



Preparation for the AGATA campaign at GANIL

E. Clément (GANIL)

EGAN 2012 June 2012

AGATA Demonstrator/1 π Experimental Program



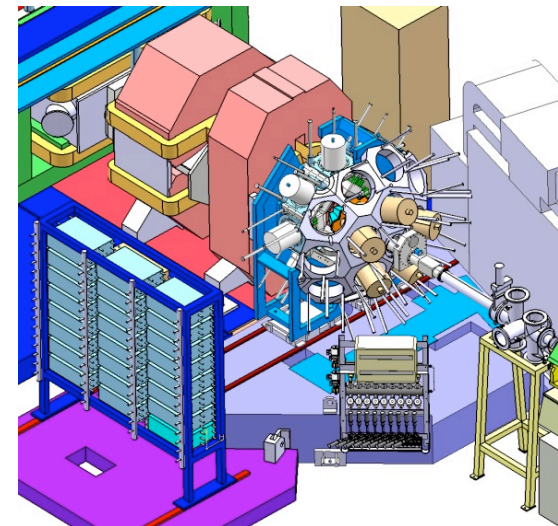
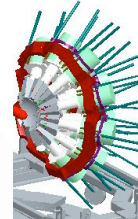
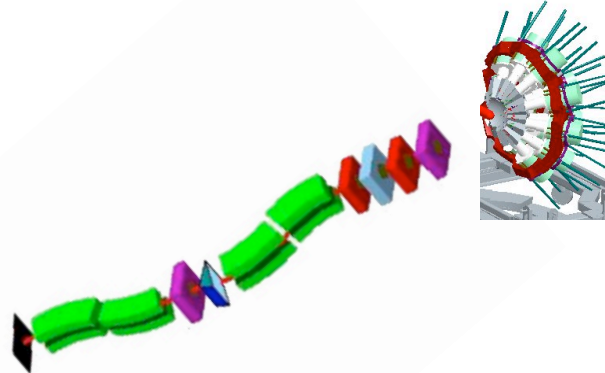
2010 → LNL
5TC



2012 → GSI/FRS
5TC+5DC



2014 → GANIL
10TC+5DC



AGATA D.+PRISMA

Total Eff. ~6%

AGATA @ FRS

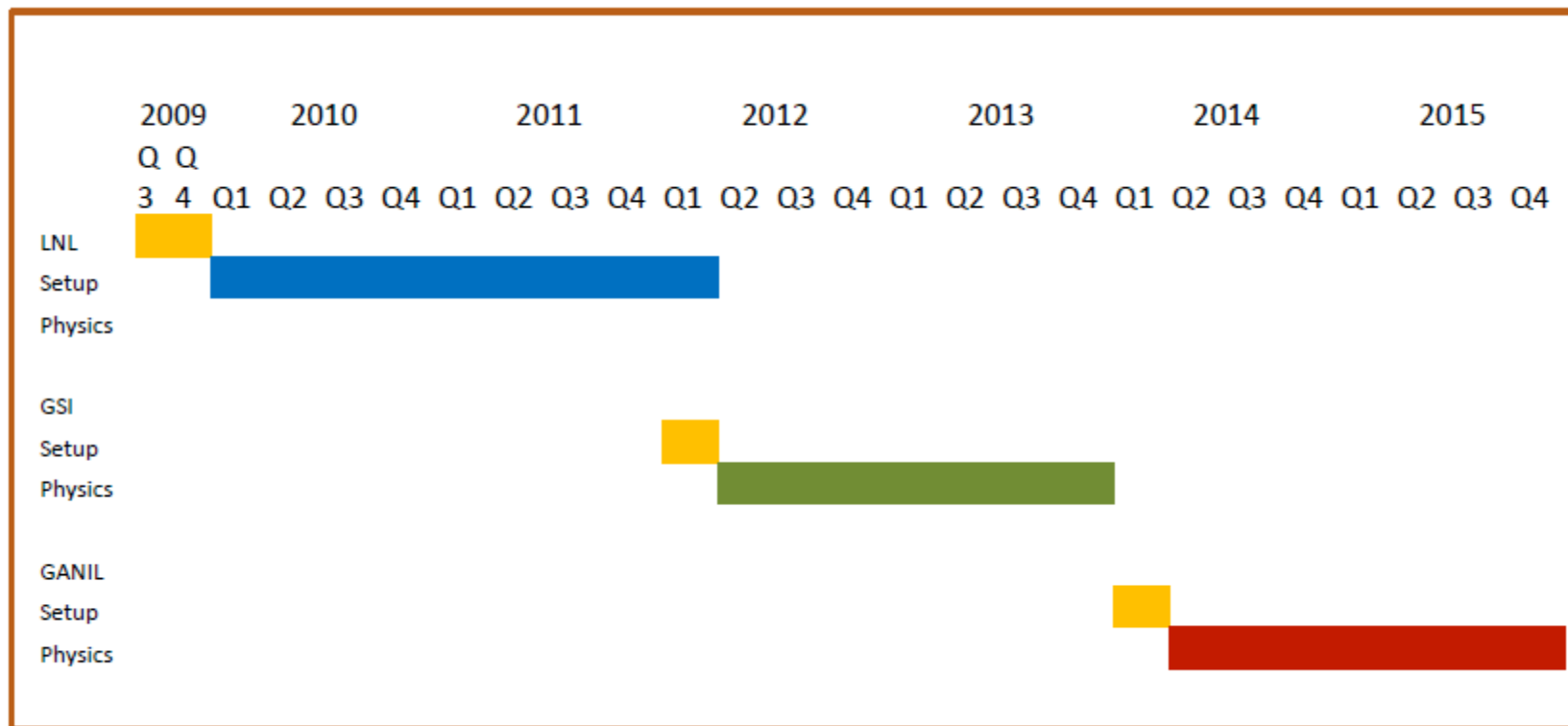
Total Eff. > 10%

AGATA + VAMOS
+ EXOGAM

Total Eff. > 20%



Schedule

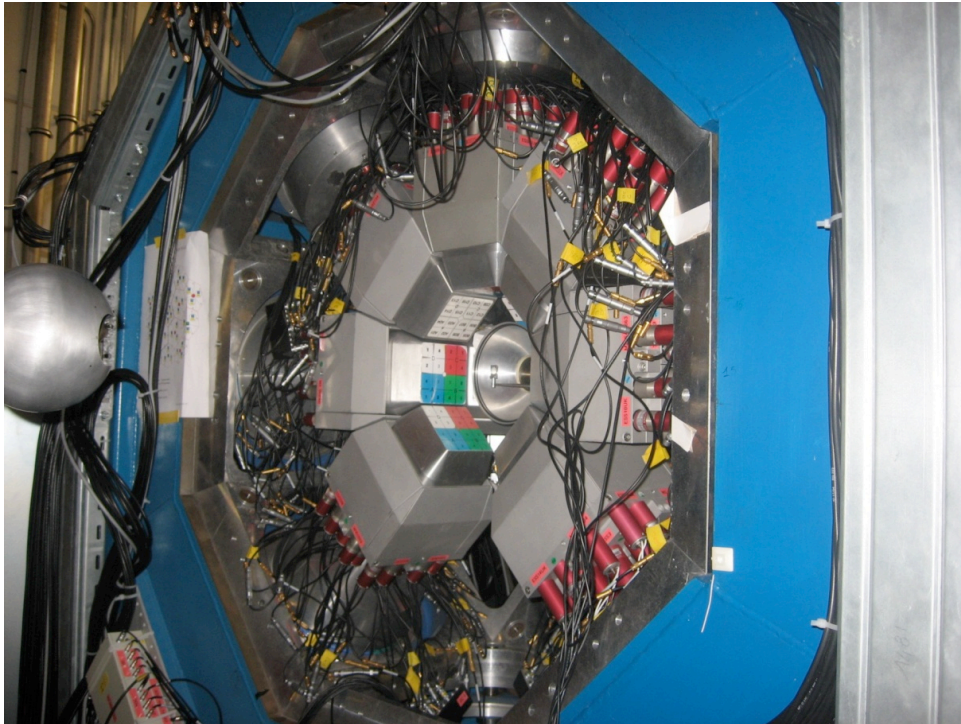


GANIL Assets / Uniqueness

- Energy range E/A from 0.3 to 95 MeV/A
- Heavy stable beams (up to uranium)
- High intensity ($\sim 2\text{pnA } ^{238}\text{U}$; $1\mu\text{A } ^{36}\text{S}$; $0.5\mu\text{A } ^{48}\text{Ca}$;...)
- Intermediate energy fragmentation
- ISOL (SPIRAL1)
- Spectrometers (SPEG, VAMOS)
- γ -ray arrays (EXOGAM, Château de cristal)
- DIAMANT; MUST2, TIARA
- nWall



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



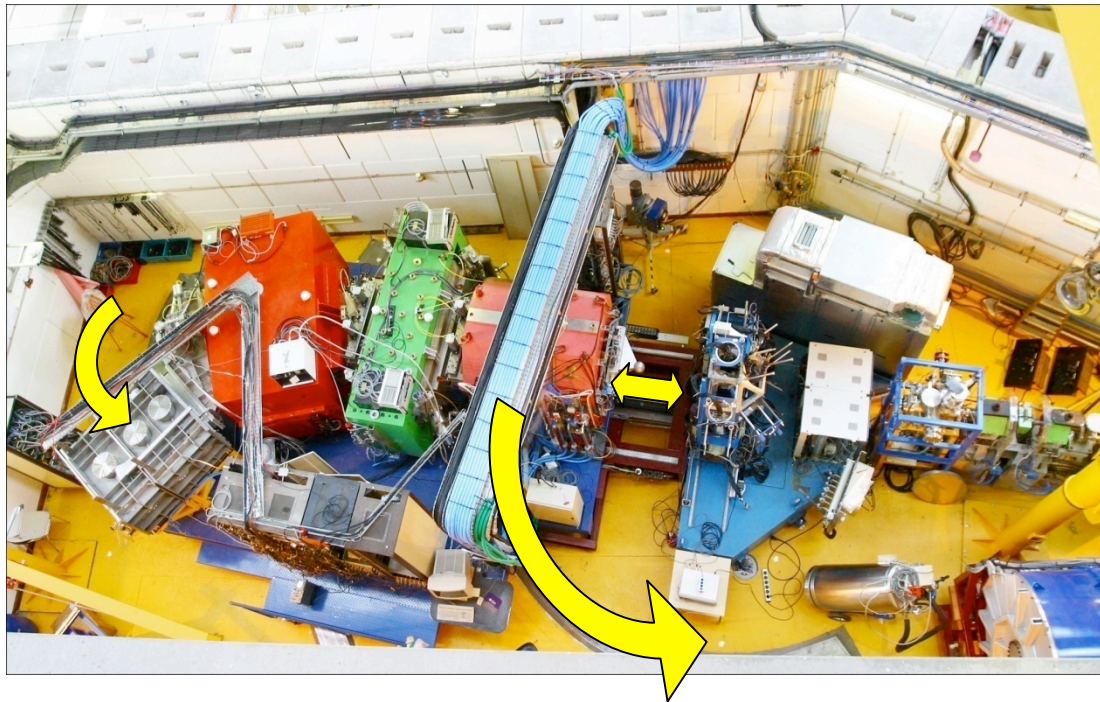


EXOGRAM coupled to VAMOS: Spectroscopy of n-rich nuclei

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

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

- VAMOS + EXOGAM at grazing angle (for target-like)
- Detection of target-like 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. Gorgen et al.*)
- Spectroscopy of heavy element Os (*J. Valient-Dobon et al*)

Structure around the closed shells:

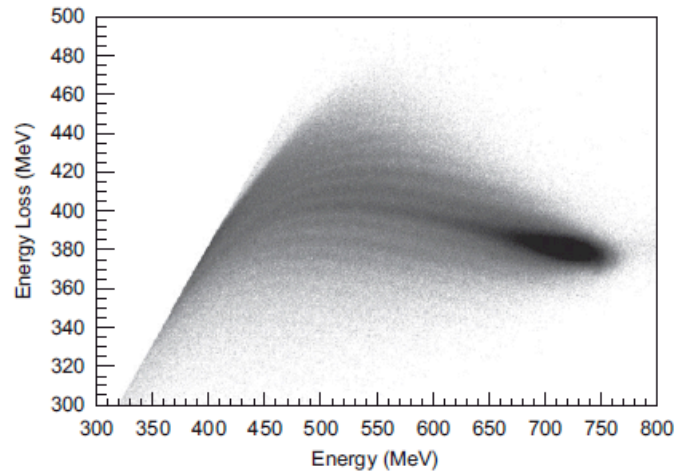


Fig. 7. Two-dimensional spectrum of energy loss (ΔE) vs total energy ($\Delta E + E_t$) measured over the full focal plane for the $^{129}\text{Xe} + ^{197}\text{Au}$ system.

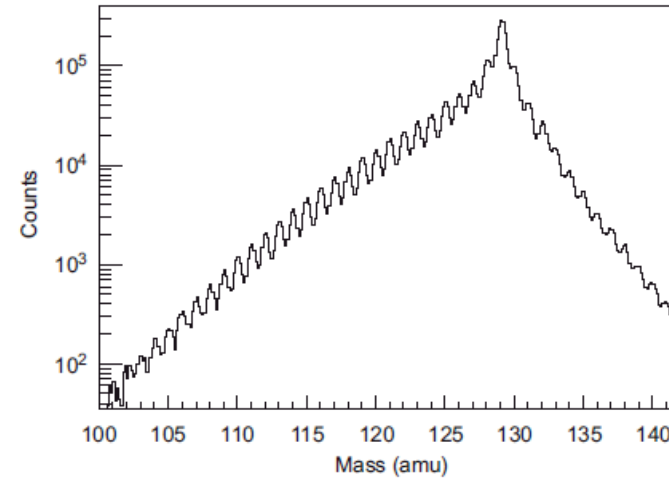
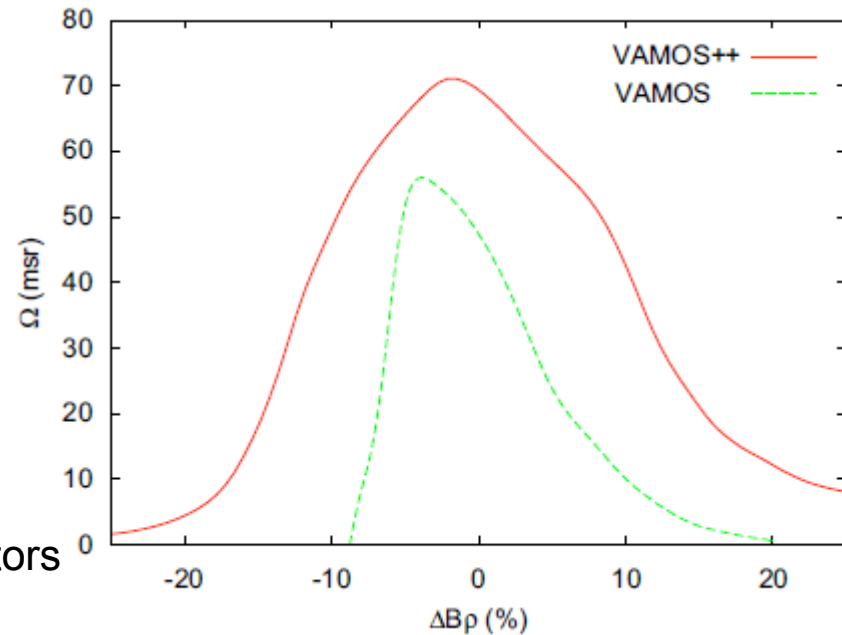


Fig. 9. A typical mass spectrum of the fragments detected in the focal plane corresponding to Fig. 8. The dominant peak corresponds to the mass of the projectile.

Mass resolution $\sim 1/220$
Z identification up to $Z = 60$

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

Larger acceptance due to the size of the detectors

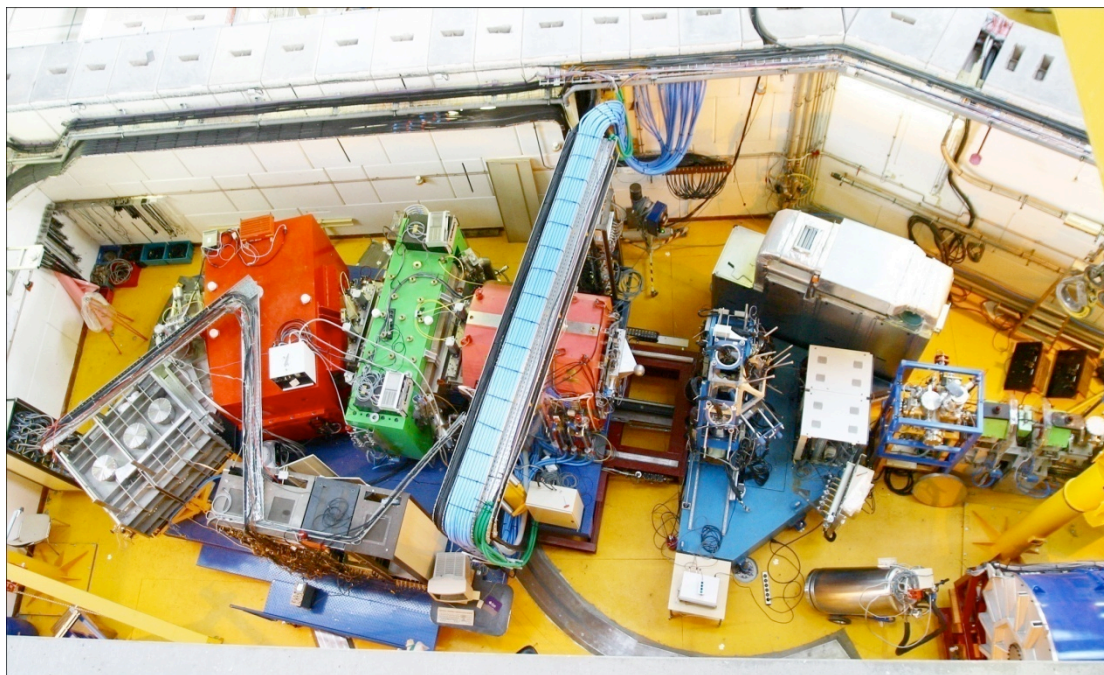


EXOGRAM coupled to VAMOS+MUSETT: Spectroscopy of SHE nuclei

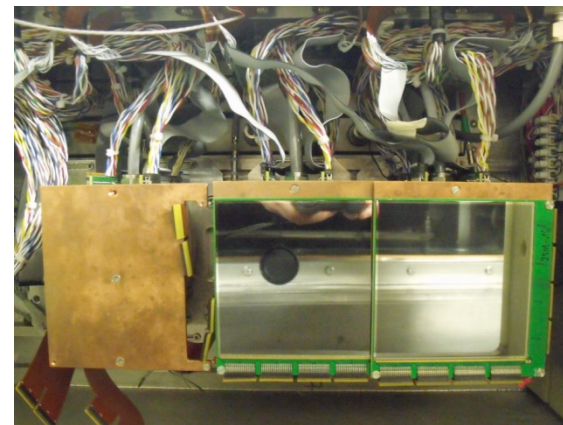
Vacuum mode : $^{22}\text{Ne} + ^{197}\text{Au} \rightarrow ^{214}\text{Ac}$
Gas filled mode : $^{48}\text{Ca} + ^{198}\text{Pt} \rightarrow ^{244}\text{Cf}$

- VAMOS + EXOGRAM+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)

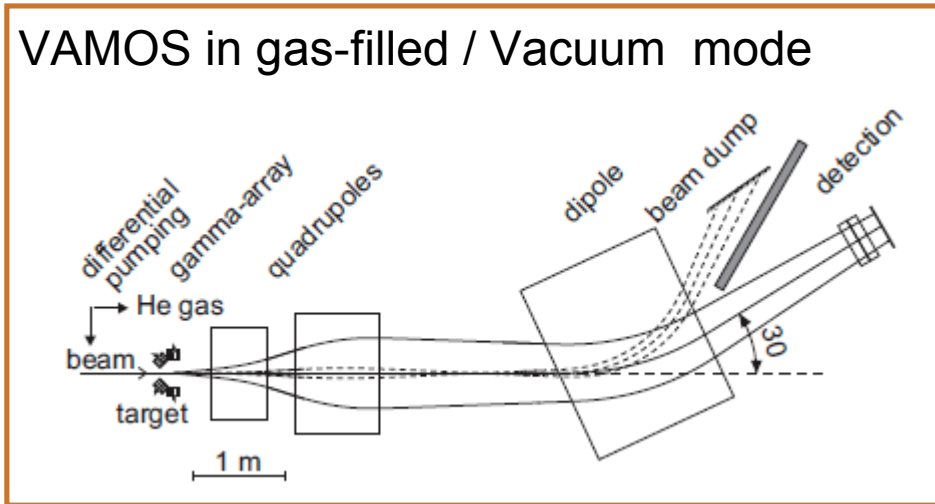


MUSETT array

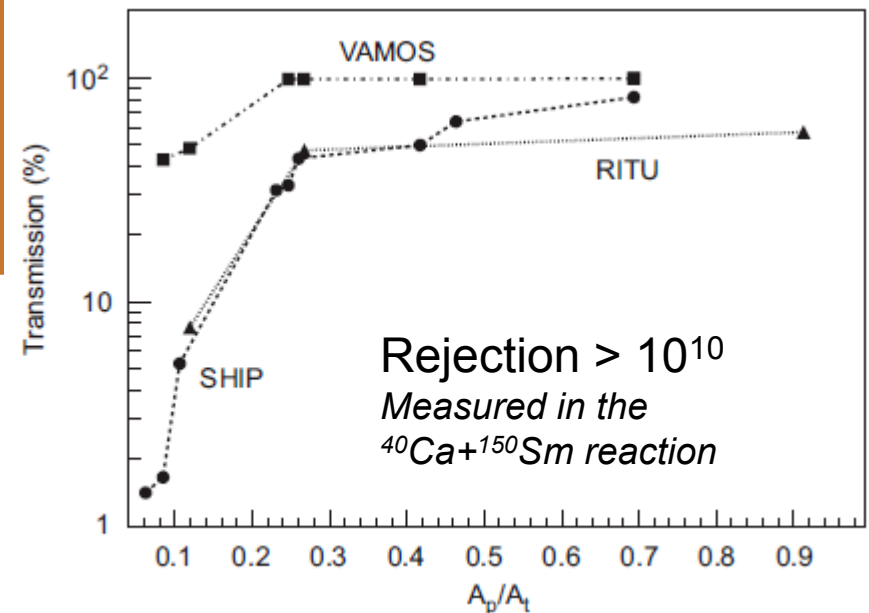


Spectroscopy beyond Fm: the shell model towards SHE

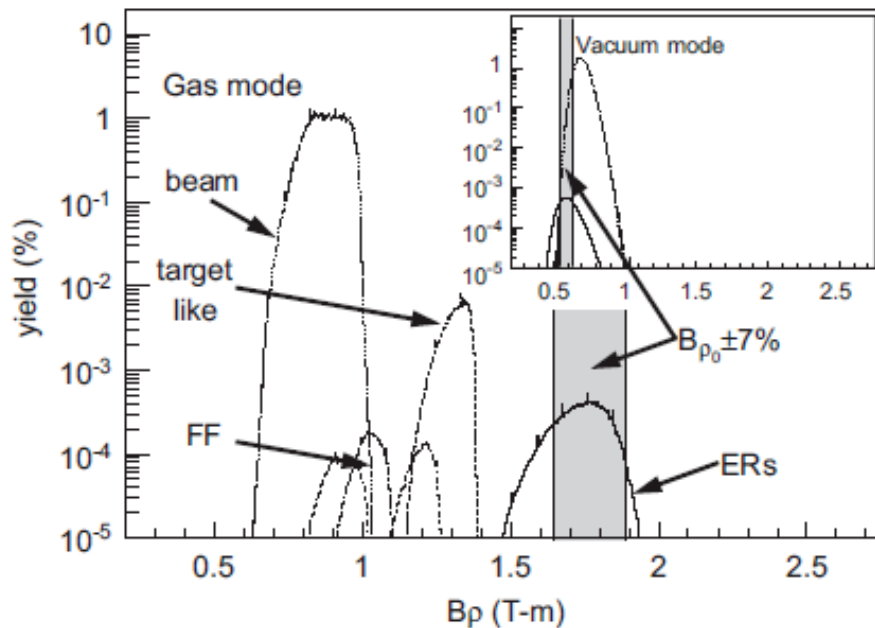
VAMOS in gas-filled / Vacuum mode



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

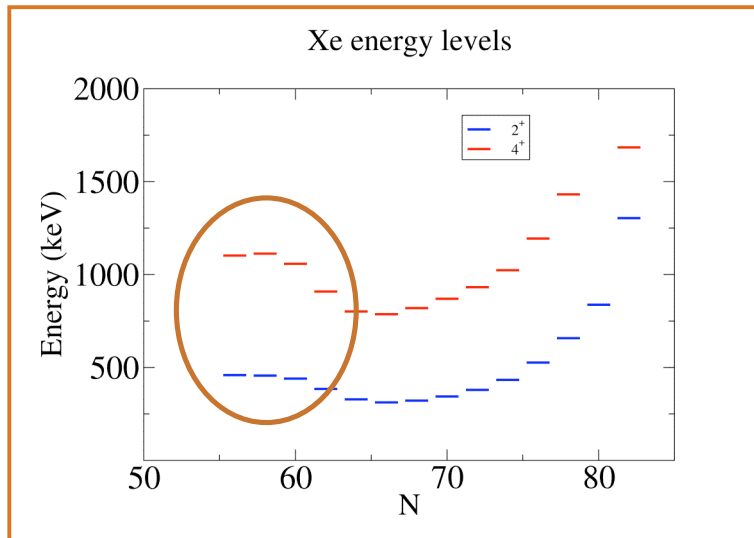


**Prompt spectroscopy with π, α
tagging at the focal plane
(MUSSETT)**



Collectivity in $N \approx Z$ 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).

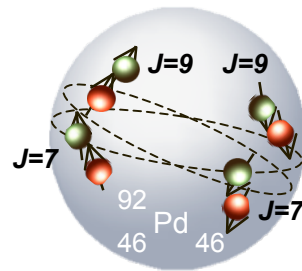
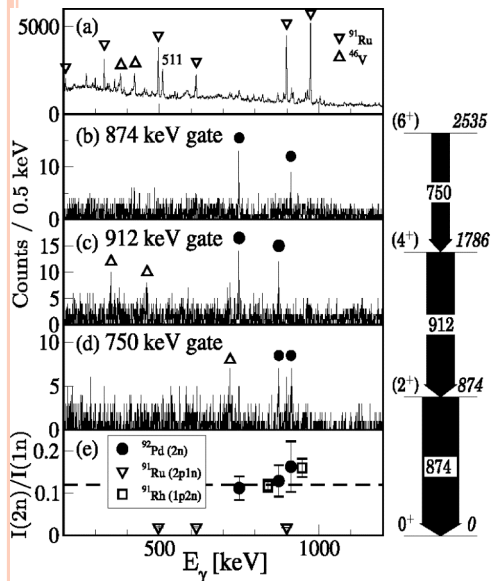
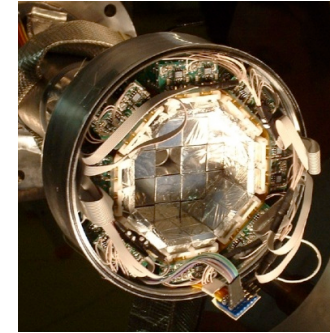
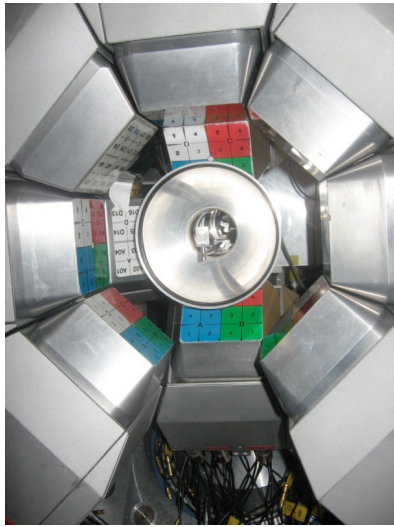
Gas filled mode : $^{54}\text{Fe} + ^{54}\text{Fe} \rightarrow ^{106}\text{Te} + 2n$ (25 nb)

$^{54}\text{Fe} + ^{58}\text{Ni} \rightarrow ^{110}\text{Xe} + 2n$ (50 nb)

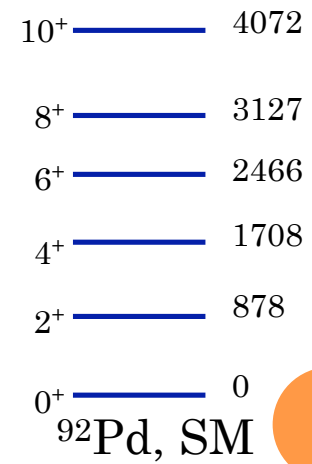
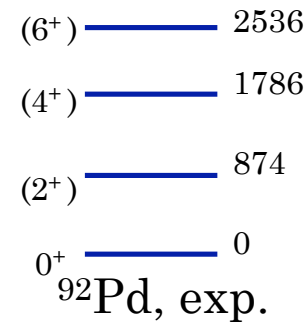
$^{54}\text{Fe} + ^{58}\text{Ni} \rightarrow ^{109}\text{I} + p + 2n$ (10 μb)



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



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



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 and ^{238}U induced fission
- Exotic nuclear shapes
- Spectroscopy after single nucleon transfer at SPIRAL1





AGATA 1π at GANIL :

Angles >10 deg for fission & MNT

At 0° as separator (vacuum/gas-filled)

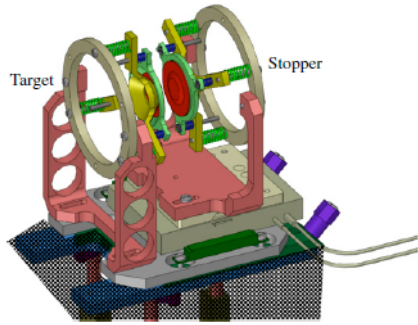
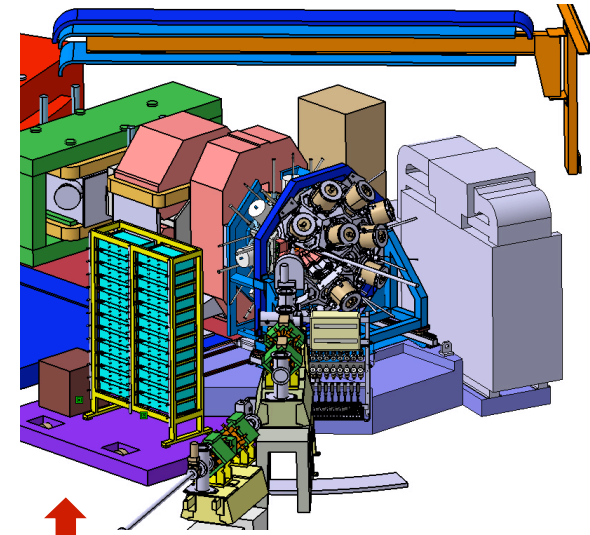
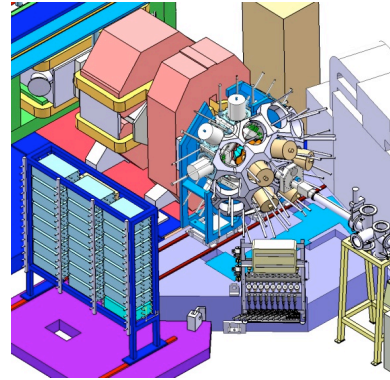
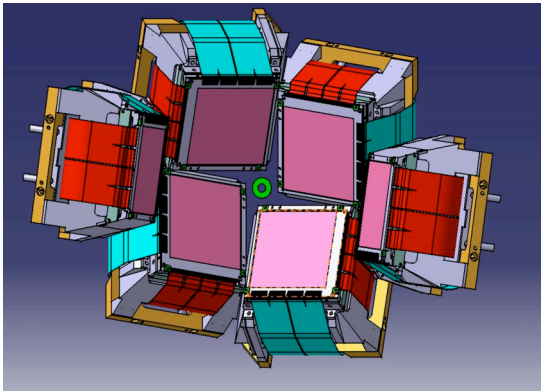
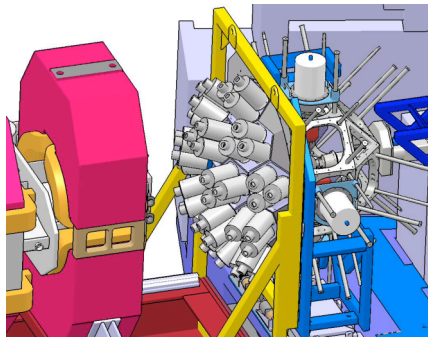


Fig. 4. Three dimensional view of the Orsay Plunger. The target and stopper foils are in place. The shaded part is a support structure specific for the commissioning experiment.



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



Cryogenic target ?

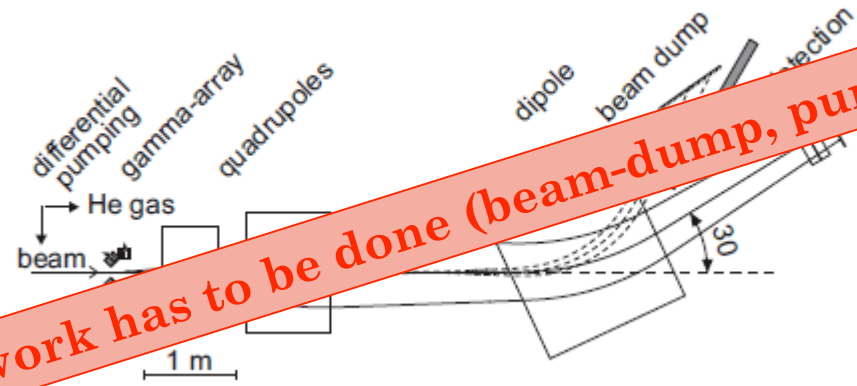
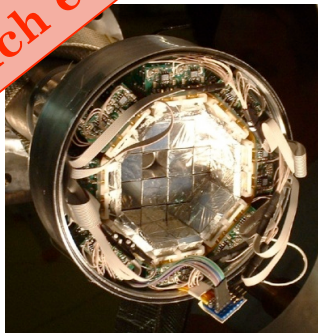
- ❑ Charged particle array for transfer reaction
MUST2/TIARA : (d,p) etc ... program with SIB and RIB
- ❑ Charged particle array for prompt tagging : *DIAMANT*
- ❑ Charged particle array for Recoil Decay Tagging :
MUSETT
- ❑ Scintillator : *BaF2 array, LaBr3*
- ❑ Future detector : *NEDA (n) , GASPARD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



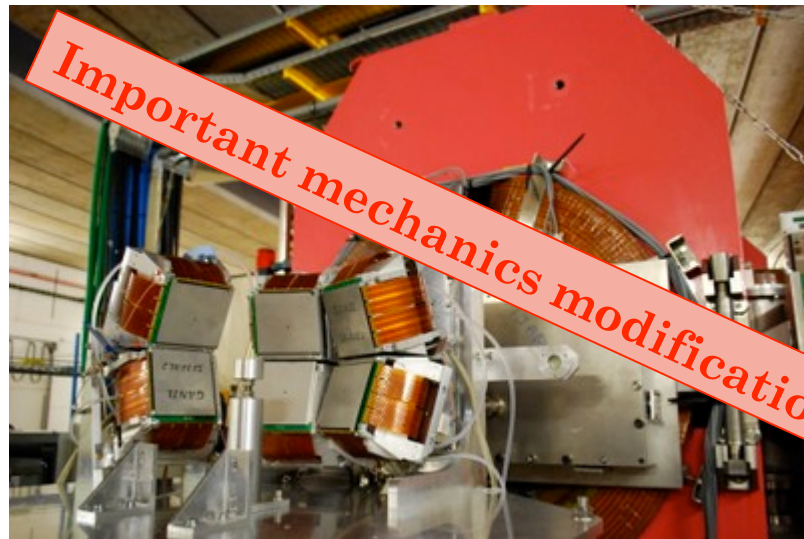
AGATA 1π at GANIL



Which electronic in 2014-2015 ?



Some work has to be done (beam-dump, pump ...)



Important mechanics modifications

+ CHYMENE

(Cible d'HYdrogène Mince pour l'Etude des Noyaux Exotiques)



Scientific Roadmap

- ❑ Installation of AGATA in **the G1 cave** for the 2014-2015 campaign
- ❑ AGATA collaboration meeting
 - Proposed scientific coordinator (external GANIL)
 - Nomination at the next ASC (Autumn 2012)
- ❑ Call for letter of intent in **summer-autumn 2012**
All stable beams from GANIL, existing and new RIB from SPIRAL1 will be proposed as well as available detectors.
- ❑ Discussion and harmonization of the Lol'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)

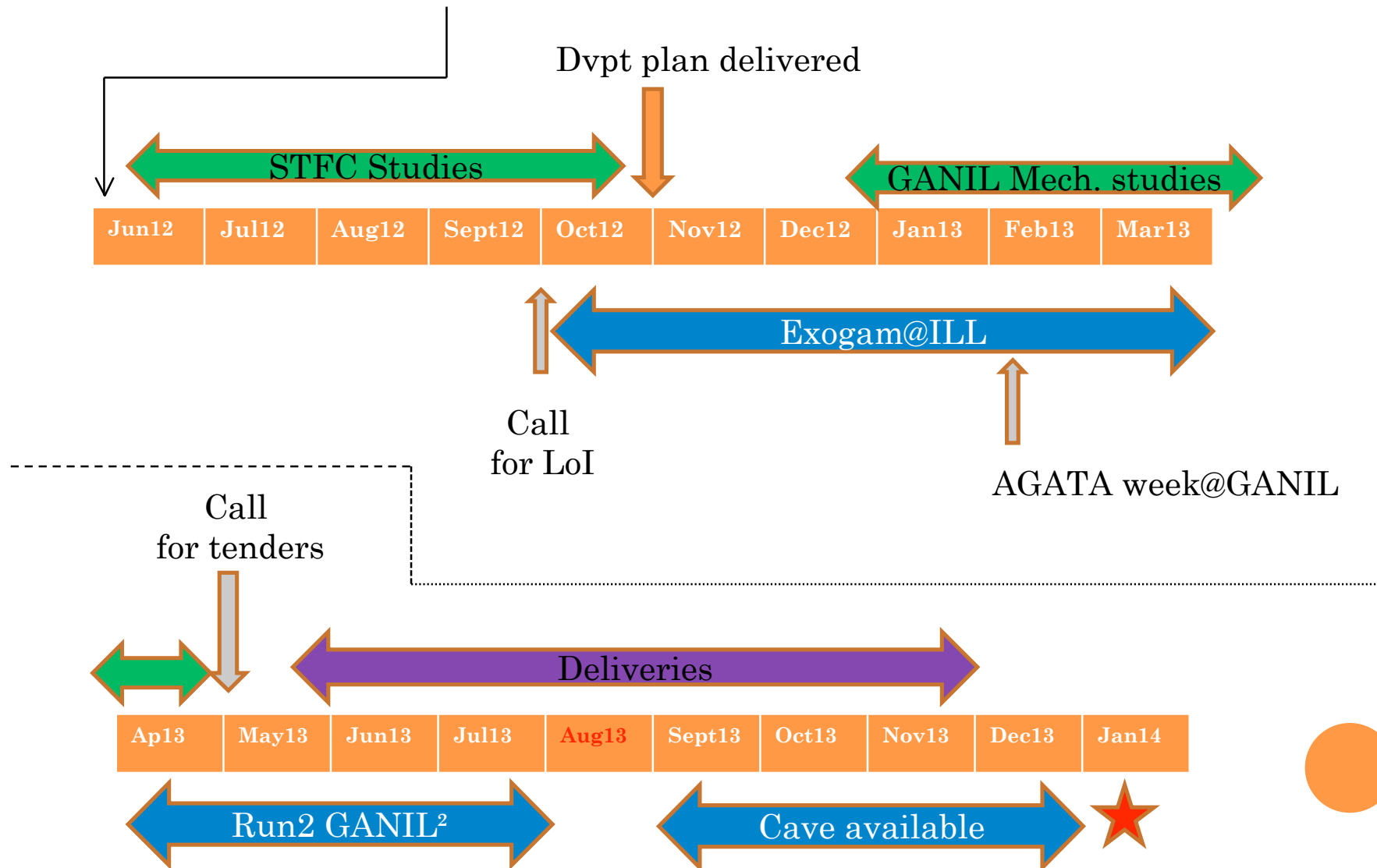
- ❑ Early 2014 : AGATA **installation** in G1 for the 1st campaign
- ❑ **Commissioning** during run 2 of 2014

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



Project Roadmap

The project has been de-frozen the 1st of February 2012
Set of specifications document delivered on the 3rd of March
→ Validated and distributed on the 25th May





Installation of AGATA at GANIL

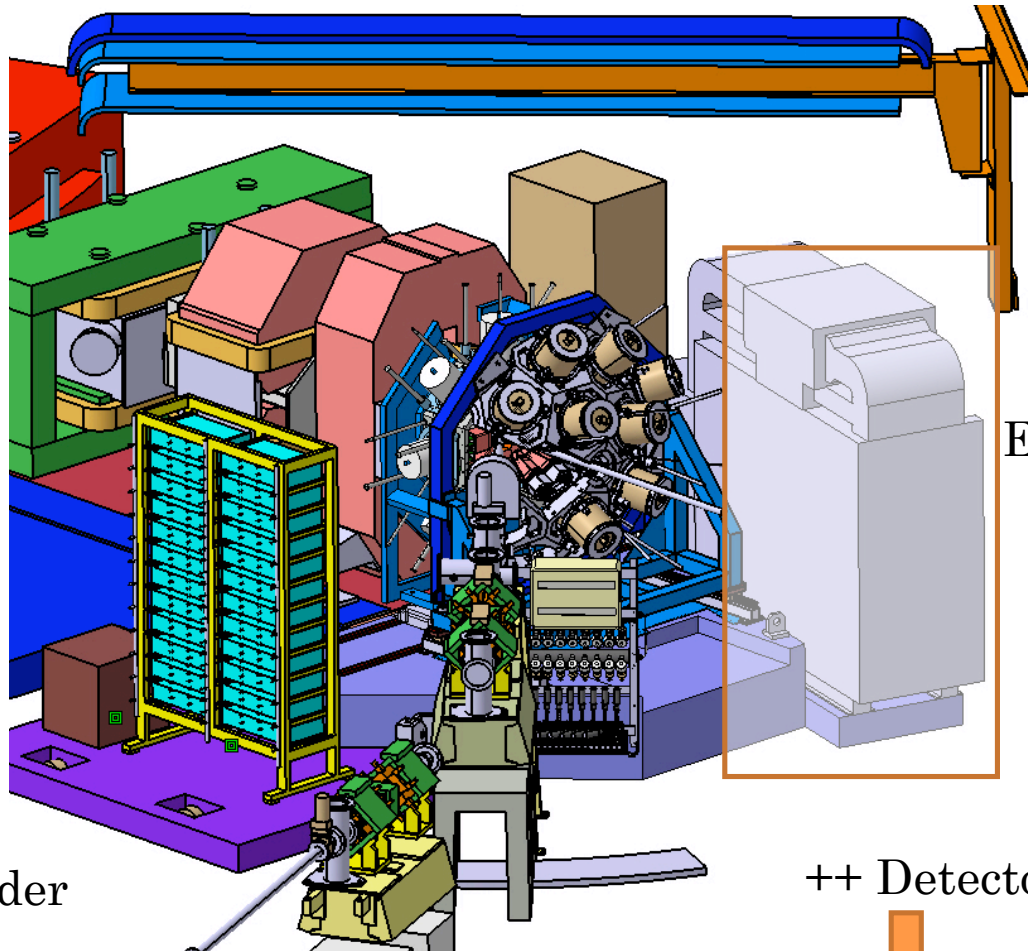
- Campaign organized with:
 - ✓ Local Project Manager (E.Clément)
 - ✓ Technical coordinator (L. Ménager)
 - ✓ Scientific Coordinator (Collaboration meeting June 2012)
- Task identification, personnel, local organization in contact with the AGATA working group and cost estimate in progress





First design in 2008 for 8 TC following the LNL campaign
→ GANIL commitment in MoU: 190 k€ and 101mm
Update for 8TC → 15 Clusters

- ++ digitizer
- ++ Optic fibers
- ++ DSS
- Installation



Exogam → Exogam2

New target loader

++ Detectors

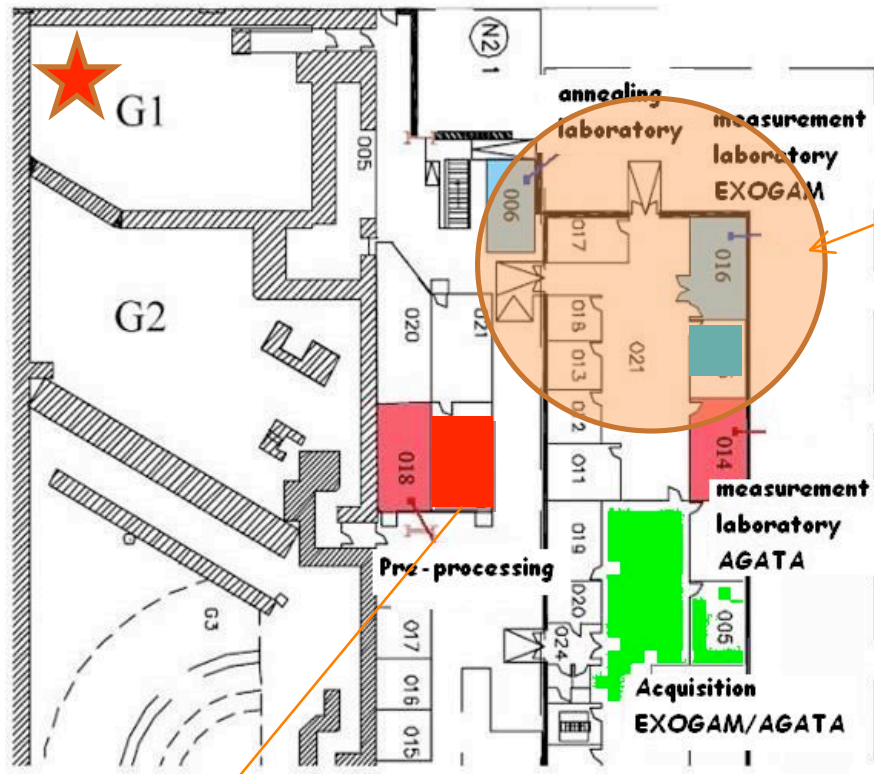


Re-design of the full platform ? (STFC)





GANIL north Acquisition



Refurbishment of acquisition
and lab room on-going

A « clean » room is already
available

Pre-processing room identified: air-conditioning already available, test on-going
Cold water also available is required for the ATCA racks
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)
- Gas-Filled is not yet fully operational. If we want it, we need to push hard !
- We will perform rapidly realistic updated simulations for the LoI's

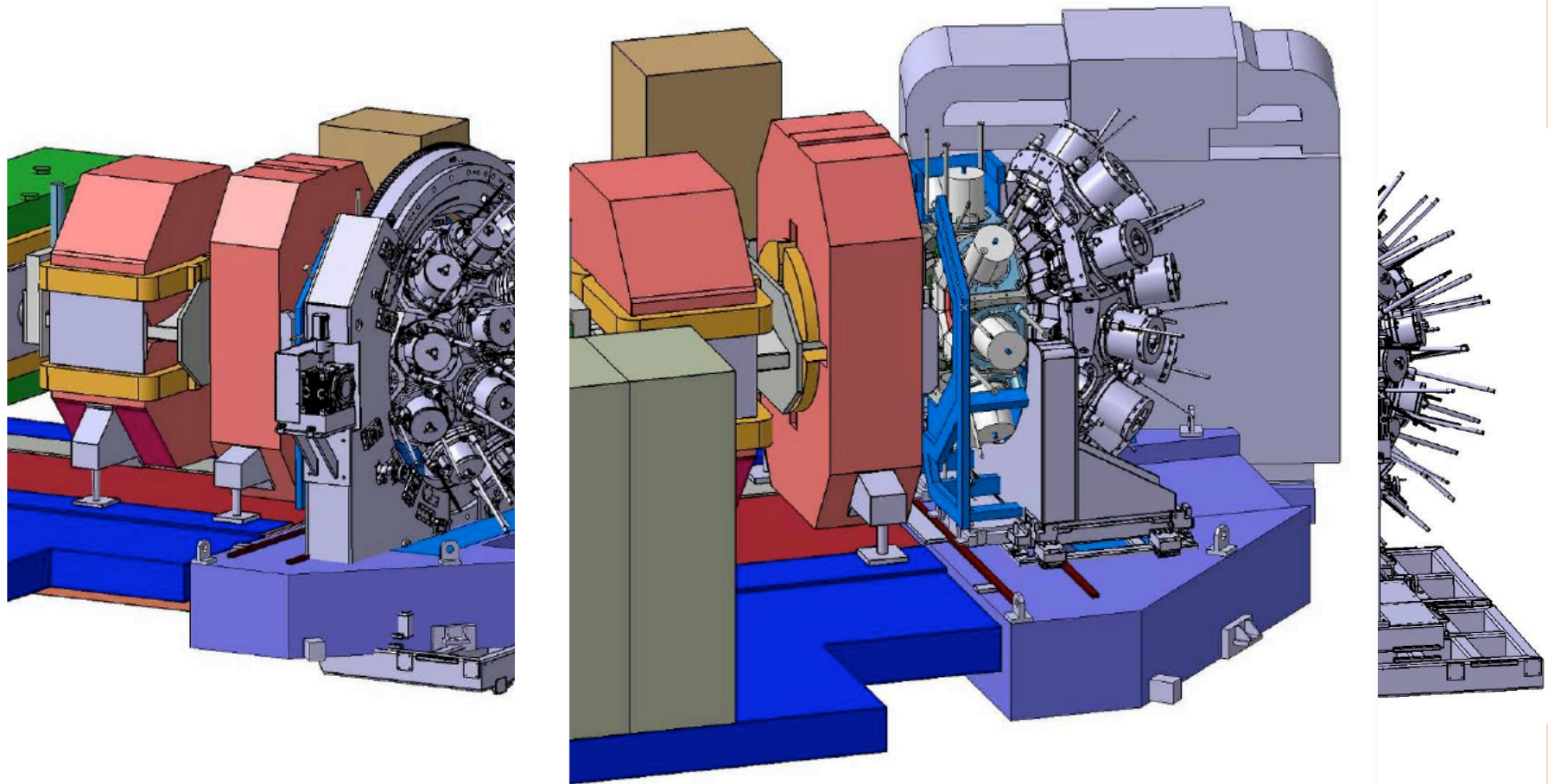
Local organization on-going in contact with the AGATA working group

Mechanical design will be a priority in the coming months





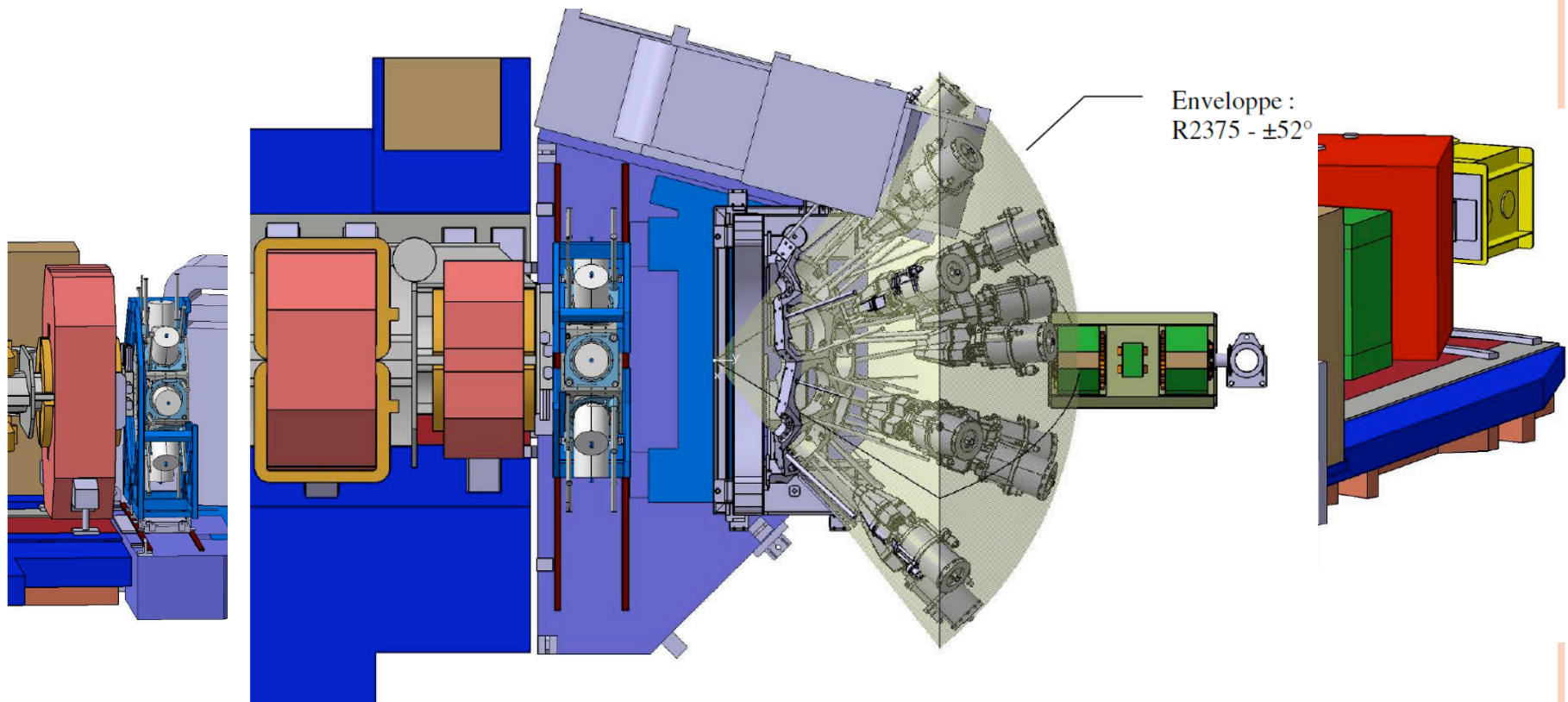
Pre-Studies Yvan Merrer (LPC-Caen)
GSI or LNL mechanics cannot be re-used



Pre-Studies Yvan Merrer (LPC-Caen)

With 15 Cluster, lot of interference with existing mechanics appear

→ Full re-design (€€)





- 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





J. Strachan & I. Burrows (STFC-Daresbury) : mechanics for support-Platform
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

