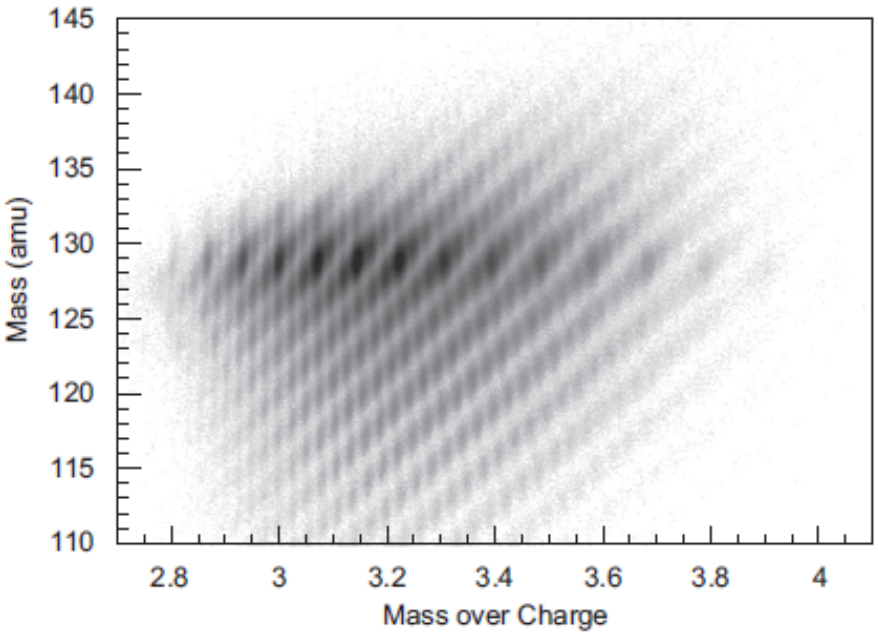
Structure around the closed shells:
n-rich nuclei using DIC

VAMOS → VAMOS++



Larger acceptance due to the size of the detectors

$^{129}Xe+^{197}Au$ at 967 MeV



Full reconstruction over the whole acceptance

M. Rejmund al, NIM A 646 (2011) 184–191

Structure around the closed shells:
n-rich nuclei using DIC

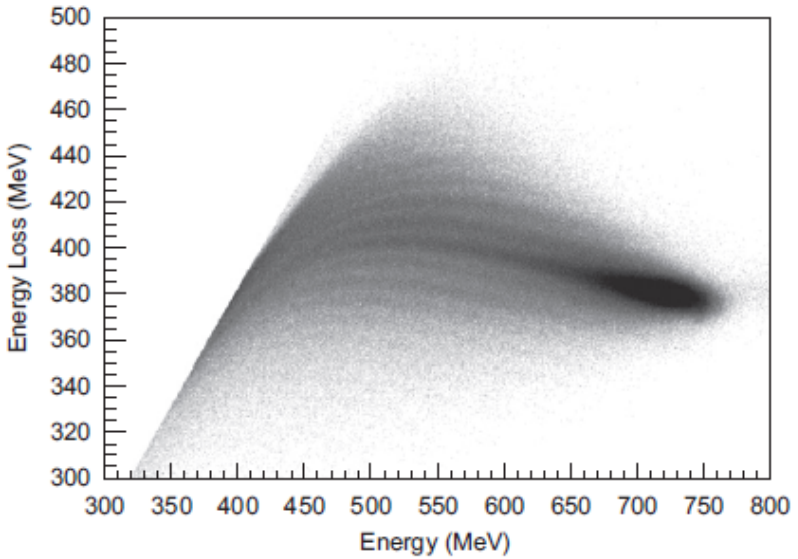


Fig. 7. Two-dimensional spectrum of energy loss (ΔE) vs total energy ($\Delta E + E_r$) measured over the full focal plane for the $^{129}Xe + ^{197}Au$ system.

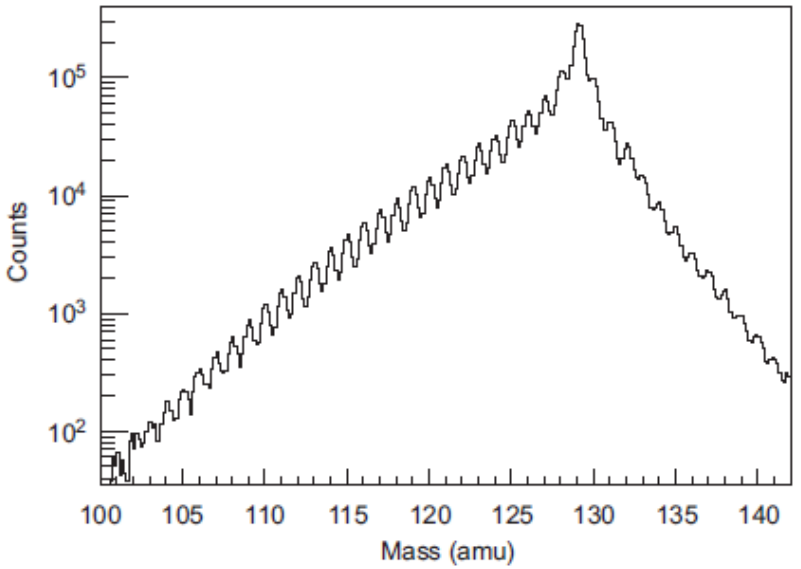


Fig. 9. A typical mass spectrum of the fragments detected in the focal plane corresponding to Fig. 8. The dominant peak corresponds to the mass of the projectile.

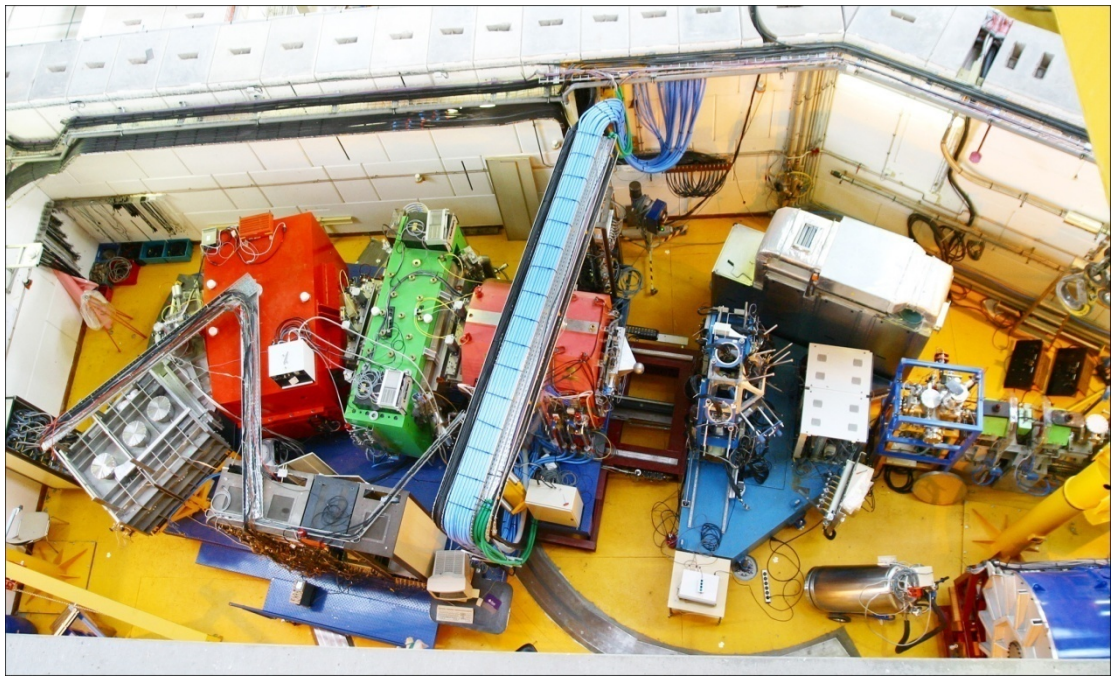
Mass resolution ~ 1/220
Z identification up to Z= 60

Using the Pb or U beams : opportunity for prompt spectroscopy of heavy elements populated in MNT : **Ni, Sn, Pb region**

M. Rejmund al, NIM A 646 (2011) 184–191

EXOGAM coupled to VAMOS+MUSETT:
Spectroscopy of SHE nuclei

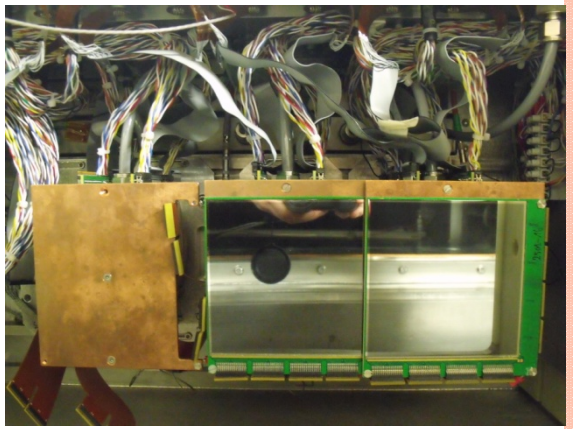
Vacuum mode : $^{22}Ne + ^{197}Au \rightarrow ^{214}Ac$
Gas filled mode : $^{48}Ca + ^{198}Pt \rightarrow ^{244}Cf$



- VAMOS + EXOGAM+MUSETT
- Vamos at 0 degree used as separator
- Prompt spectroscopy after Recoil decay tagging (α-decay) in MUSETT

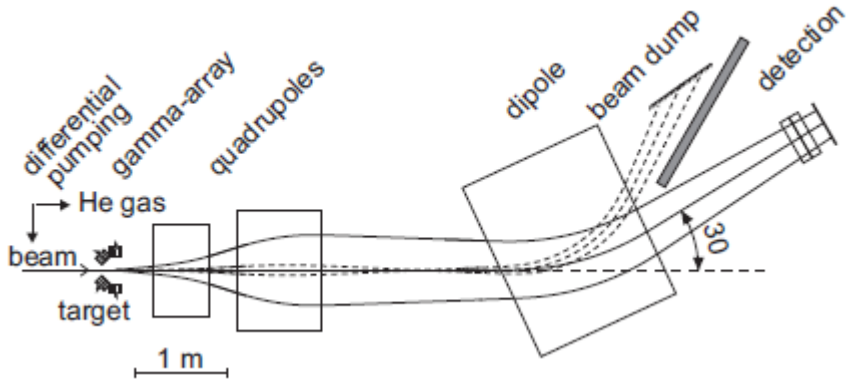
- ^{214}Ac spectroscopy
  (C. Theisen et al, under preparation)
- ^{244}Cf spectroscopy
  (B. Sulignano, Accepted E579a)

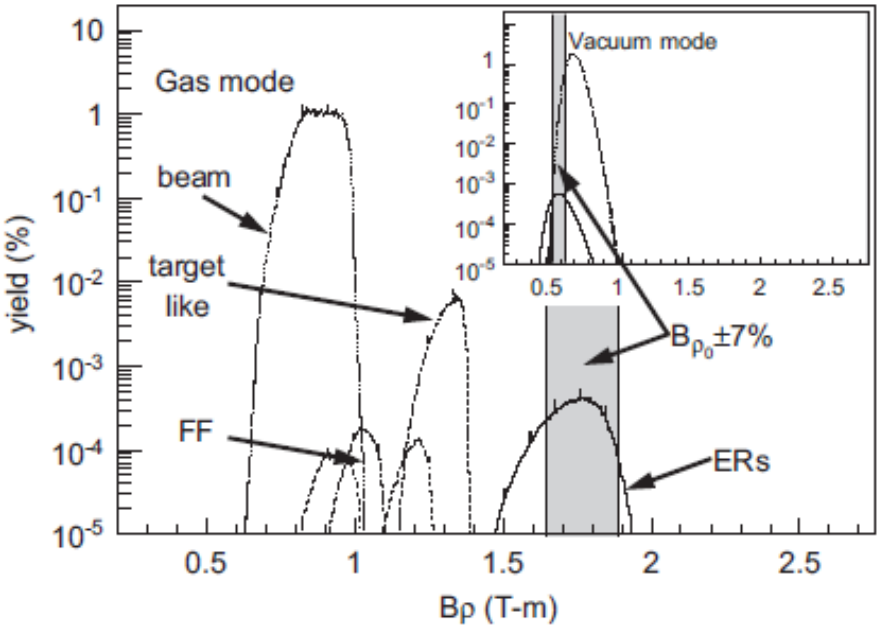
MUSETT array



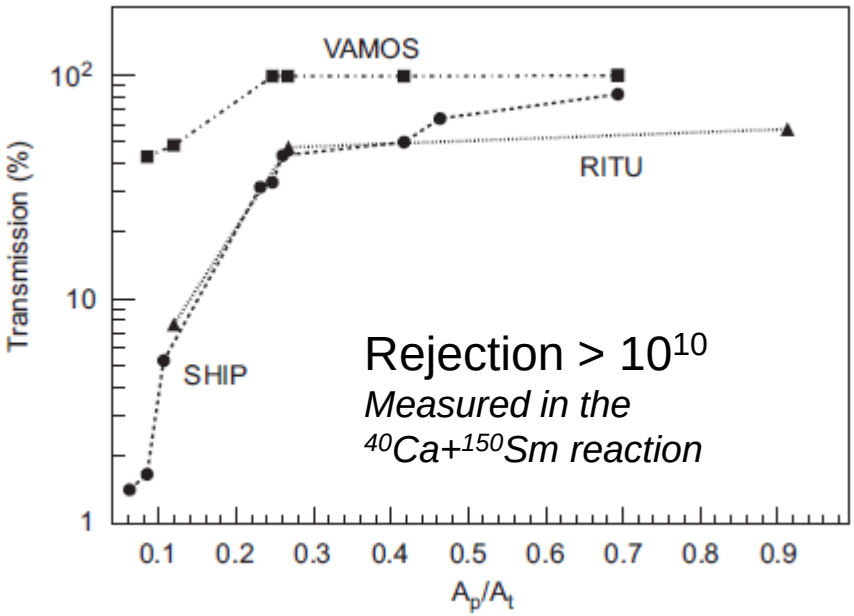
Spectroscopy beyond Fm:
the shell model towards SHE

VAMOS in gas-filled / Vacuum mode





Unique opportunity to couple AGATA -1π with a separator in fusion induced reaction



Rejection > 10^{10}

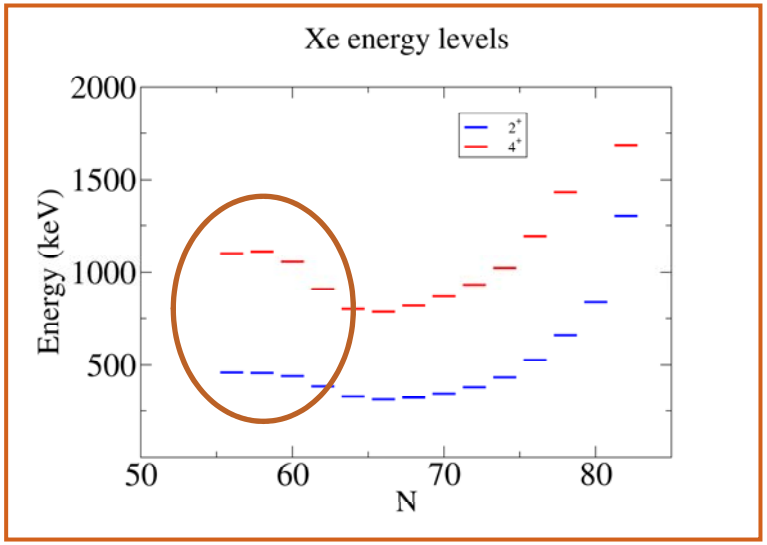
Measured in the $^{40}Ca+^{150}Sm$ *reaction*

Prompt spectrocopy with π,α tagging at the focal plane (MUSETT)

C. Schmitt et al NIM A 621 (2010) 558–565

Collectivity in N≈Z nuclei: Enhancement from T=0?

VAMOS in gas-filled with AGATA and MUSETT (Island of α-emitter)



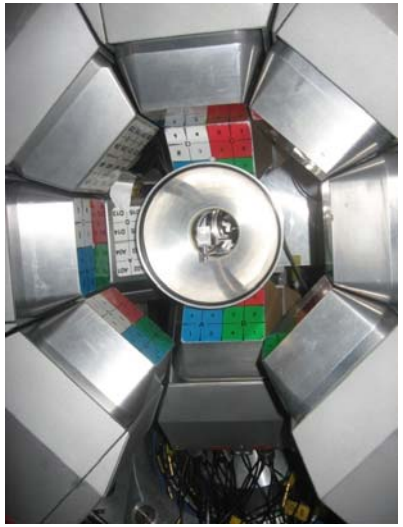
Onset of collectivity induced by np pairing near N=Z and closed shells ?

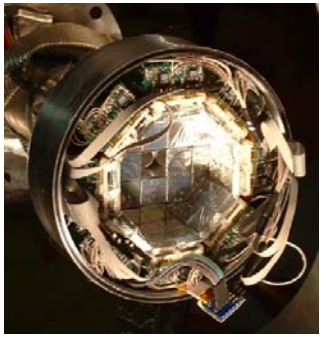
→Prompt spectroscopy of light Xe,Te,I isotopes
→ α and π emitter
→ AGATA use : from spectroscopy to lifetime measurement (plunger)

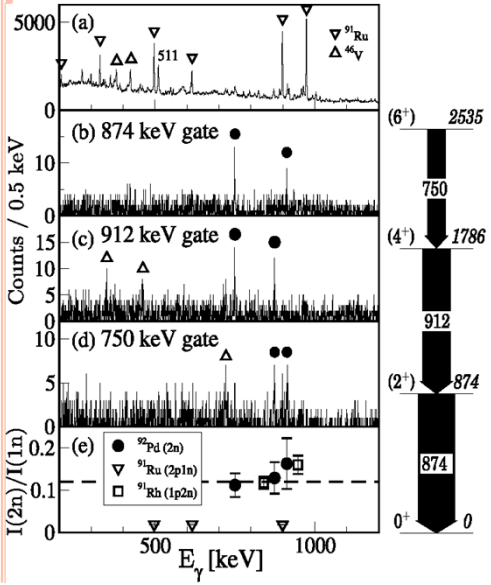
M. Sandzelius et al., Phys. Rev. Lett. 99, 022501 (2007).

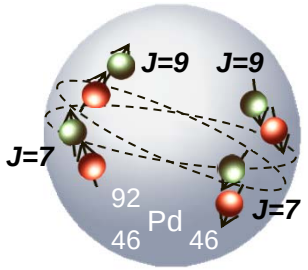
Gas filled mode : $^{54}Fe+^{54}Fe \rightarrow {}^{106}Te + 2n$ (25 nb)
$^{54}Fe+^{58}Ni \rightarrow {}^{110}Xe + 2n$ (50 nb)
$^{54}Fe+^{58}Ni \rightarrow {}^{109}I + p2n$ (10 μb)

EXOGAM coupled to the NWalla
Prompt Spectroscopy of N=Z nuclei

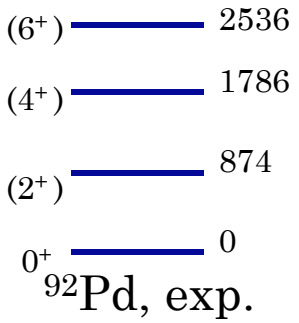




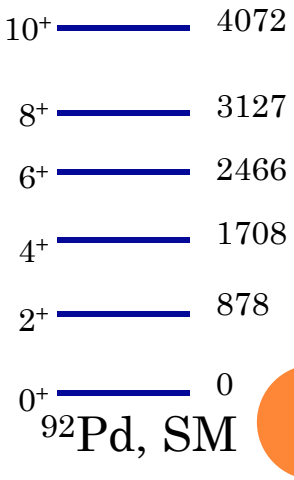




A new Spin-aligned pairing phase in ^{92}Pd



^{92}Pd, exp.



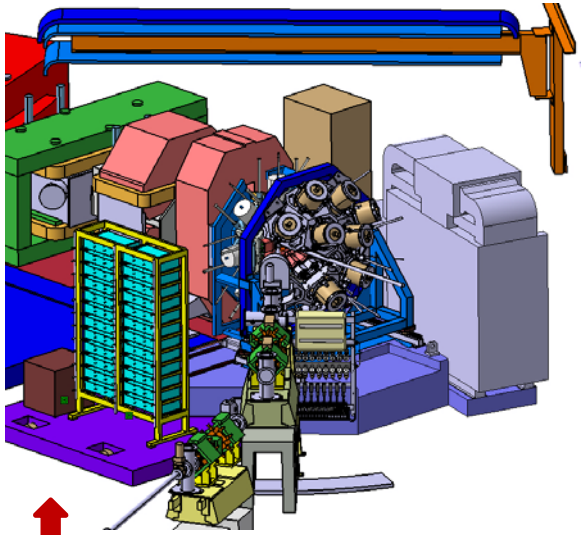
^{92}Pd, SM

B Cederwall, et al, Nature 469, 68-71 (2011)

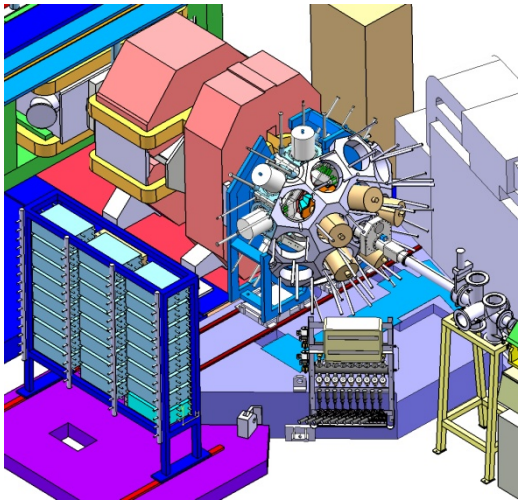
- Spectroscopy of heavy elements towards SHE and N=Z nuclei
- Gamma-ray spectroscopy of very neutron-rich nuclei populated in Deep Inelastic Reaction
- Spectroscopy at large isospin; spectroscopy with reactions at intermediate energies
- Exotic nuclear shapes
- Spectroscopy after single nucleon transfer at SPIRAL1

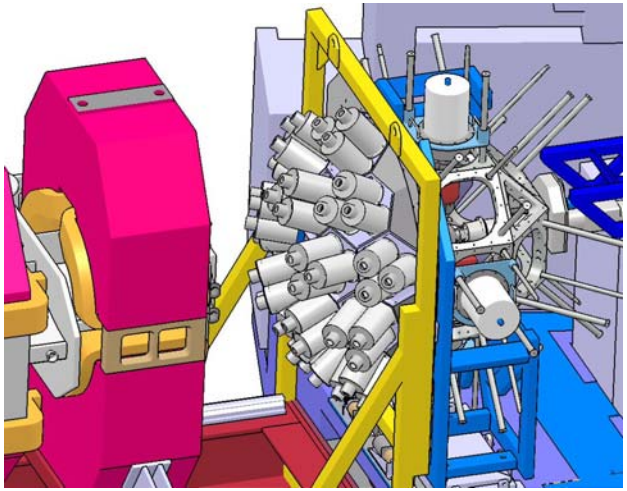
AGATA 1π at GANIL :

Angles >10 deg for fission et MNT



At 0° as separator (vaccum/gaz-filled)





In G1 coupled to VAMOS (+ EXOGAM2 & NWall): SIBs, RIBs

- ❑ *Charged particle array for transfer reaction MUST2/TIARA : (d,p) etc … program with SIB and RIB*
- ❑ *Charged particle array for prompt tagging : DIAMANT*
- ❑ *Charged particle array for Recoil Decay Tagging : MUSETT*
- ❑ *Scintillator : BaF2 array, LaBr3*
- ❑ *Future detector : NEDA (n) , GASPARD (MUST2-like), PARIS (LaBr3)*

Roadmap

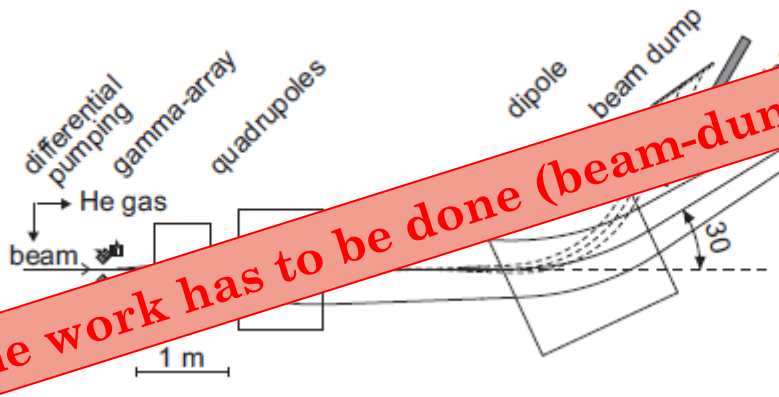
- Installation of AGATA in the G1 cave for the 2014-2015 campaign

- AGATA collaboration meeting end of June 2012
  →Nomination of the scientific coordinator (external GANIL)

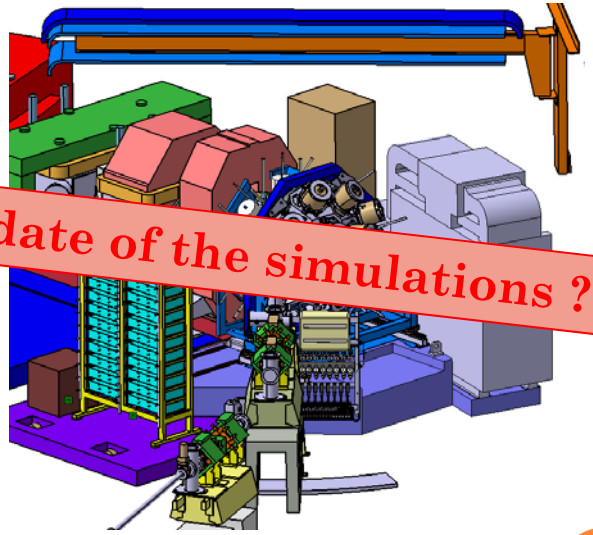
- Call for letter of intent in summer 2012
  All stable beams from GANIL, existing and new RIB from SPIRAL1 will be proposed as well as available detectors.

AGATA 1π at GANIL : the separator option …

Which electronic in 2014-2015 ?



Some work has to be done (beam-dump …)



Update of the simulations ?

Roadmap

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- Discussion and harmonization of the LoI's within the AGATA-GANIL collaboration
  (millstones : AGATA week physics case early 2013 at GANIL)

- Conclusions and proposed physics campaigns will be presented at the 2013 GANIL scientific council

- 2013 PAC : proposal for experiments that will be scheduled in 2014 (1st campaign)
- 2014 PAC : proposal for experiments that will be scheduled in 2015 (2nd campaign)

- Early 2014 : AGATA installation in G1 for the 1st campaign
- Commissioning during run 2 of 2014

- 6 months of campaign will be available in 2014-2015 for AGATA@GANIL

Installation of AGATA at GANIL

- Studies including task identification, manpower and cost estimate done for 8 TC updated for up to 15 TC
- Tasks identified:
  - ✓ Mechanics
  - ✓ Infrastucture
  - ✓ Equipment and cables
  - ✓ Installation of detectors and acquisition
  - ✓ Running AGATA
- GANIL commitment in MoU: 190 k€ and 101mm
- Dedicated Ge labs and acquisition rooms

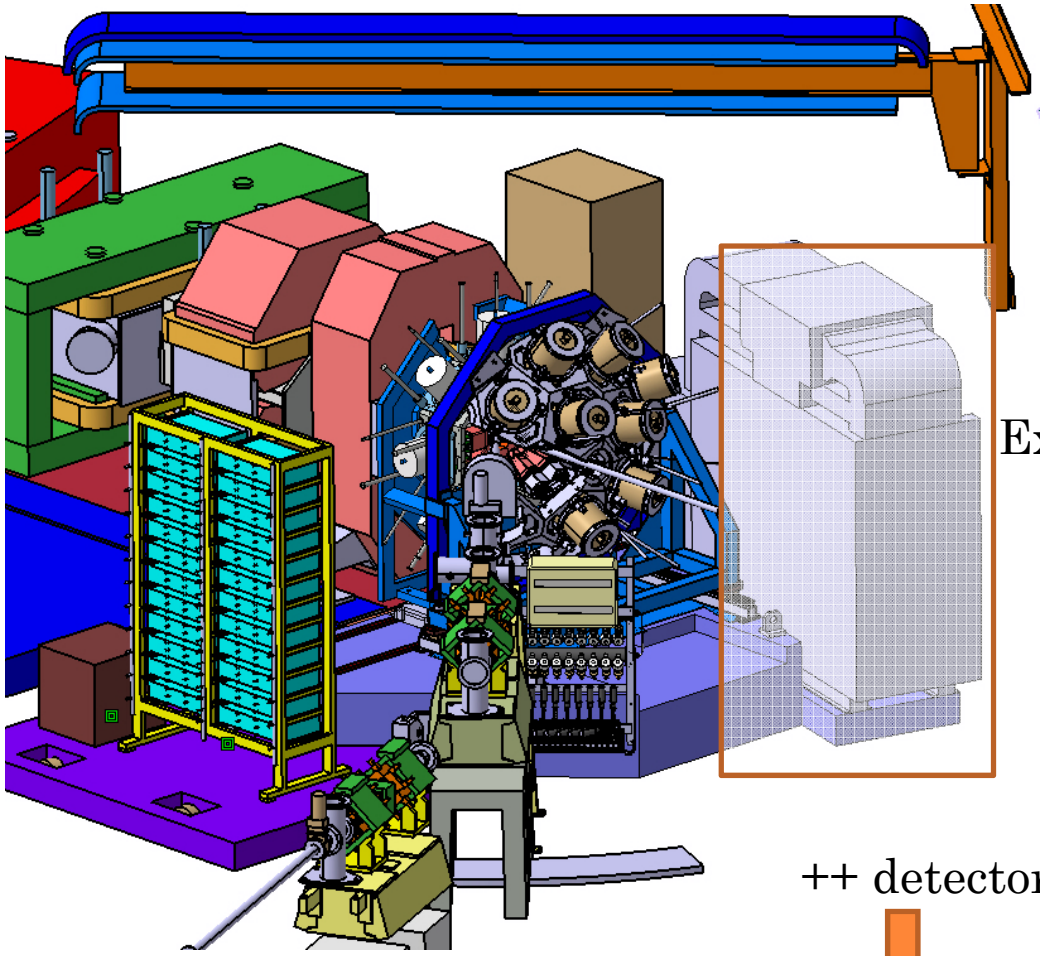
- Campaign organized with:
  - ✓ Local Project Manager (E.Clément)
  - ✓ Technical coordinator (L. Ménager)
  - ✓ Scientific Coordinator (Collaboration meeting June 2012)
- Task identification, personnel, local organization in contact with the AGATA working group and cost estimate.

- Design :2012
- Manufacturing: 2013
- Setting-up: early 2014

- Jean Ropert L. Ménager :: infrastructure and detectors
- G. Voltolini :: room & lab
- G2I J-L Foucher, L. David et N. Ménard :: network infrastructure, data transfer etc ..
- GAP B. Raine, M. Tripon, F. Saillant :: DAQ, Electronic, grounding, coupling AGAVA …
- Surveyors
- Mechanics C. Feierstein feat M. Ozille + J. Strachan & I. Burrows (STFC-Daresbury)
- Target loader G. Frémont

First design in 2008 for 8 TC following the LNL campaign

Update for 8TC → 15 Clusters



Exogam → Exogam2

++ digitizer
++ Optic fibers
++ DSS
→ Installation

New electronic beyond GSI ?

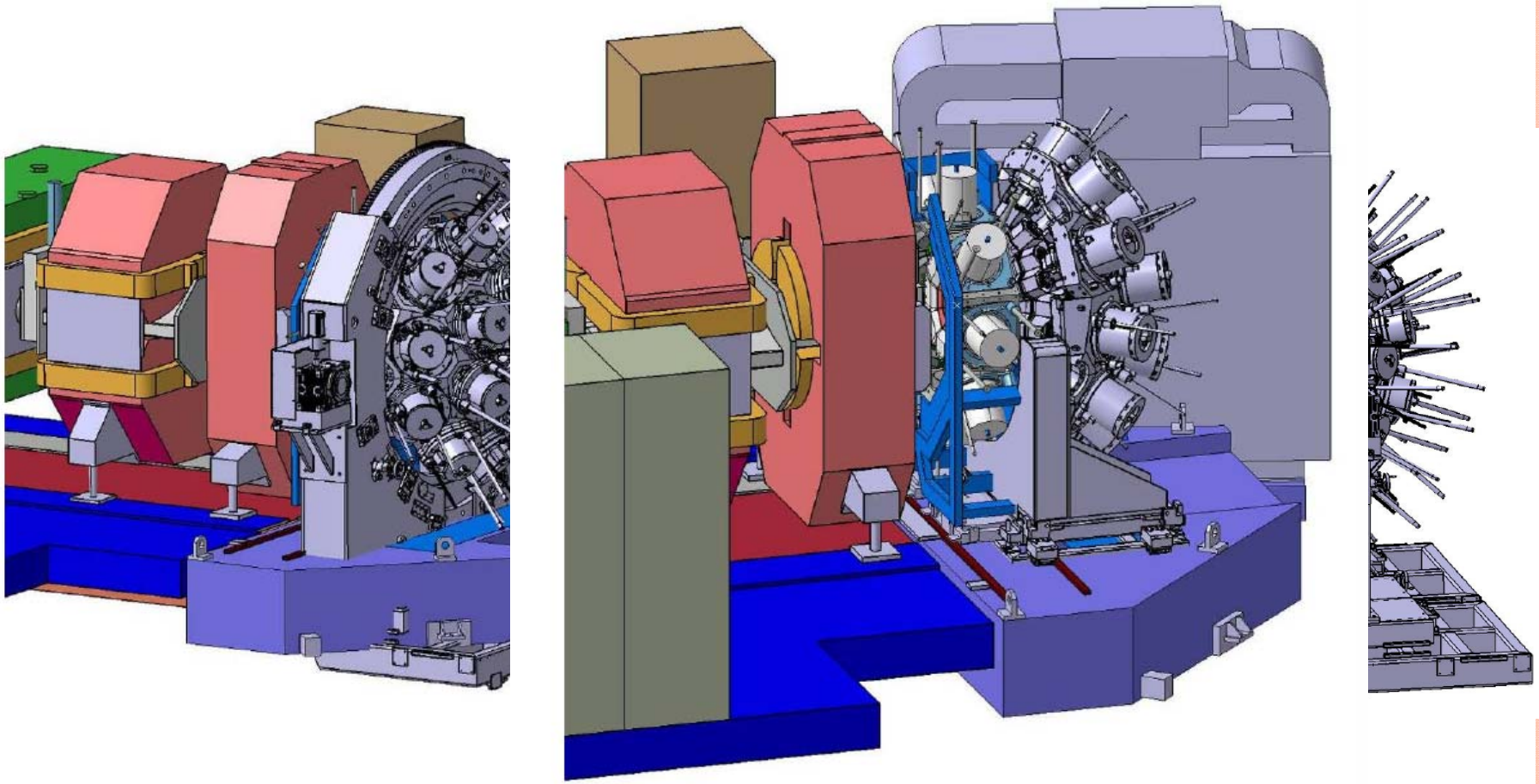
New target Loarder

++ detectors

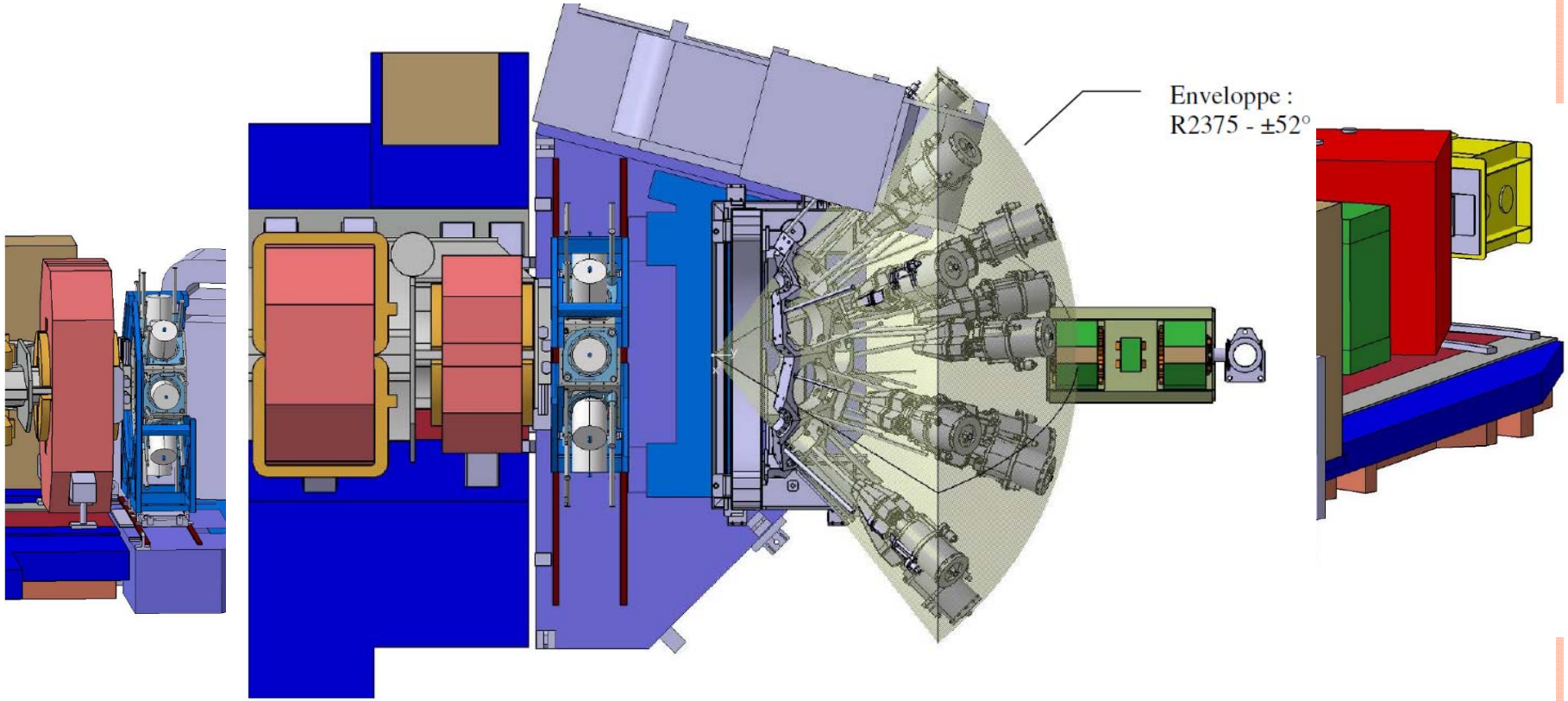
Compatibility with existing mechanics ?

Pre-Studies Yvan Merrer (LPC-Caen)

GSI or LNL mechanics cannot be re-used



Pre-Studies Yvan Merrer (LPC-Caen)
With 15 Cluster, lot of interference with existing mechanics appear
→ Full re-design (€€)



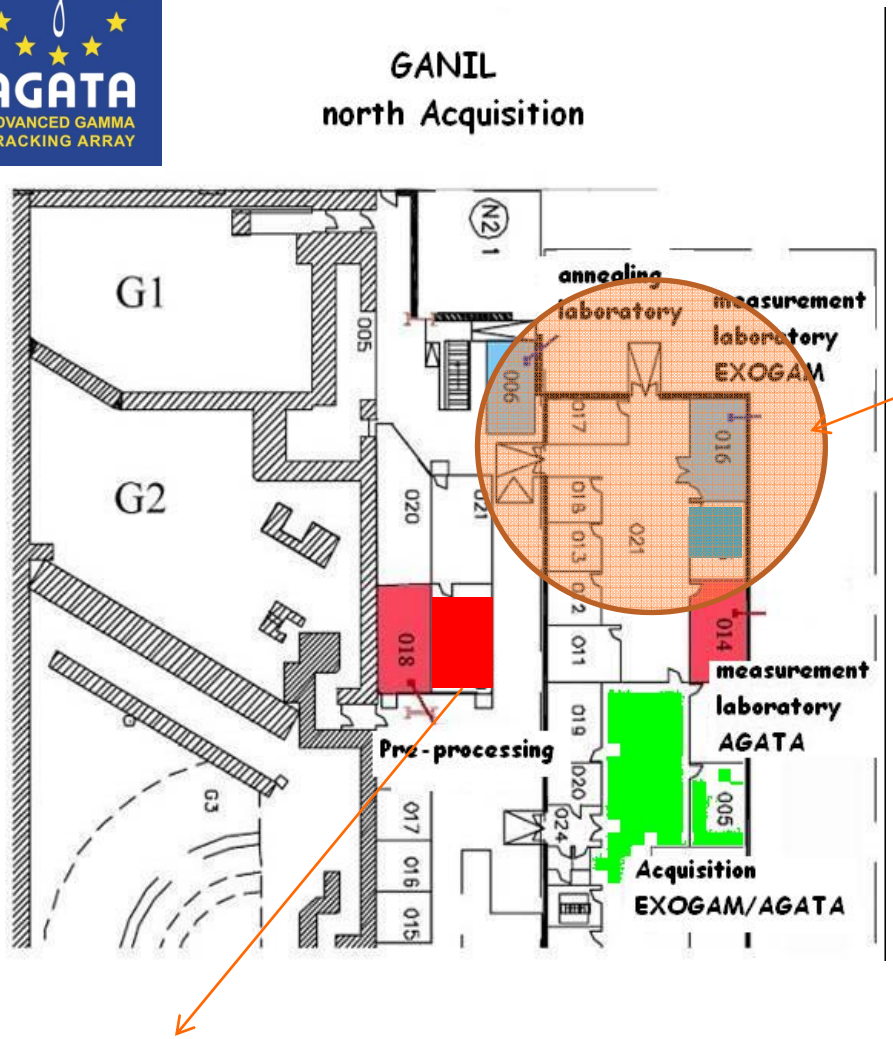
J. Strachan & I. Burrows (STFC-Daresbury) : mecanics for support-Plateform
visit last 16th of May

5 Months are also allocated at GANIL for design starting next January
Claire Feierstein (feat. M. Ozille)

Target loader (G. Frémont)

Gaz-filled → who ?

8TC → 15 TC + 8 Clover EXOGAM:
* Clover integration in AGATA AF → 2 LN2 buffer tanks



Refurbishment of acquisition and lab room on-going
A « clean » room is already available

Pre-processing room identified: air-conditionning already available, test on-going
Cold water also available is required for the ATCA rack
Evaluation of the electric power on-going

Conclusion

There are lot of opportunities for AGATA@GANIL !

In 2012, we need to spend time to define the setup we want :

- Call for L.o.I and AGATA week physics, Scientific coordinator
- Clear view of what will be available as ancillary detectors (electronic)
- Gaz-Filled is not yet fully operational. If we want it, we need to push hard !
- We need rapidly realistic updated simulations for the LoI's

Local organization on-going in contact with the AGATA working group

Mechanical design will be a priority in the coming months


AGATA
ADVANCED GAMMA
TRACKING ARRAY