

AGATA at GANIL

NSP13

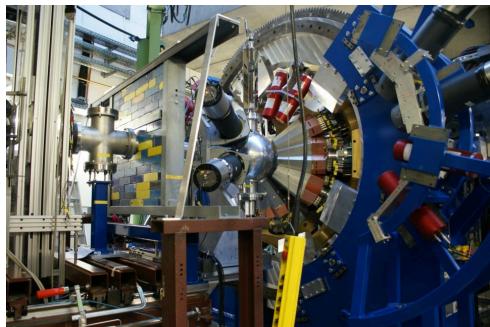
2010 → 2012
LNL : 5TC



AGATA D.+PRISMA
Total Eff (compact). ~6%



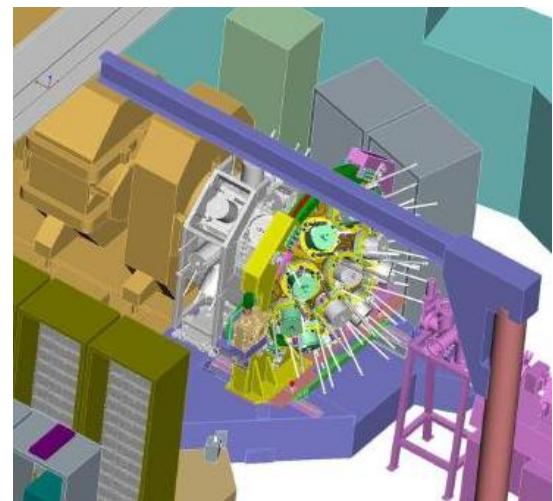
2012 → GSI/FRS
5TC+3 DC



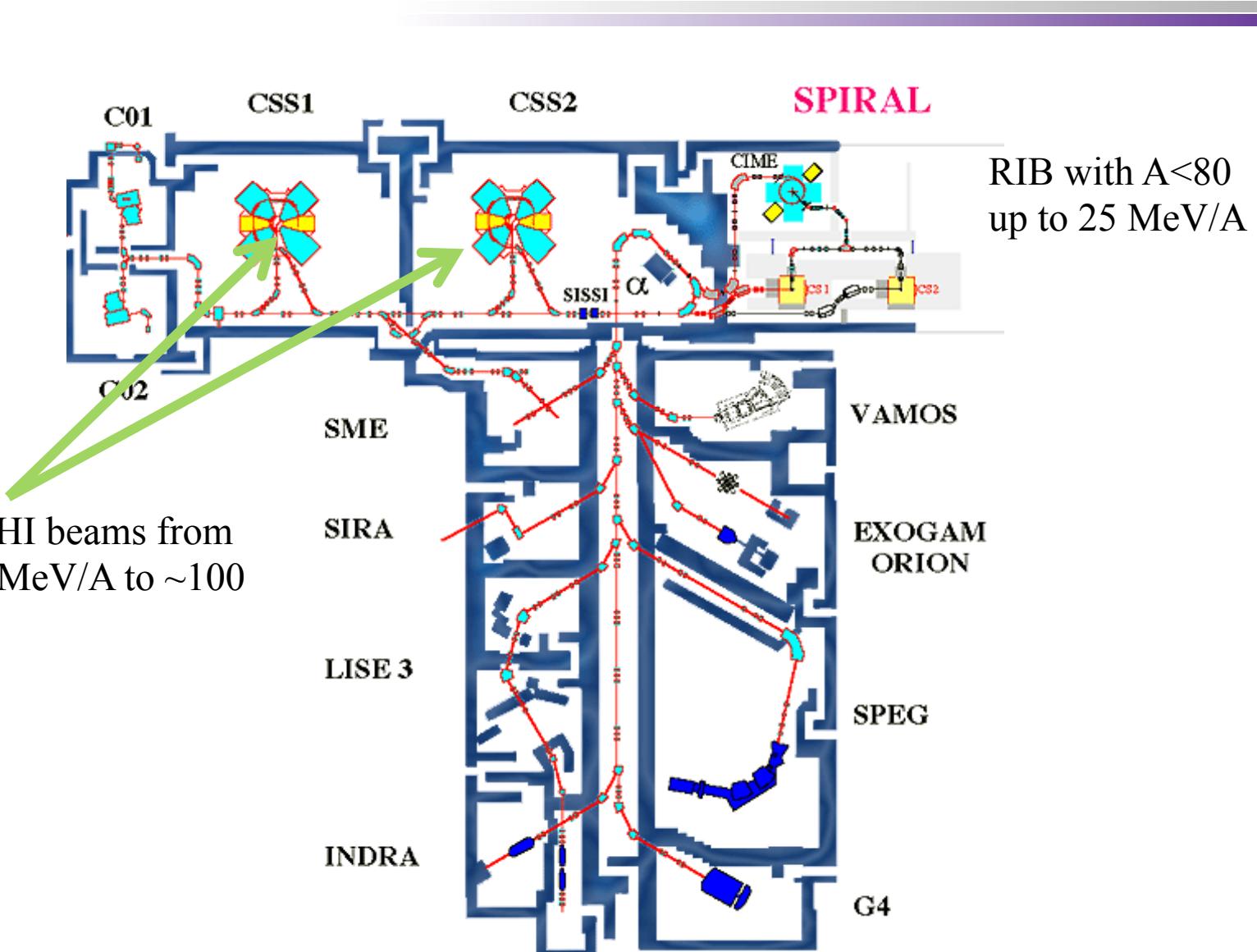
AGATA @ FRS
Total Eff. ($\beta=0.5$) ~ 10%



2014 → GANIL/SPIRAL2
15TC



**AGATA + VAMOS
+ (EXOGAM2)**
**AGATA Eff_{Nominal} ~ 8% to
14% in close configuration**

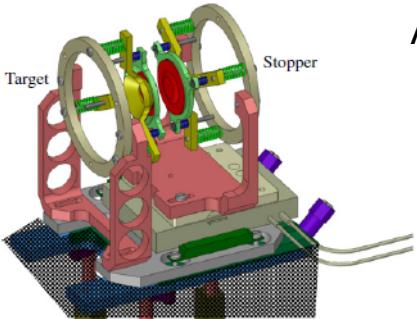


GANIL physics cases

- Gamma-ray spectroscopy of very neutron-rich nuclei populated in Deep Inelastic collisions or induced fission using VAMOS to identify the reaction products in Q, A and Z.
- Spectroscopy of heavy elements towards SHE and N=Z nuclei populated by fusion – evaporation with VAMOS in gas-filled mode.
- Spectroscopy of p-rich nuclei at the N=Z line using the N-wall
- Spectroscopy using existing and new SPIRAL1 beams

→ Ensuring these physics cases with the appropriate ancillaries detectors

→ The mechanical integration has to take into account this broad list of configurations



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

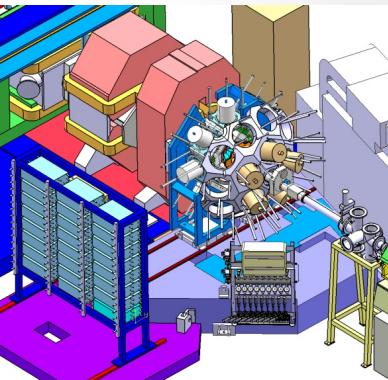
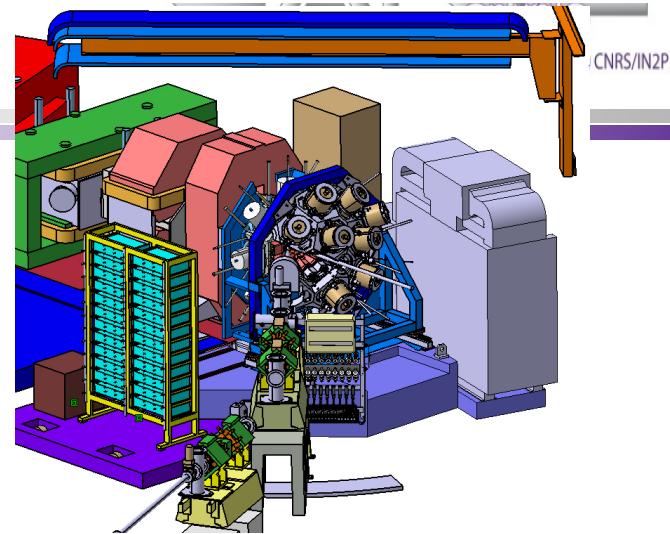
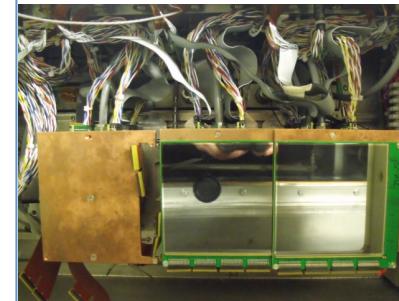
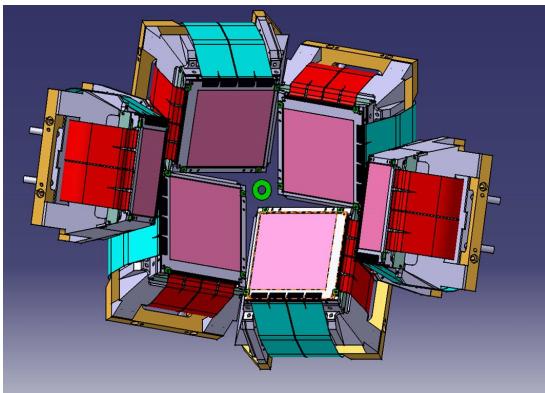
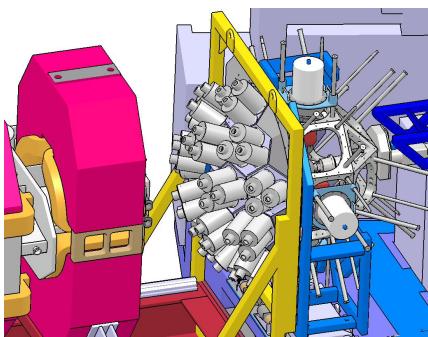


Fig. 4. Three dimensional view of the Orsay Plunger. The target and stopper foils are in place. The shaded part is a support structure specific for the commissioning experiment.



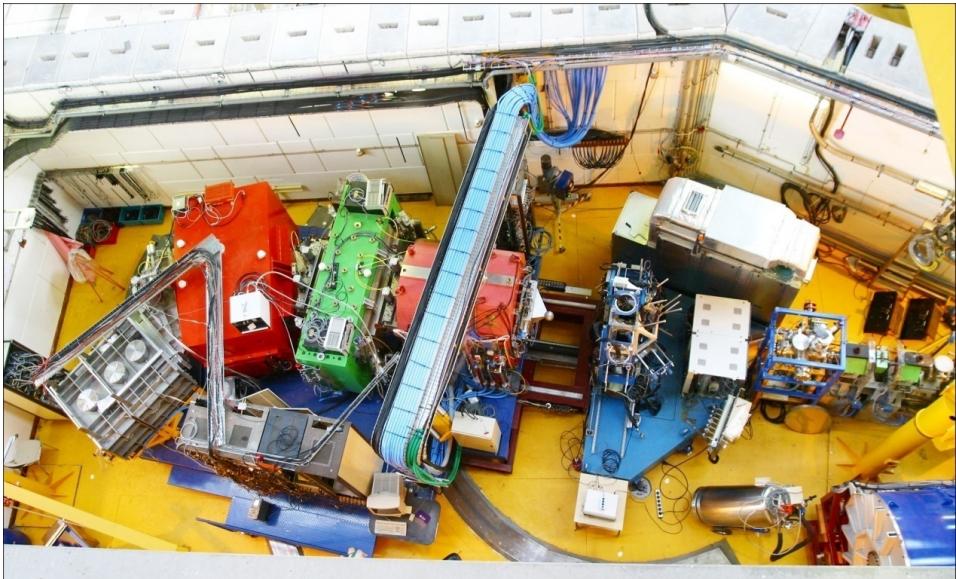
In G1 coupled to VAMOS (+ EXOGAM2): SIBs, RIBs

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



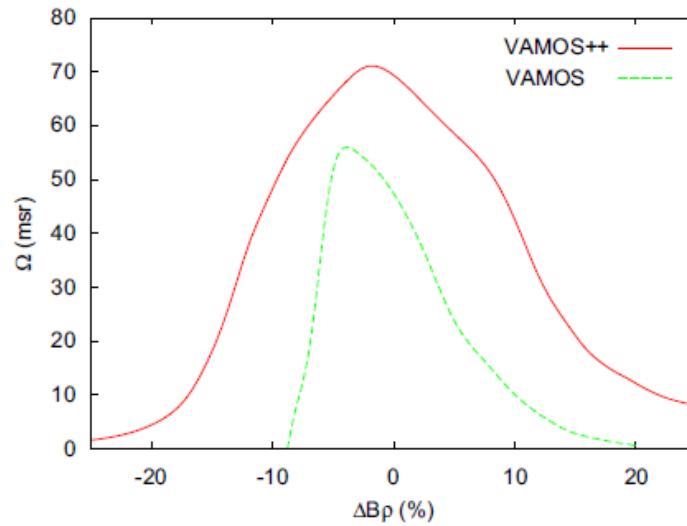
Beam: ^{238}U @ 5.5 MeV/u, (I~2pnA) (^{208}Pb , ^{136}Xe)

Target : ^9Be , ^{12}C , ^{48}Ca , ^{70}Zn , ^{198}Pt ... (1 mg/cm²)



- Full identification of the heavy recoil in VAMOS

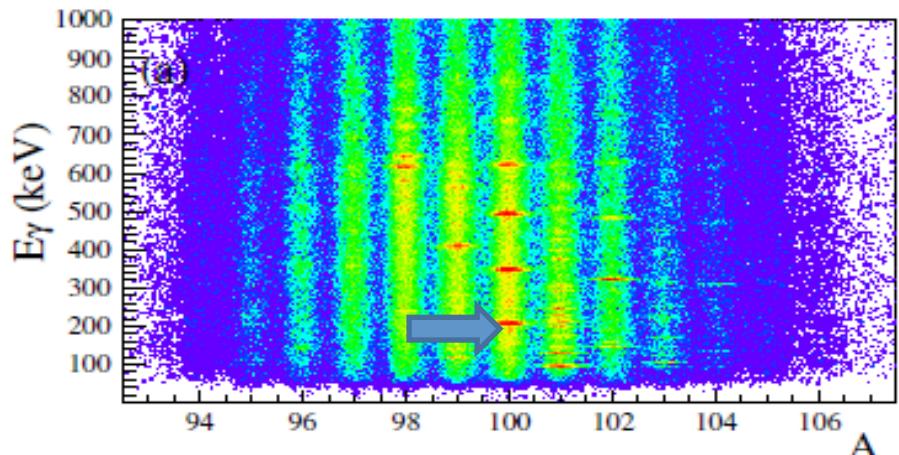
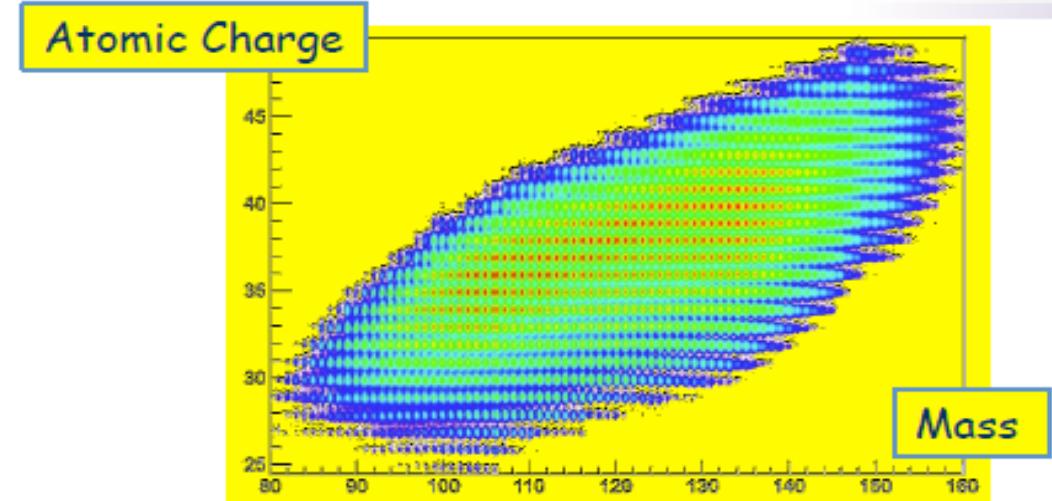
- Shell evolution toward ^{54}Ca
(*M. Rejmund et al*)
- lifetime measurement with a plunger in n-rich nuclei beyond ^{68}Ni (*J Ljungvall et al; A Dijon et al, I. Celikovic et al*)
- Delayed and prompt gamma spectroscopy around ^{68}Ni (*A Dijon et al*)
- FF spectroscopy after Transfer induced fission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



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

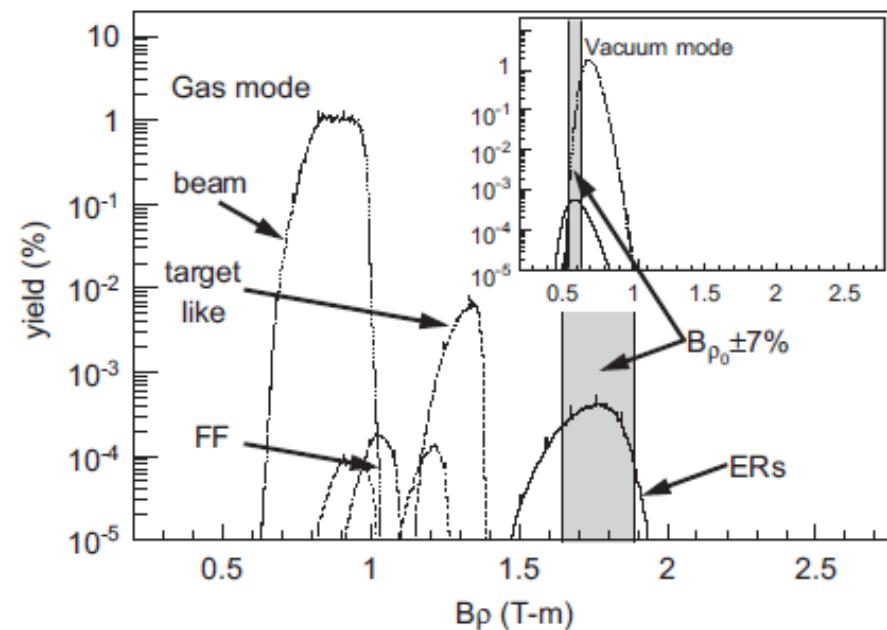
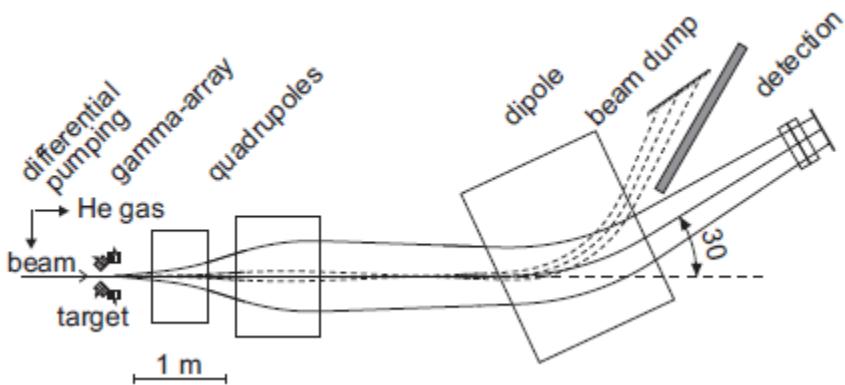
Full reconstruction over the whole acceptance
 Mass resolution $\sim 1/220$
 Z identification up to Z= 62

Using the high quality heavy beams delivered by GANIL:
 opportunity for prompt spectroscopy of heavy elements
 populated in MNT : **Ni, Sn, Pb region**
 Plunger measurement → see next talk by Marie Delphine



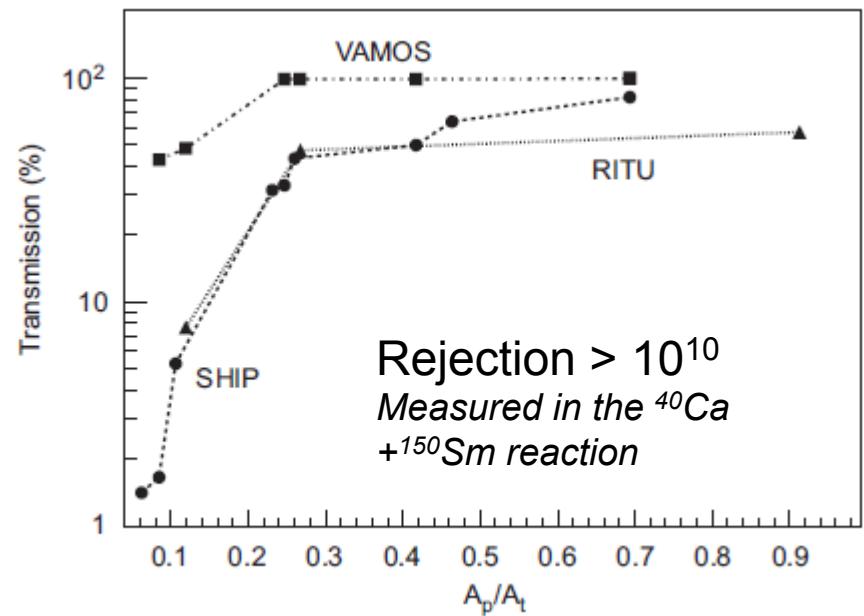
M. Rejmund, A. Navin *et al*

VAMOS in gas-filled / Vacuum mode



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

Intense $^{48,40}\text{Ca}$, ^{50}Ti , ^{36}Ar , ^{58}Ni , ^{54}Fe beam



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

Vacuum mode : $^{22}\text{Ne} + ^{197}\text{Au} \rightarrow ^{214}\text{Ac}$

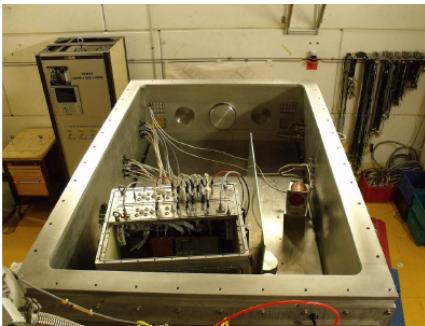
Gas filled mode : $^{48}\text{Ca} + ^{198}\text{Pt} \rightarrow ^{244}\text{Cf}$

Not yet fully funded and operational

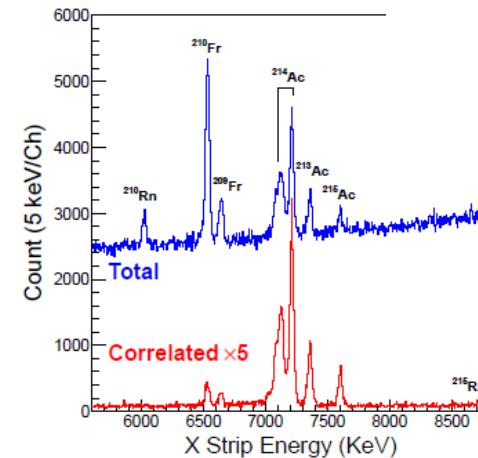
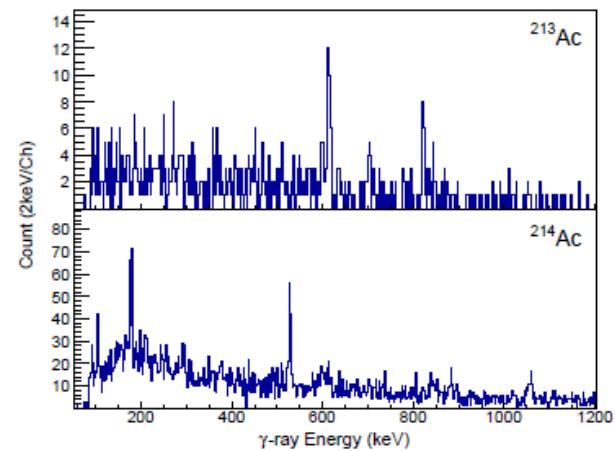
→ French grant Agency for Research 2013 request (Saclay -GANIL)



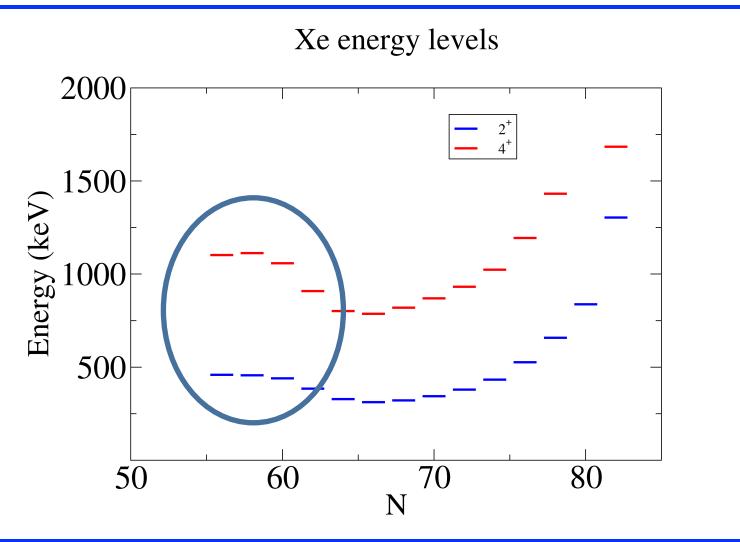
MUSETT array



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



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

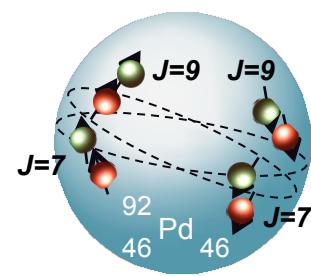
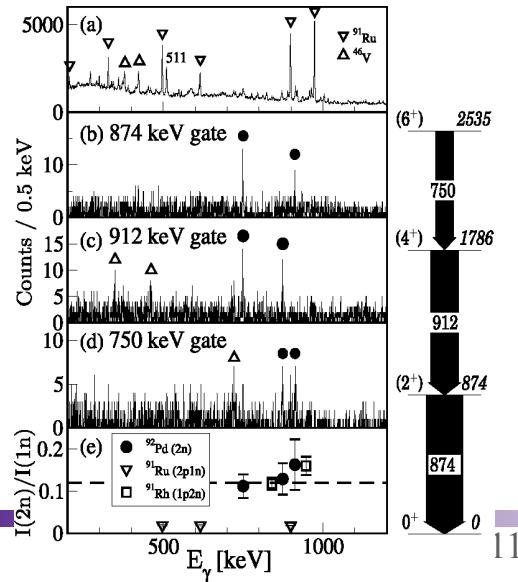
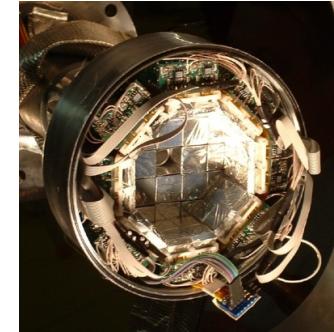
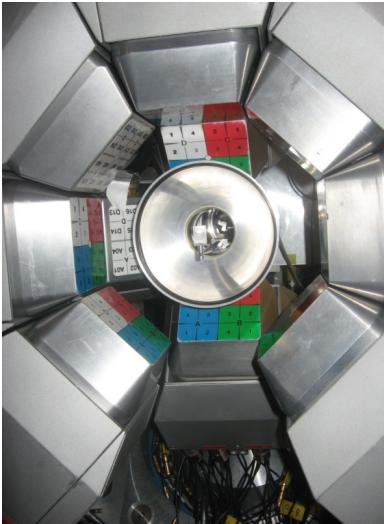


Onset of collectivity induced by np pairing near N=Z and closed shells ?

- Prompt spectroscopy of light Xe,Te,I isotopes
- α and π emitter

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

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

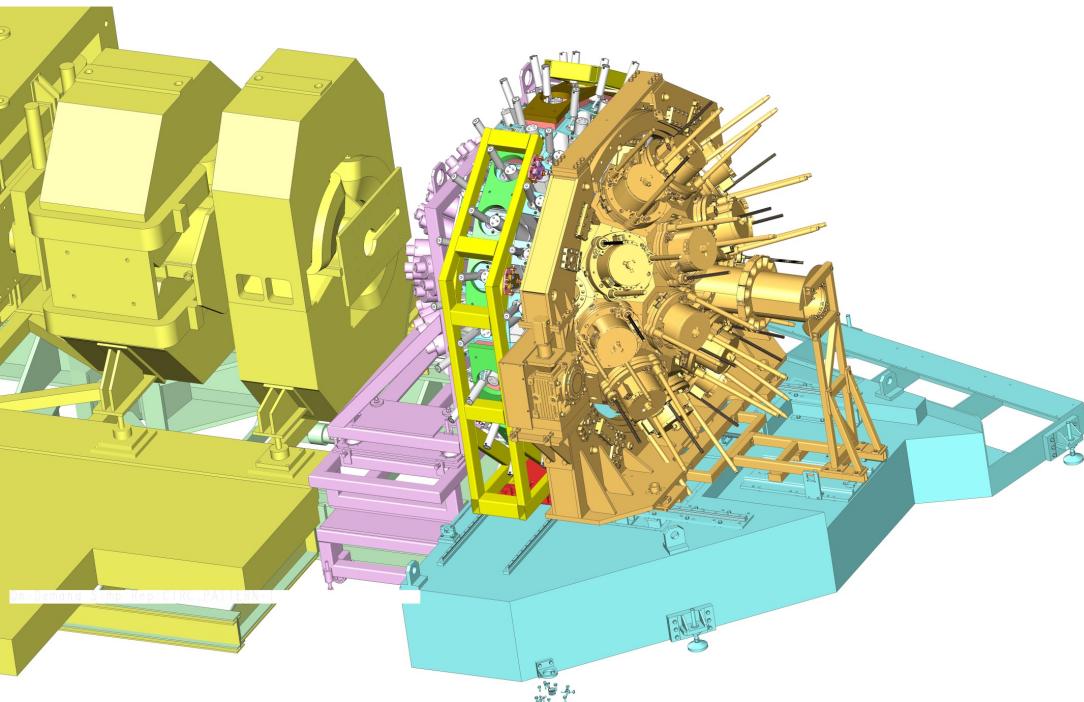


A new Spin-aligned pairing phase in ${}^{92}\text{Pd}$

10^+	4072
8^+	3127
6^+	2466
4^+	1708
(2^+)	874
0^+	0
${}^{92}\text{Pd, exp.}$	${}^{92}\text{Pd, SM}$

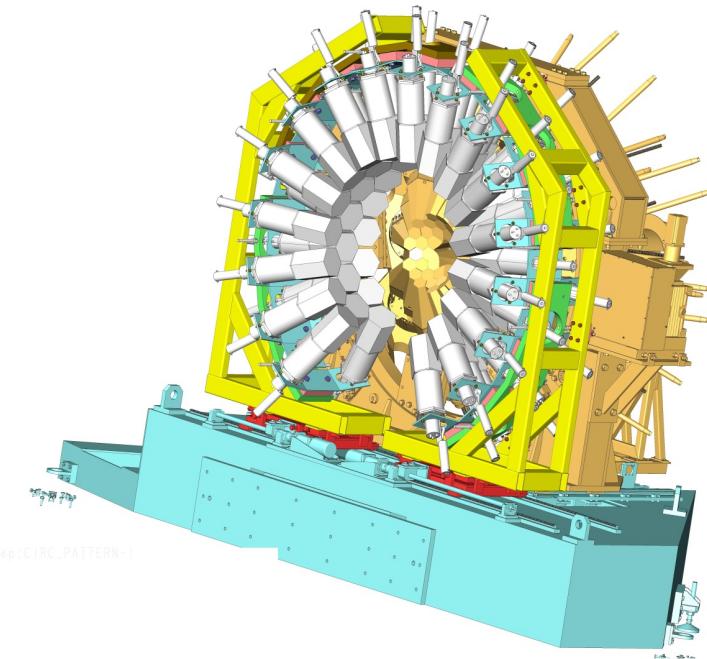
Neutron detectors++

In-beam spectroscopy of N=Z nuclei using
the ^{36}Ar , ^{40}Ca and ^{58}Ni beam



~40 Neda modules

Operational in 2015-2016

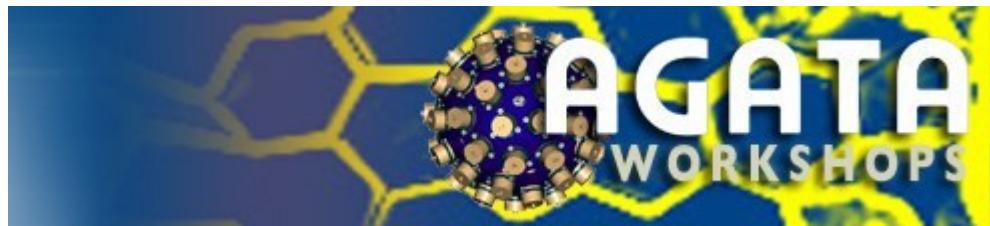


FACE OF NEDA DETECTORS 516mm FROM TARGET CENTRE

The GANIL Campaign (2014-2016)

2014 → VAMOS cave toward 1π

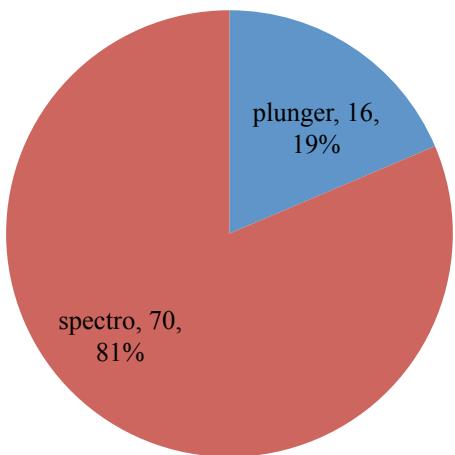
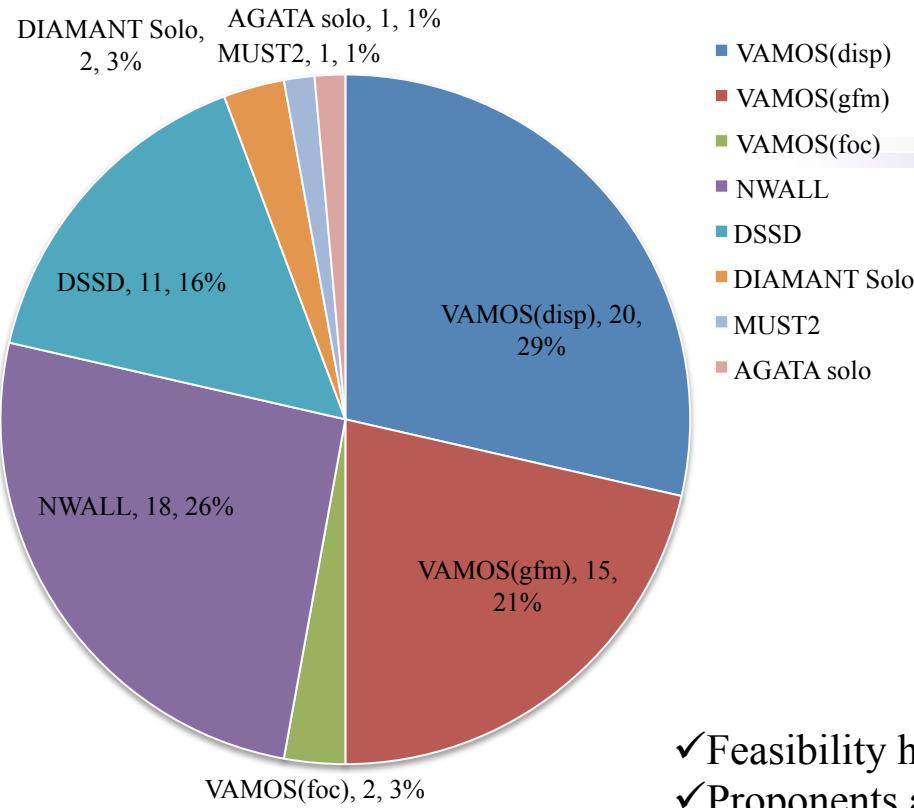
Campaign spokesperson : S. Lenzi (Univ. Padova)



1st workshop on the 18th - 20th of February organized at GANIL, dedicated to the physics of the GANIL Campaign using stable and radioactive beams (SPIRAL1) based on LoI sent in February

- Create the basis for defining the priorities for a detailed scientific program of the campaign
- Assess the technical feasibility, constrain the infrastructure and ancillary detectors integration.
- Identify common setup to be run in a row or physics case and collaborations

→ 1st PAC including AGATA proposal first half of 2014



- ✓ Feasibility has been checked and technical solutions suggested
- ✓ Proponents are encouraged to discuss with the experts of the ancillaries

We need to organize sub-campaigns by setup and investigate the technical issues case by case :

- Working Group
- Planning of upgrade of some ancillaries (gas-filled, NWALL, DIAMANT)

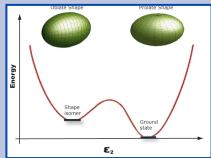
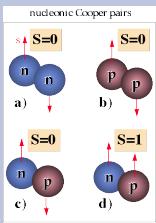
Physics cases for the AGATA campaign in GANIL



^{256}Rf
 ^{254}No

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

Cm, Bk
Cf, Es



^{194}Pb
 ^{176}Hg
Sm, Pm
 ^{102}Sn

Ru, Pd
Zr, Mo
 ^{77}Y
 ^{80}Zr
 ^{75}Sr
 ^{63}Ge
 ^{38}K
 ^{34}Ar
S, Cl, Ar, K
Ne, Na

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

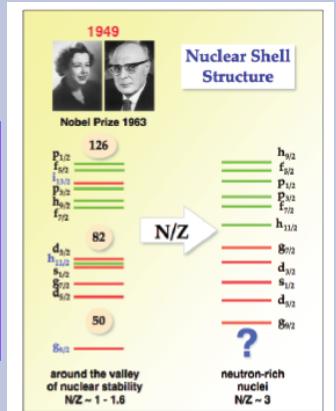
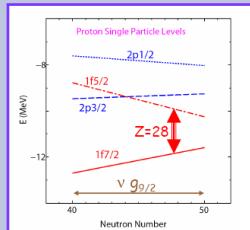
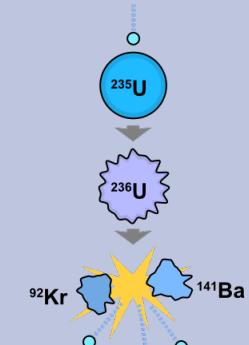
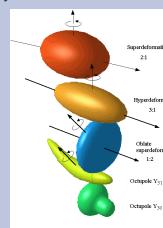
$^{68}\text{Ni, Fe, Co, Cu}$

^{46}Ti
 $^{46,48}\text{Ca}$

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



SPIRAL1



Working groups for the different setups have been formed to face together the developments needed

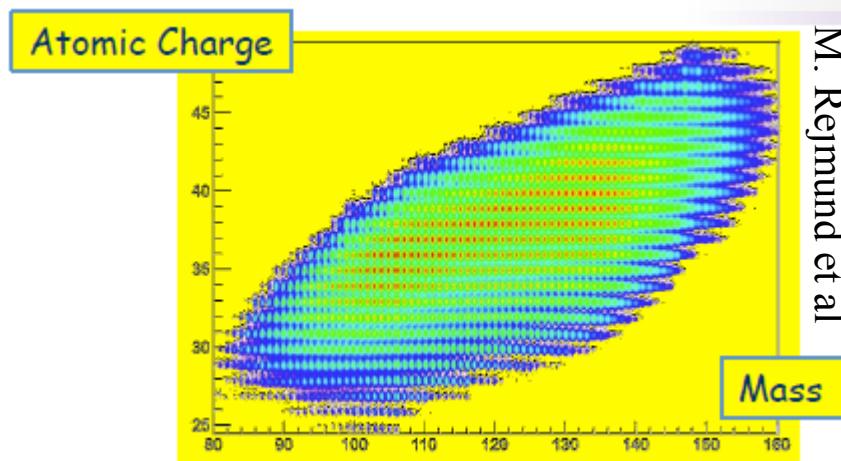
- Identifying problems and limits
- Improve the technical aspects and the physic toward the proposals

- Neutron Wall and/or Diamant campaign
Coordinator: Gilles de France
- VAMOS in gas filled mode campaign
Coordinator: Christoph Theisen/Christelle Schmitt
- Plunger campaign
Coordinator: Joa Ljungvall
- DSSD detectors for coulex Campaign
Coordinator: Peter Reiter

- VAMOS (M. Rejmund)
- EXOGAM2 (G. de France)
- MUST2 and Tiara (O. Sorlin)
- PARIS (A. Maj)
- OUPS Plunger (J. Ljungvall)
- Cologne Plunger (Ch. Fransen)

The first campaign will be
AGATA + VAMOS std. (+ EXOGAM2)(+ Plunger)

Nuclear structure in n-rich nuclei populated by induced fission or MNT



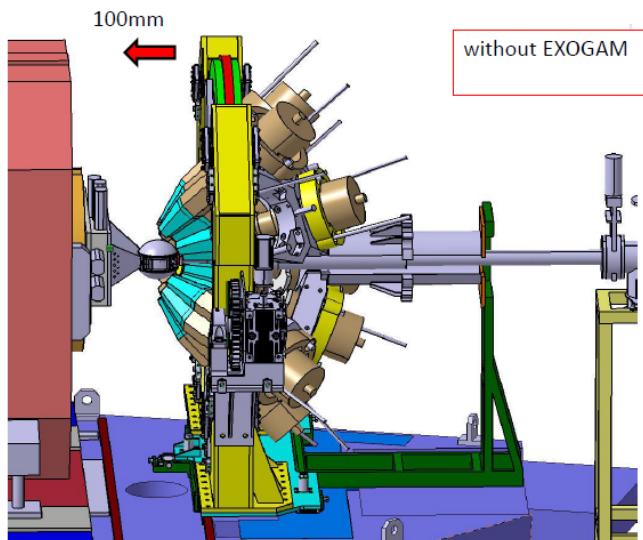
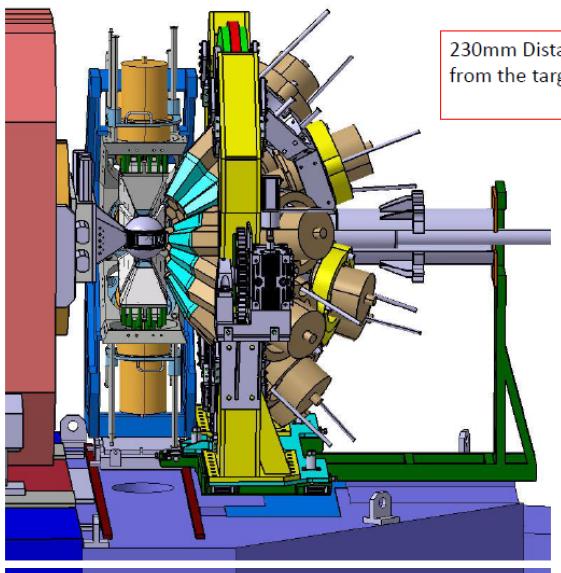
Proposals using these setups will be submitted to the next PAC meeting
(first half of 2014).

~two months before the PAC meeting, we will organize a collaboration meeting to discuss together the proposals based on the LoI of this call, eventual new proposals, check the feasibility and eventual overlaps.

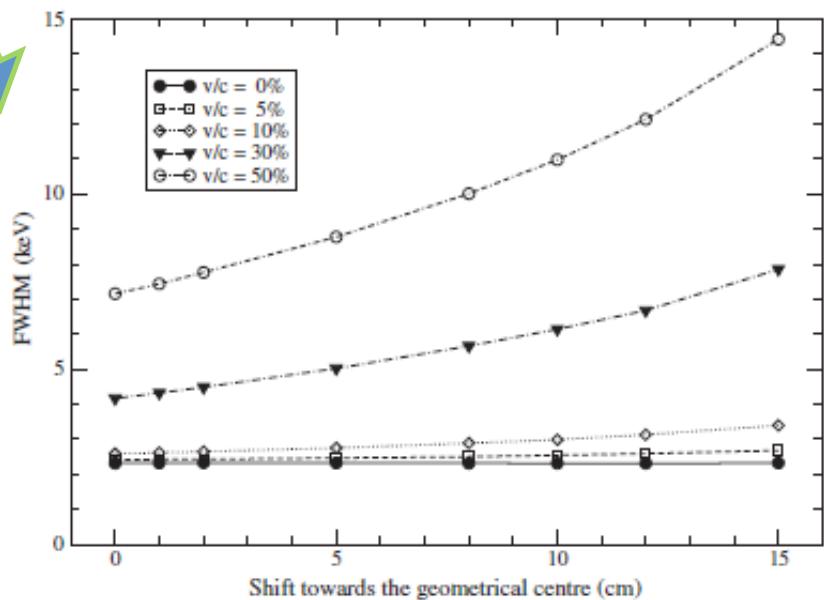
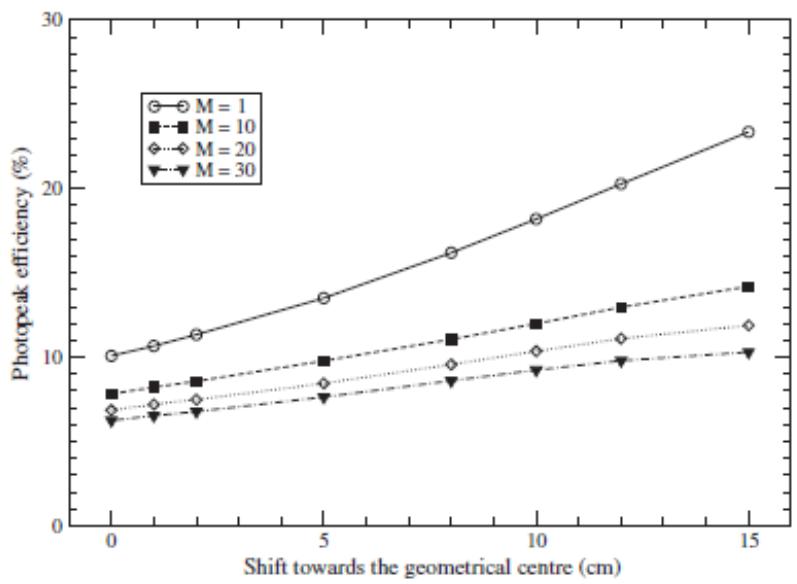
All proposals have to be discussed at this meeting before being submitted to the PAC.

AGATA Configurations at GANIL

EXOGAM, LaBr₃, BaF₂ ...



E. Farnea *et al.*, Nuclear Instruments and Methods in Physics Research A 621 (2010) 331–343



Performance of the AGATA array

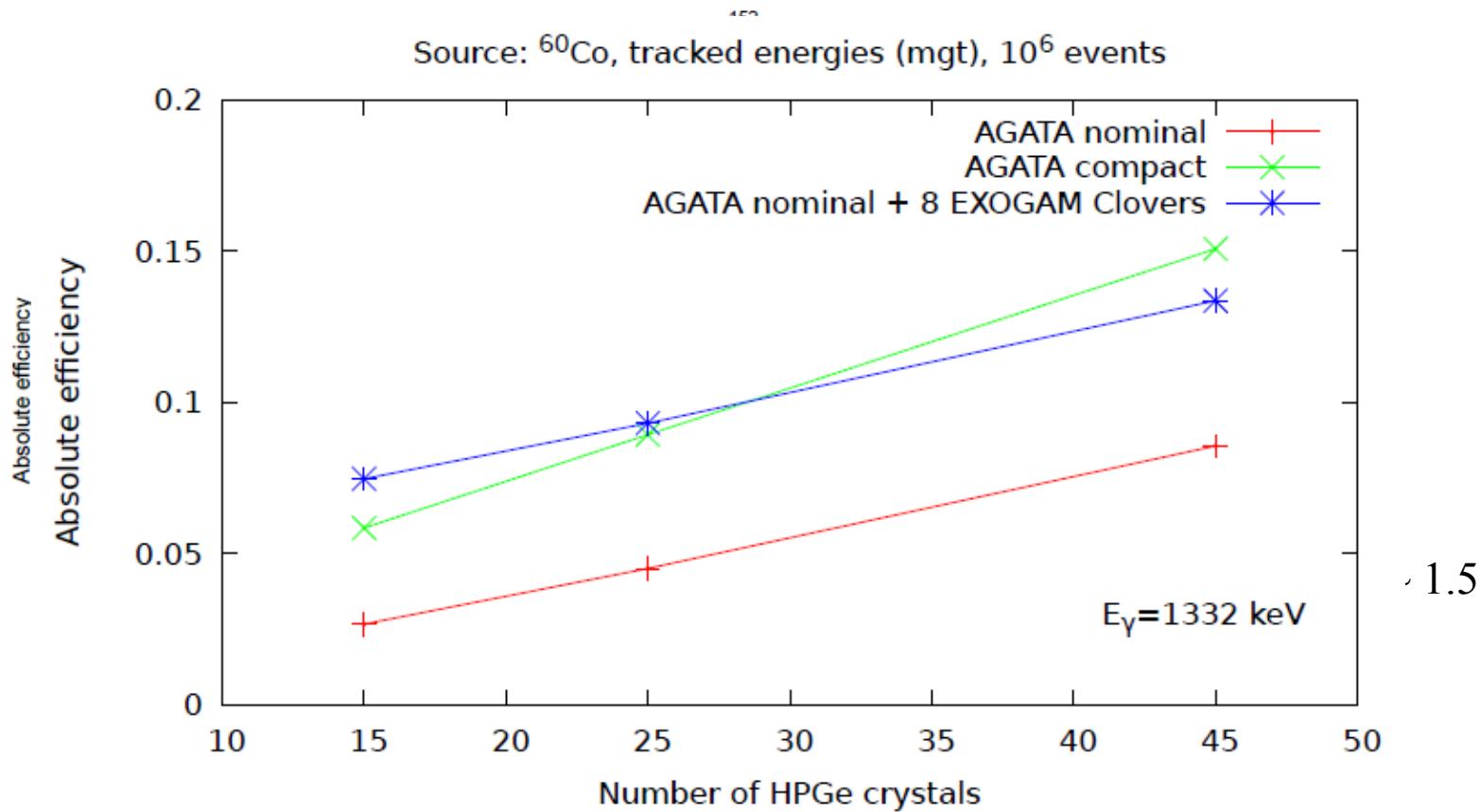
- AGATA should leave GSI with a minimum of 25 capsules (5ATC + 5ADC) fully instrumented
- Additional detectors will be delivered during the campaign
- End of the campaign : 45 capsules covering 1π

J. Ljungvall (CSNSM)

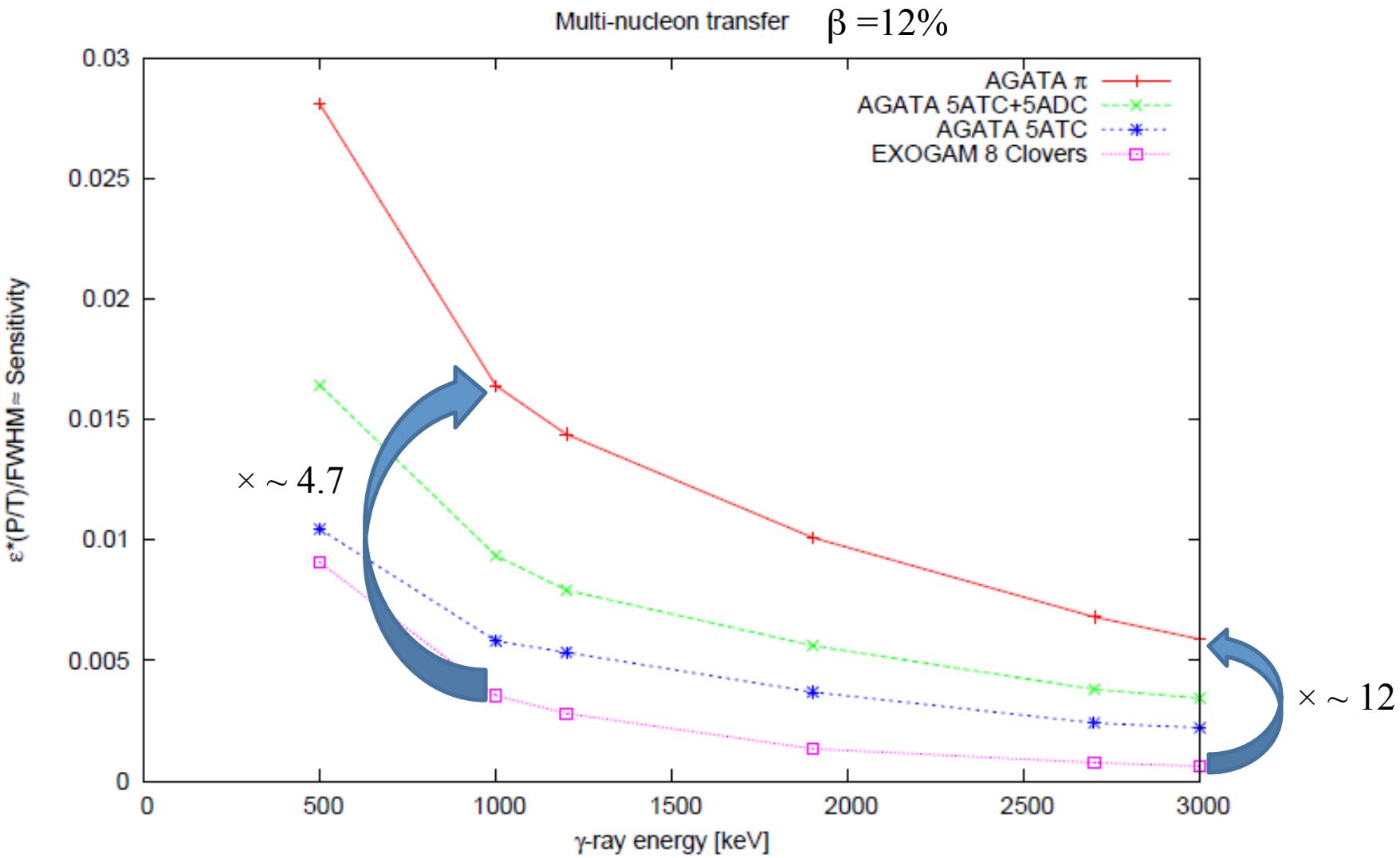
M. Labiche (STFC)

for the AGATA collaboration - Preliminary

AGATA nominal 233 mm
EXOGAM nominal 145 mm



Performance of the AGATA array



Schedule



	T2-12	T3-12	T4-12	T1-13	T2-13	T3-13	T4-13	T1-14	T2-14	T3-14	T4-14	...	T4-16
Mechanics		STFC Design		GANIL Impl		IPHC construc		Mounting					
Infrastructure det			GANIL Studies			Collecting items		Installation					
LN2, AF			GANIL Studies			Collecting items		Installation					
DAQ Hardware			GANIL Studies			Collecting items		Installation					
DAQ Software					Renov Aire Proj	AGATA infra	Prep.	Test					
Processing Room													
Detector										Mounting			
Source & Commi													
Expt												...	

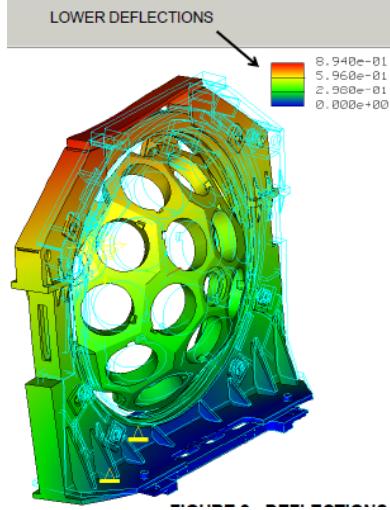
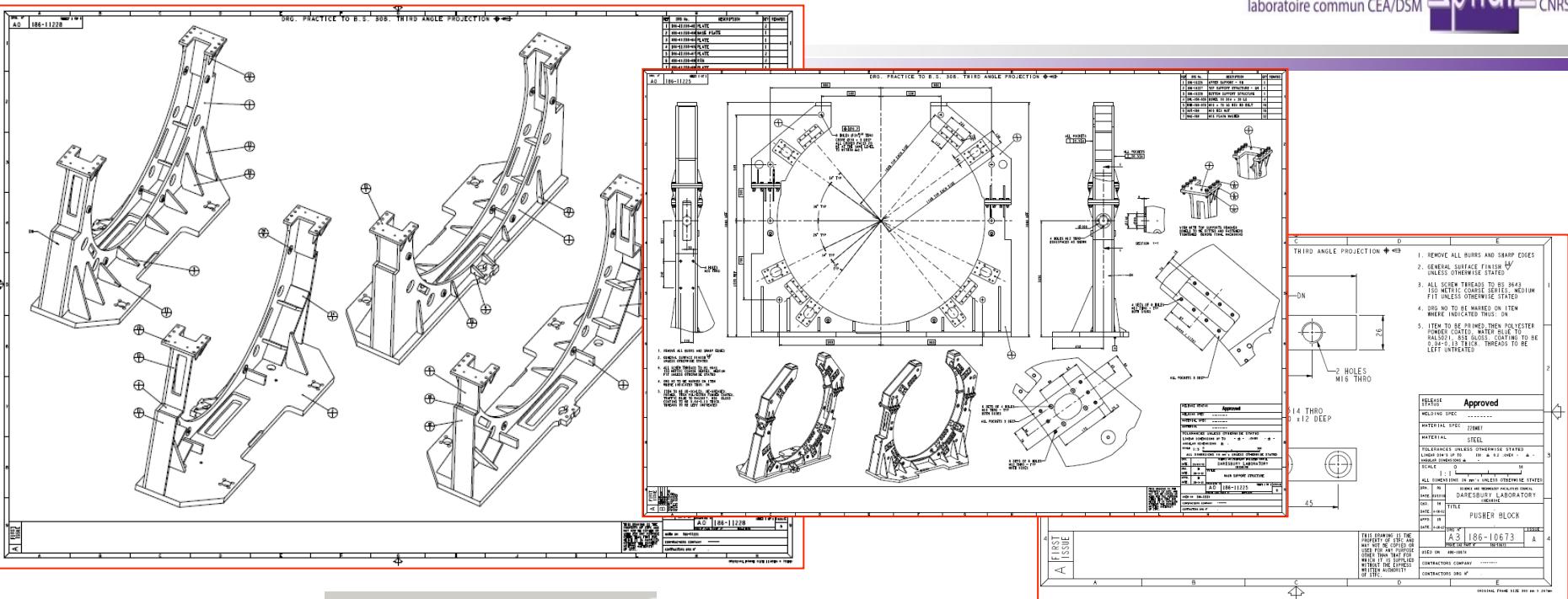
- Installation can be started early April 2014
- Commissioning end of 2014
- Gas-filled installation expected in end-2015 if funded in 2013
- SPIRAL1 beam from 2016

- 2015 – VAMOS magnetic spectrometer
- Mid 2015 : decision to be taken for either first gas-filled or neutron detectors
- ISOL experiments from 2016

Conclusion

- ❑ Many opportunities for the incoming campaign. New proposals are still welcome !!
- ❑ The GANIL planning (existing facility schedule and SPIRAL2 construction) and GSI beam schedule will be clarified ASAP
- ❑ Next Sub-campaigns to be adjusted with upgraded planning
 - *1st (2015): VAMOS in dispersive mode as it is (Spectro+plunger)
 - *2nd (2015-2016): gas-filled/NEDA: Depend of the availability of these setups
 - *3rd (2016- ?) : SPIRAL1 : DSSD-Coulex, MNT
- ❑ The AGATA project at GANIL made progress in all different items with a particular attention on the mechanic and the integration
- ❑ Mechanical construction and infrastructure work should start soon or is started
- ❑ GANIL technical involvement is already significant
- ❑ You are all welcome to participate to the installation and to the experimental campaign !

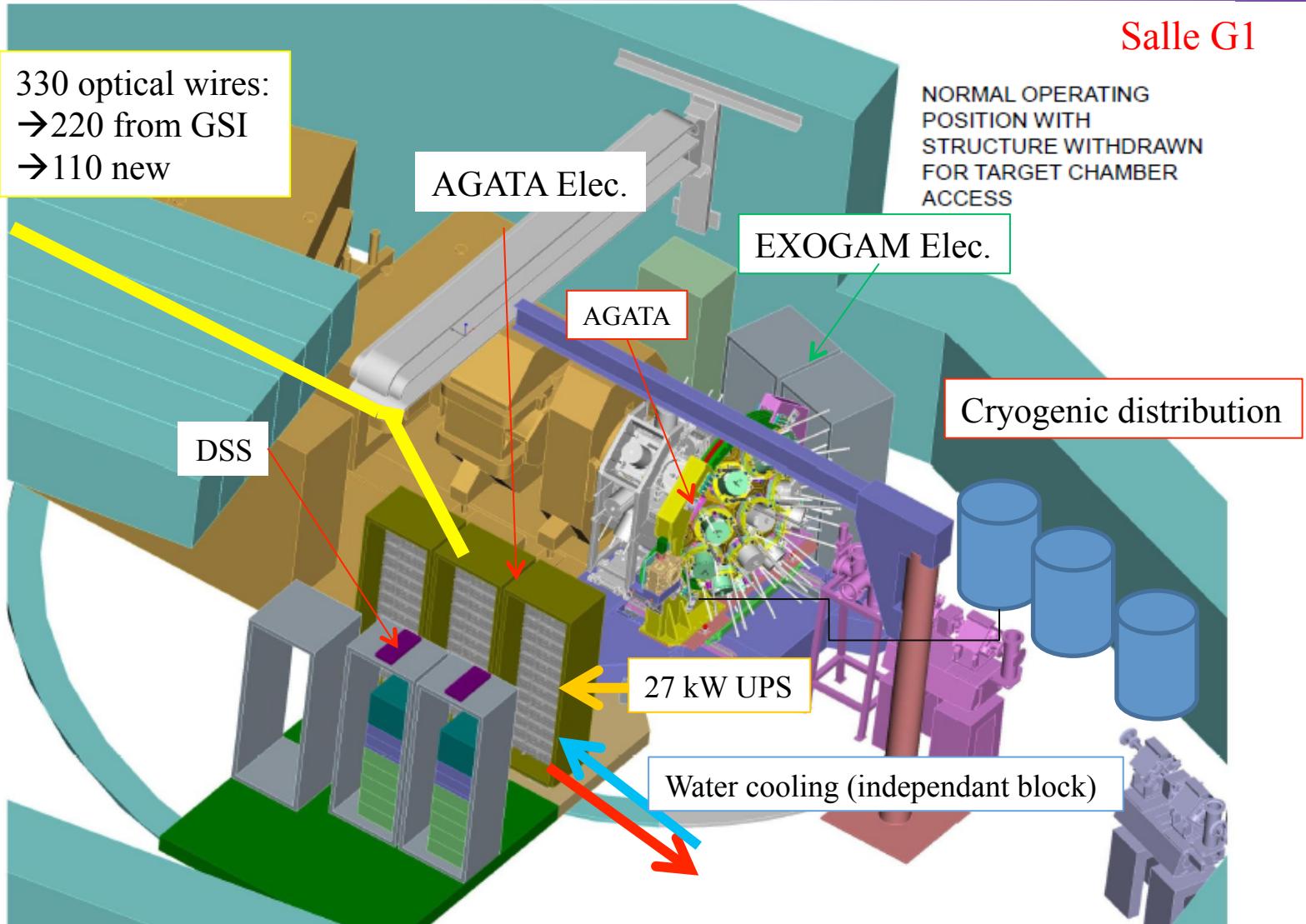
Mechanic



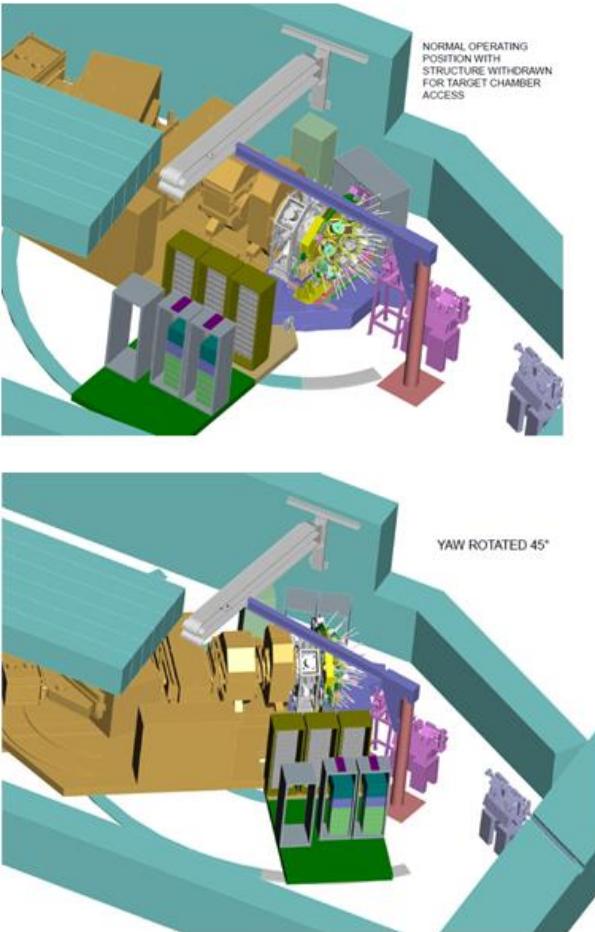
- First 2D projections have been released in January
- Final Validation done
- Mechanical stress and rigidity calculations validated
- IPHC takes in charge the construction: delivery 2nd week of February 2014, construction has started

Integration

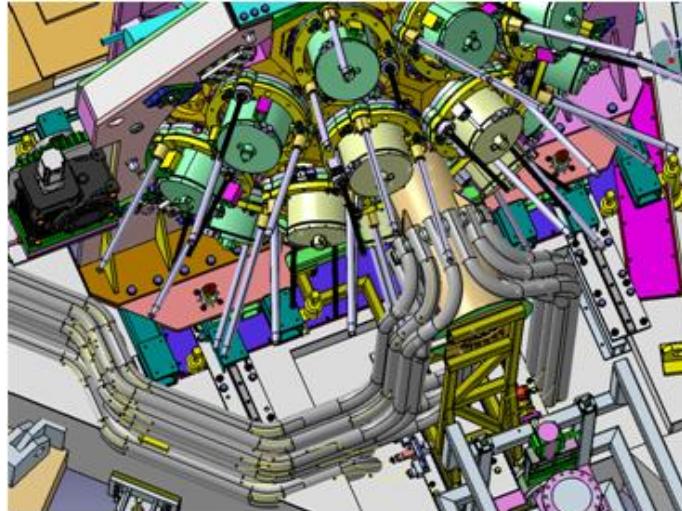
L. Menager, J. Ropert, P. Gangnant, M. Jean, M. Lemaitre, JL. Foucher, J. Goupil



Mechanic

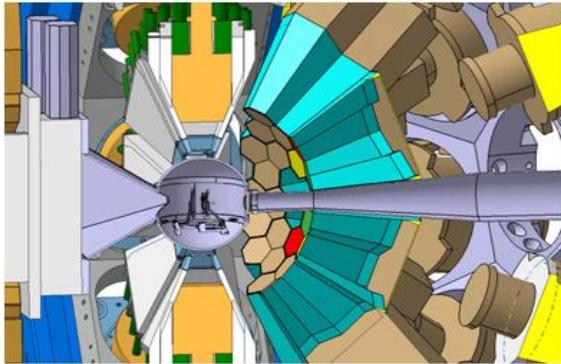


- ❑ Detectors support design done by STFC Daresbury in close collaboration with GANIL
- ❑ GANIL designs the additional platform
- ❑ GANIL takes in charge the integration work

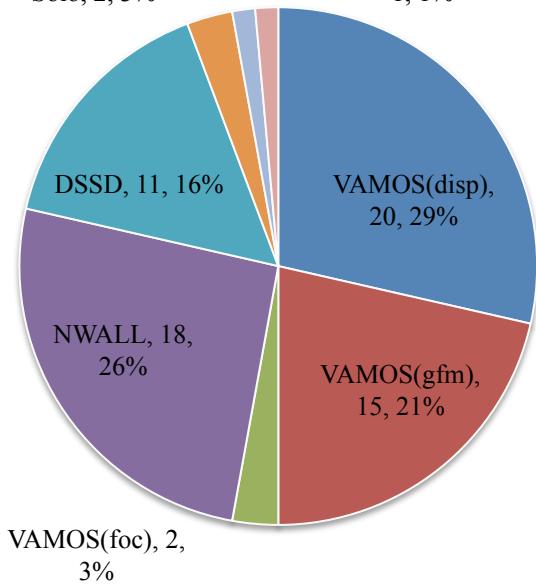


I. Burrows (STFC) M. Ozille, P. Gangnant (GANIL)

Target loader and beam line



DIAMANT MUST2, 1, 1%
Solo, 2, 3%



- GANIL is in charge of the beam section and target chamber design for most of the experiment
- Specific configurations will be treated case by case
- Target loader :
Detailed design done by GANIL
We insure the compatibility for gas-filled, rotating target, plunger, fragile target, and standard spectroscopy

