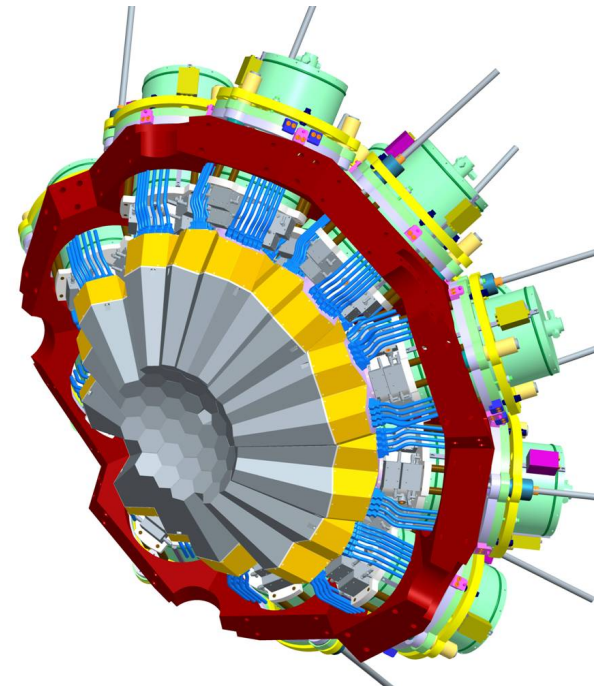


# AMB Report: AGATA Status and Outlook



**Andres Gadea (IFIC-CSIC, Spain)**  
on behalf the AMB and AGATA Collaboration



AGATA Collaboration Meeting / NUSPIN Workshop , 27<sup>th</sup> June – 1<sup>st</sup> July 2016



# AGATA MANAGEMENT BOARD AND TEAMS

**A. Gadea (Project Manager)**

**A. Boston, G. Duchêne, B. Million, A. Korichi, P. Reiter F. Recchia and J.Nyberg (ACC).  
J. Gerl (LCM-GSI), E. Clement (LCM-GANIL)**

## AGATA Working Groups

## AGATA TASKS

**AMB Chairman  
Project Manager  
A.Gadea**

**Resource  
Manager  
G.Duchêne**

**Detector  
Module  
P. Reiter**

**Detector &  
Cryostat  
H.Hess**

**Detector  
Characterisation  
H.Hess**

**Detector  
CAT & Testing  
H. Boston**

**R & D on gamma  
Detectors &  
Applications**

**Front-end  
Electronics  
A. Gadea**

**Pre-Amplifier  
Digitizer  
A. Pullia**

**Global Trigger &  
Synchronization  
M. Bellato**

**Pre-processing  
I. Lazarus**

**Slow Control  
& FEE Monitoring  
E. Legay**

**Data Flow  
A.Korichi**

**Software: Flow,  
Services & GRID  
X. Grave**

**Hardware: Local  
Infr. & Network  
N. Ménard**

**Data Analysis  
A.Boston**

**Data Analysis  
& TRACKING  
O. Stezowski  
A. Lopez-Martens**

**PSA Algorithm  
Development  
L. J. Harkness**

**GRID  
Data managing  
and Analysis**

**Infrastructure.  
Comp. Det.  
B.Million**

**Detector array  
Infrastructure  
R.Menegazzo**

**Complementary  
Detectors  
J.J. Valiente**

**Mechanical  
Infrastructure  
A.Grant**

**Performance  
and Simulation  
F.Recchia**

**AGATA  
Performance  
C.Michelagnoli**

**AGATA  
Commissioning  
C. Domingo-Pardo**

**AGATA Physics &  
exp. Simulation  
M. Labiche**

**Technical  
Coordinator  
Engineering Advi.**

**Compatibility  
EMC, Interfacing**

**Specification  
control**

**Quality  
Control**

**Documentation**

## Local Campaign Managers (LCM)

**INFN-LNL  
Legnaro**

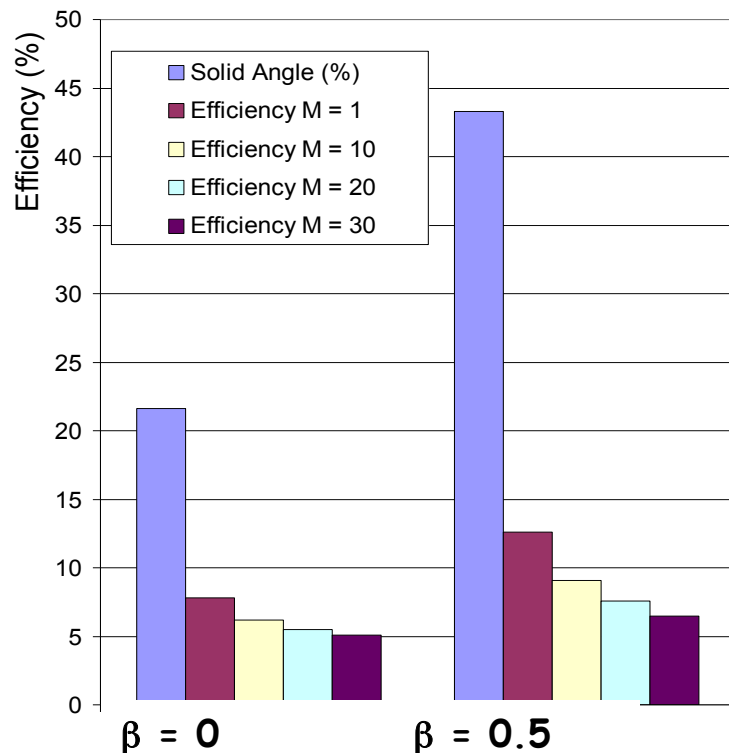
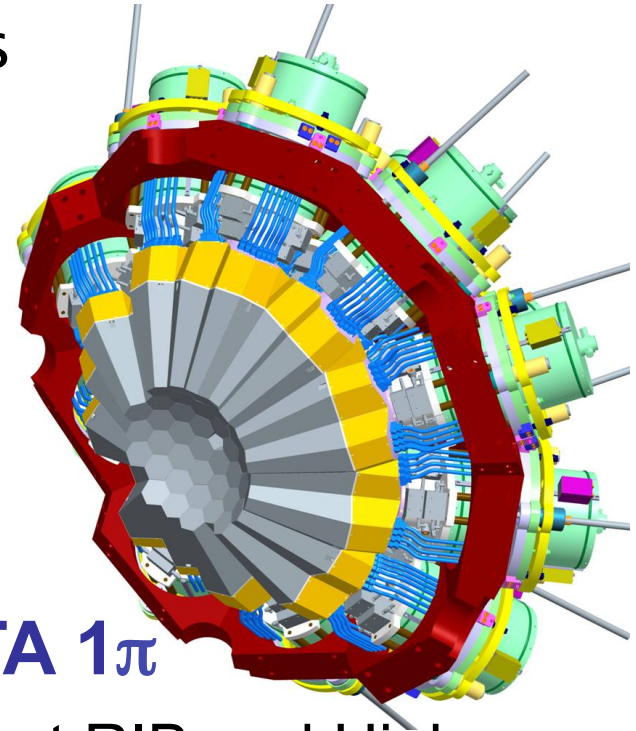
**GSI  
Darmstadt  
J.Gerl**

**GANIL-SPIRAL2  
Caen  
E.Clement**

# The AGATA Phase 1

## 2009-(2015) 2020

- Phase 1 of AGATA ( $>1\pi$ )  $\rightarrow$  60 crystals
- **MoU ongoing, only 70% achieved, decided prolongation till 2020**
- Triple and Double clusters
- The first “real” tracking array

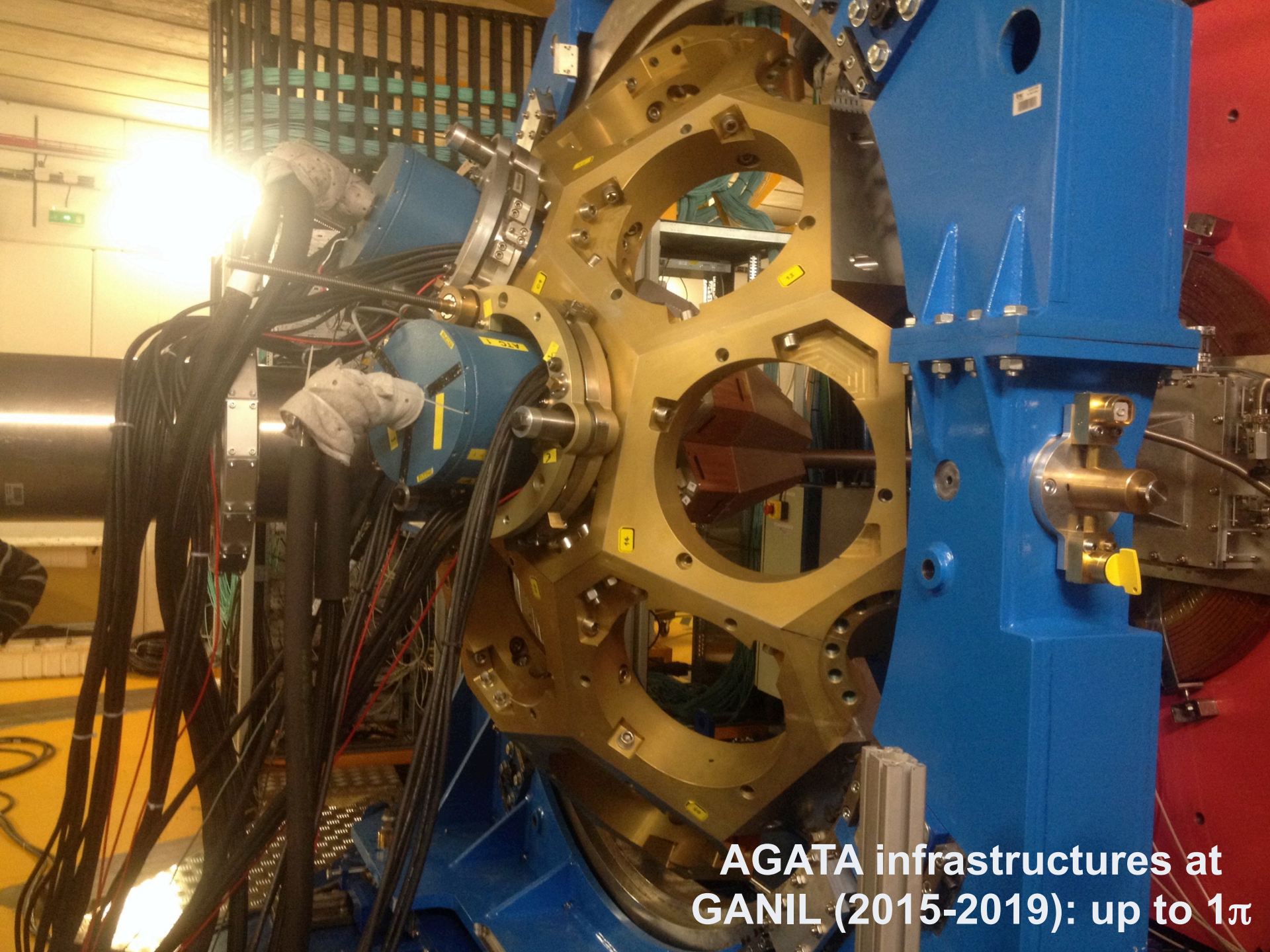


### AGATA $1\pi$

To be used at RIB and High Intensity Stable beam facilities  
**(FAIR-HISPEC, SPIRAL2, SPES, GSI, LNL, GANIL, ...)**

Coupled to spectrometers, trackers neutron and LCP arrays...





AGATA infrastructures at  
GANIL (2015-2019): up to  $1\pi$



# AGATA Capsules Summary

## October 2015



### 39 detectors delivered:

A001, A002, A003, A004, A005, A006, A007, A008, A009, A010, A011  
 B001, B002, B003, B004, B005, B006, B007, B008, B009, B010, B011, B012, B013, B014  
 C001, C002, C003, C004, C005, C006, C007, C008, C009, C010, C011, C012, C013, C014

A012-A014, B015-B016 and C015-C016 ordered A015 being ordered

### Detectors with leakage current issues:

B009 (leakage current) Repairing order placed  
 C002 (leakage current) Repaired on warranty  
 C004 (leakage current) Repaired on warranty

Colorcode:  
 Working  
 broken  
 CAT pending

8 detectors being produced: 2 France (2016-18) + 6 Germany (end 2016-17).

### Usage of the available detectors:

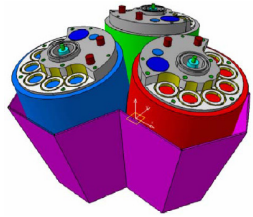
A008	A003	A002	A007	A005	A001	A006	A009	A004	A010	A011	
B001	B003	B010	B007	B002	B004	B013	B005	B008	B012	(B006)	B011
C003	C005	C001	C007	C009	C010	C006	C008	C013	C014	(C012)	C011
ATC1	ATC2	ATC3	ATC4	ATC5	ATC6	ATC7	ATC8	ATC9	ATC10	ATC11	ADC3

32 Capsules in detectors at GANIL, 36 available. CTT Mounting ATC11.

ATC11 to be delivered summer or early fall 2016.

A012 failed factory acceptance test recently.

CAT done at Liverpool Uni. and CEA-IRFU Saclay, maintenance at IKP-Cologne,  
 Acknowledgement to H.Hess, IKP, IRFU and GANIL teams for the prompt and  
 efficient maintenance work.

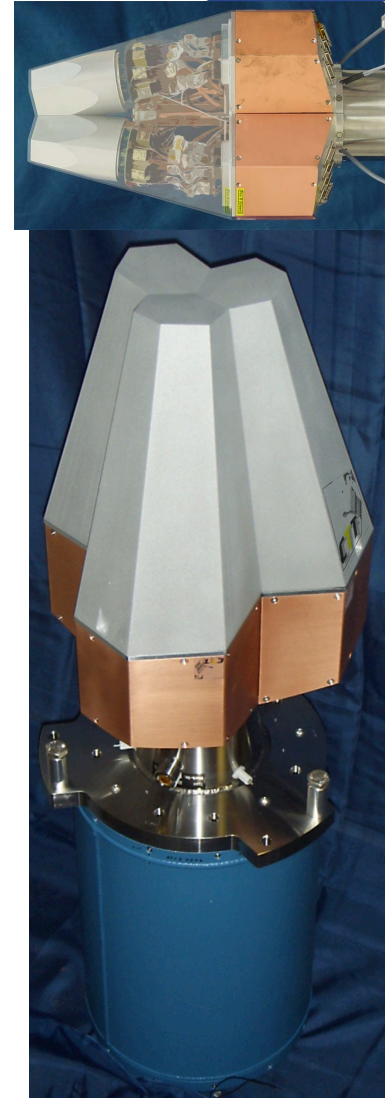


# AGATA Cryostats & characterization

- 10 Triple + 3 Double Cluster Cryostats “Comissioned by CTT
- 2 new Triples ACT9, ATC10 delivered in 2015, ATC11 is ADC2
- 2 new ATC cryostats ordered by Germany
- 1 new ATC cryostat to be order by Italy (estimated 2018)
- ADC4 to be transformed into a ATC, all parts existing (CTT)
- Expected in 2018-2019: 15 ATC + 2 ADC
- Only 15 in total ATCs + ADCs could be installed at GANIL
- Symmetric Triple Cluster

Mechanics and electronic reassembled.

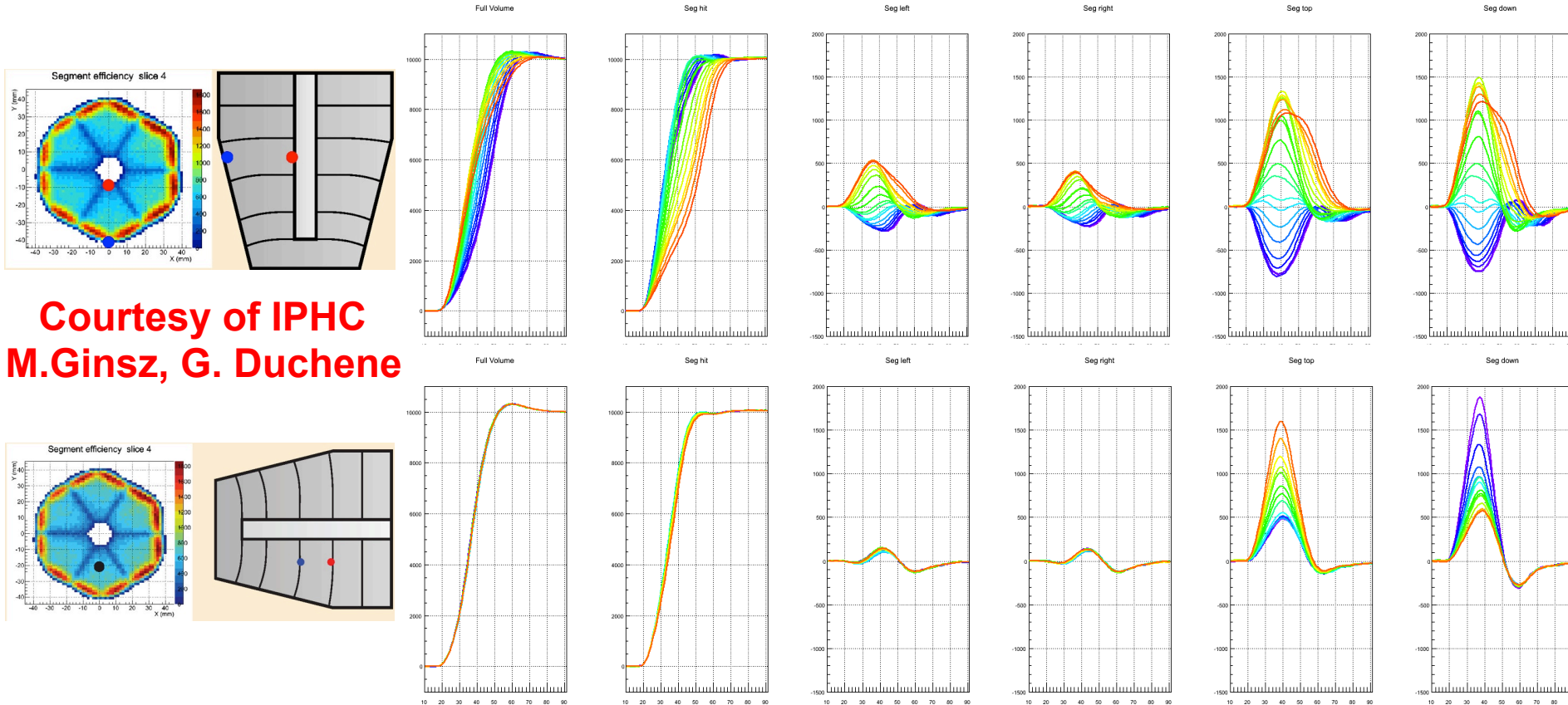
The goal is to make it compatible (in technology, not mechanically) with present clusters. It will be use for testing and technology developments.





# Detector Characterization

- Still very reduced activity due to capsule issues and the priority to have Clusters completed. Scanning sites: University of Liverpool, CSNSM Orsay, GSI
- The IPHC Strasbourg Scanning table based on the Pulse-Shape Comparison Scanning fully operational. First experimental pulse databases.



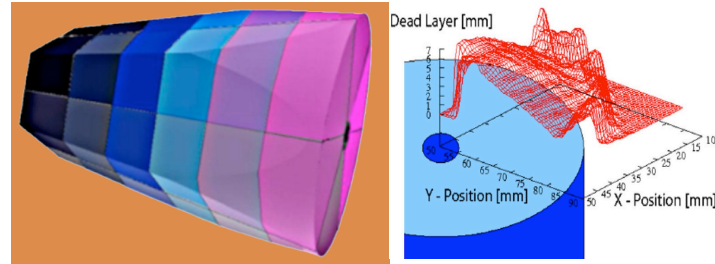
**Courtesy of IPHC  
M.Ginsz, G. Duchene**

- The University of Salamanca scanning table now being commissioned with B014, follows the GSI design with PSCS +  $^{22}\text{Na}$  source .

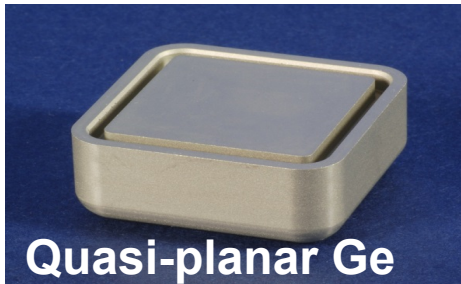
**Uni. Liverpool, CSNSM Orsay, TU-Munich, IKP-Köln  
INFN-Padova, INFN-Milano, IPHC Strasbourg, GSI , LRI Salamanca**

# ENSAR2 JRA – PSeGe : R&D on Position- Sensitive Germanium Detectors for Nuclear Structure and Applications

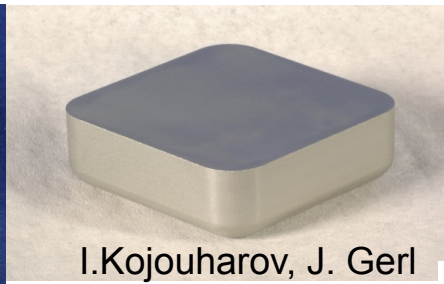
**Task 1: New technologies on passivation and segmentation (INFN-LNL & IKP-Cologne et al.)**



J. Eberth &  
J. Simpson,  
Prog.Part.Nucl.  
Phys.60,283.  
D.R.Napoli et al.



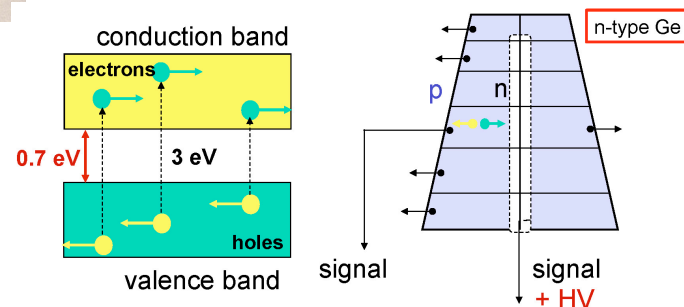
**Quasi-planar Ge**



I.Kojouharov, J. Gerl

**Task 3: R&D on segmented p-type coaxial detectors. (IFIC et al.)**

**Task 2: R&D on novel Ge-detector geometries for ultimate position resolution and efficiency (GSI et al.)**



R&D on p-type  
Contacts &  
hole barriers

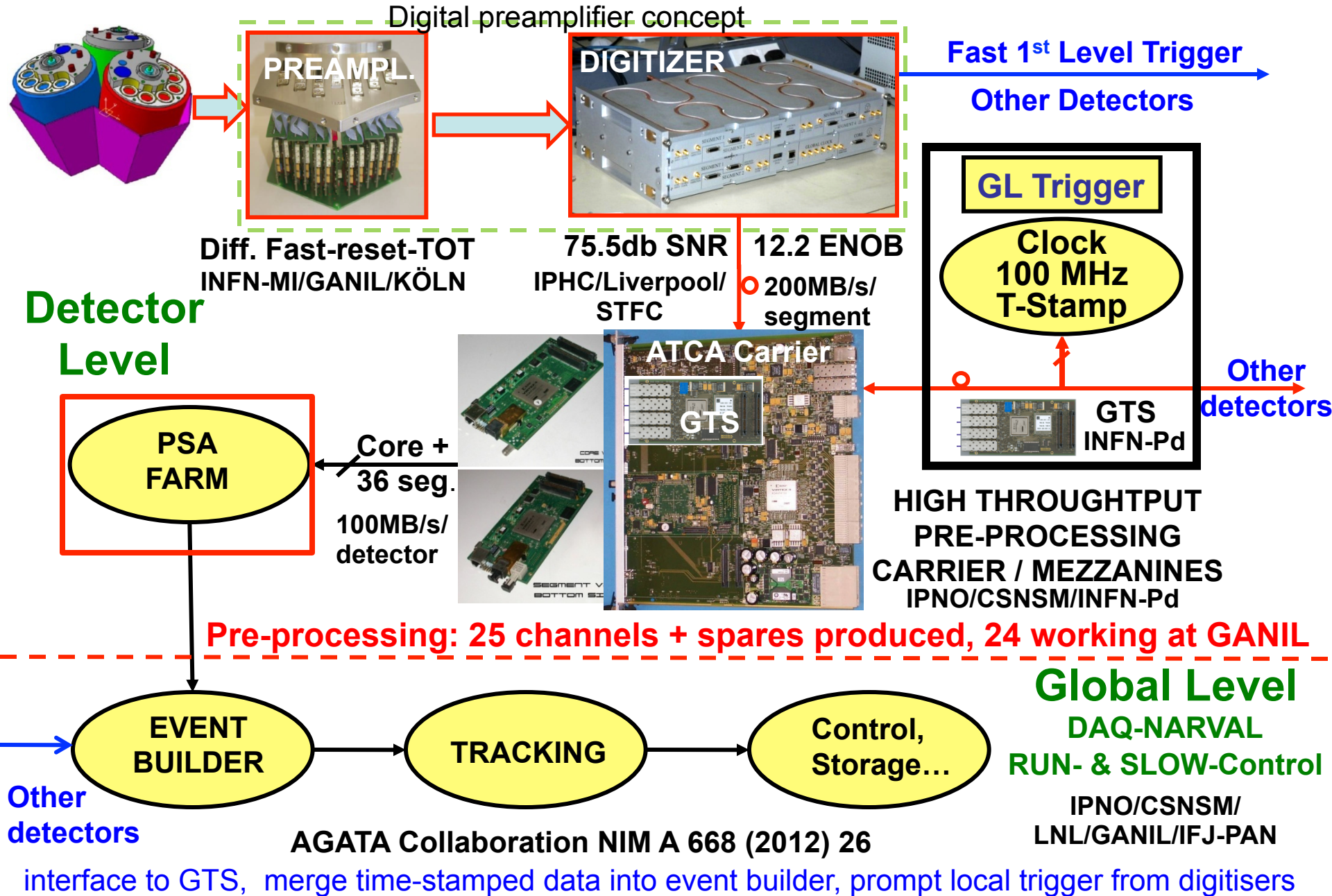
**Task 4: Network activity:  
Demonstration of imaging  
applications and associated  
detector technologies  
(Uni.Liverpool et al.)**

**ENSAR2 Kick-off meeting on 16<sup>th</sup>-17<sup>th</sup>  
March. To be organized the PSeGe  
management kick-off meeting.**

**First workshop October 2016 together  
with AGATA week**



# Structure of Early Electronics and DAQ



# AGATA Pre-Processing Phase 0/ Early 1

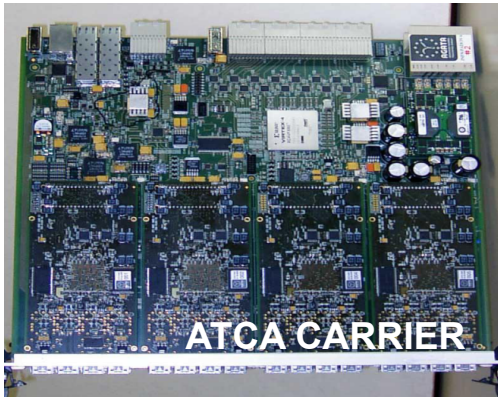
## DIGITIZERS:

All dual core upgraded in June 2014. Available 26 GANIL + 1 CSMSN. Repairs performed at STFC. 2 segment Cards failed after Christmas break



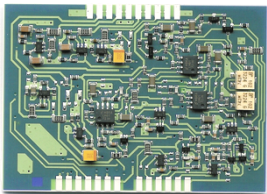
## ATCA CARRIER:

23 pairs at GANIL gained stability by fusses upgrade by CSNSM. 2 sets of cards to be repaired at CSNSM/ IPNO. Established a programme for limited maintenance. Maintenance Center at CSNSM V4 and IPNO V3. Test system now under maintenance.



## SEGMENT & CORE MEZZANINES:

181 (seg) & 25 (core) functional. Working to install VHDL0 in core mezzanines (segment-firmware). No full performance



PRE-AMPLIFIERS

GANIL, IKP-Köln, INFN-Milano

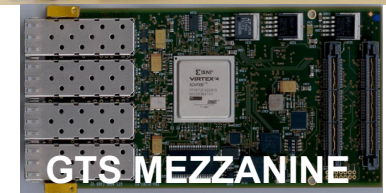
**TCLK CARDS:** 25 available

**GTS MEZZANINES:** 37 available

**LINCO2 CARDS:** 25 available.

**GTS VME CARRIERS:** 20 available

**AGAVA VME Interface:** 8 available



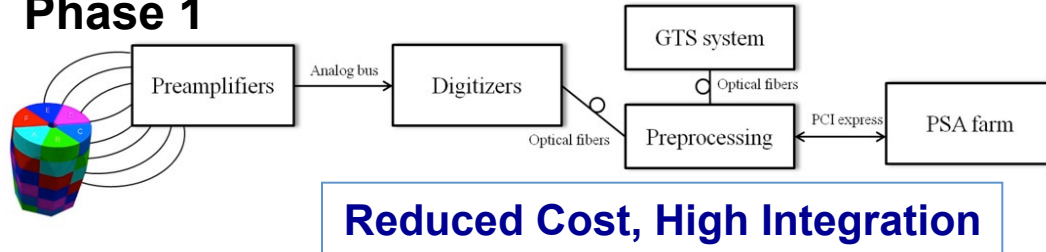
CSNSM Orsay, INFN Padova, STFC Daresbury/RAL, IPN Orsay, IFJ-PAN Cracow



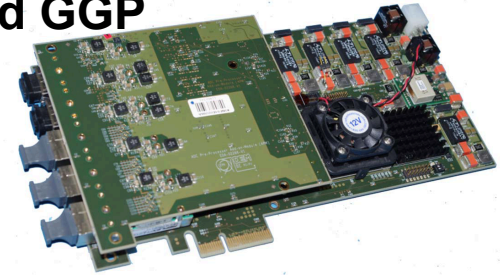
# Advanced Phase 1 Electronics

INFN-Padova INFN-Milano INFN-LNL  
IFIC-Valencia ETSE-Uni.Valencia

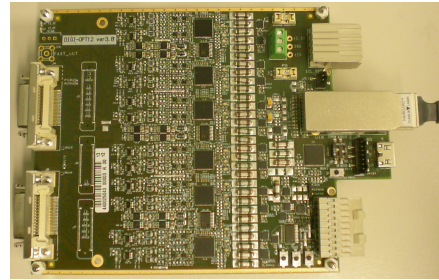
## Phase 1



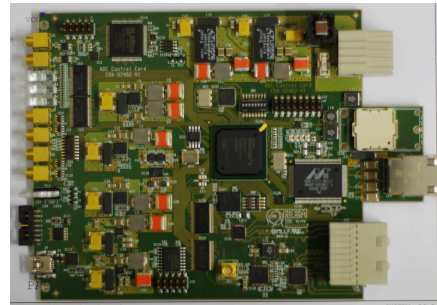
## PCI Pre-Processing Card GGP



## ADC Card



## Control Card

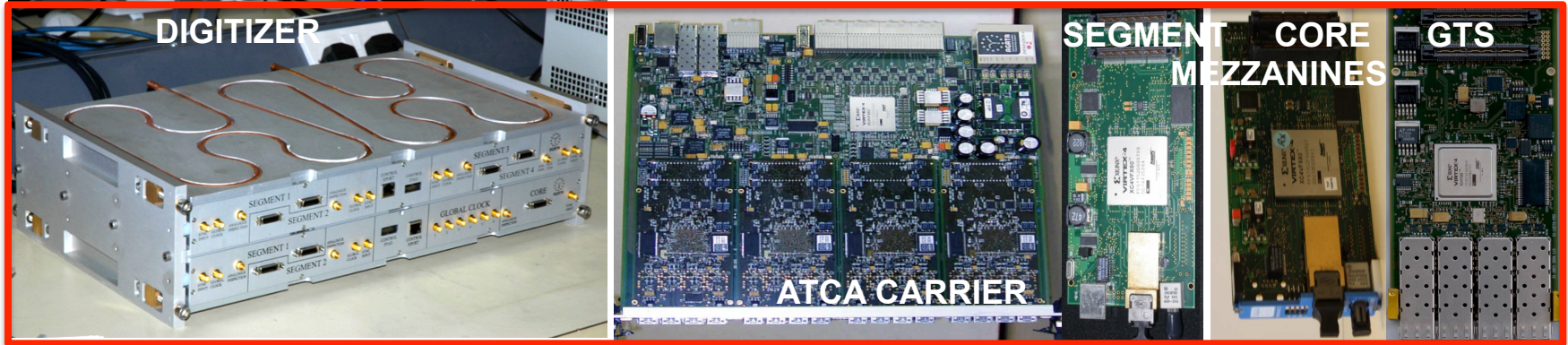


- Electronics shared with GALILEO (two versions).
- GTS Integration was complex and last till February 2016
- DAQ integration was also delayed.
- 11 Digitizers + 10 GGP at GANIL.
- In total 13 channels produced
- Efforts to deliver as many channels as possible in fall 2016
- Issues fund at high counting rate, under discussion.

D. Barrientos, et al., IEEE TRANS. NS

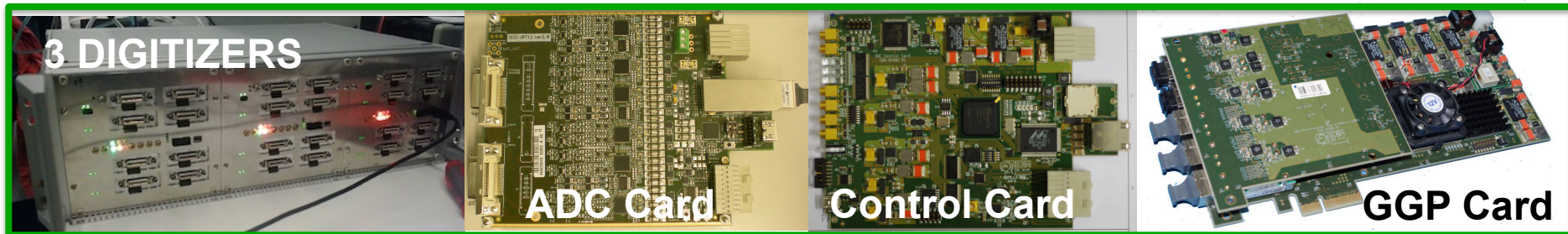
Integration in Narval 23 ATCA channels + 7 GGPs on 4<sup>th</sup> March only.

# AGATA Electronics Phase 0/Early1



23 to 25 channels available

## AGATA Electronics Advanced Phase 1



10 channels available at GANIL 3 to be delivered  
INFN initiating the production to reach 45 capsules  
Severe issues with the obsolescence of Transceivers

IPHC Strasbourg Uni.Liverpool STFC Daresbury IPNO, CSNSM-Orsay INFN-Padova  
INFN-Milano INFN-Padova INFN-LNL IFIC-Valencia ETSE-Uni-Valencia



# Electronics production and R&D

The AMB, discussing how to proceed following the January Town Meeting, arrived to the following conclusions:

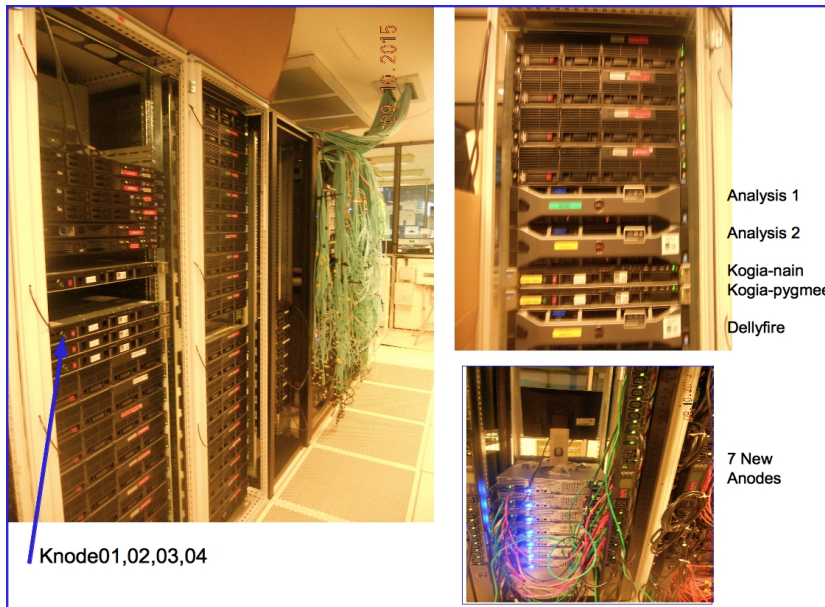
- the need of 45 channels before the end of the campaign in GANIL requires an extra production of the GGP / DIGI-OPT12 Electronics. It has been proposed to do a sufficient production of GGP and Digitizers, about 10 channels + spares.
- The AMB encouraged the development of a medium term solution with an alternative proposed by CSNSM-Orsay and ETSE-Valencia, processing an ATC and with Ethernet readout. A prototype needs to be built and the proof of feasibility must be demonstrated.  
In the positive case, this would be the solution to be used for the remaining channels of the MoU (from 45 to 60) + replacements of the ATCA electronics.
- The long term developments with ASIC preamplifiers and DIGITIZERS / Digital Pre-amplifiers in the Cluster, still shows technical difficulties that need further development.

# GTS and Trigger Processor Issues

Trigger Processor strong limitation to 40 TR due to the hardware used.  
Severe problem for NEDA and Diamant **GTS design limited to 256 leaves**

- During the January town meeting was discussed as well the situation of the GTS Trigger processor. M.Tripon (GANIL) reports that the engineer that was working with him on the EXOGAM2 GTS Trigger Processor for 255 Trigger Request has left the group. M.Tripon informs that he is taking over the work and he will do the best to finish the development.
- We have been informed that there is still possibility to produce GTS mezzanines, a company is producing them for INFN-Padova, producing 10 presently. It is relevant considering that we are planning to go for 45 detector system within 2 years.
- The colleagues from IFJ-PAN Cracow (A. Czermak, P. Bednarczyk) informed as well that they are considering the production of the future GTS interface cards for external instrumentation. The idea is to have something similar to “AGAVA” but for interfacing future digital electronics with different synchronization clocks.

# Phase 1 AGATA Data Flow NARVAL at GANIL



## Integration and GEC:

- GGP data acquisition libraries were delivered by mid February, now working
- Upgrade of the topology manager performed need fine tuning . The group collected pieces of information on the new electronics.
- Ready to extend the farm to host more GGP units.
- Started the maintenance of the PSA farm: older servers will be replaced.

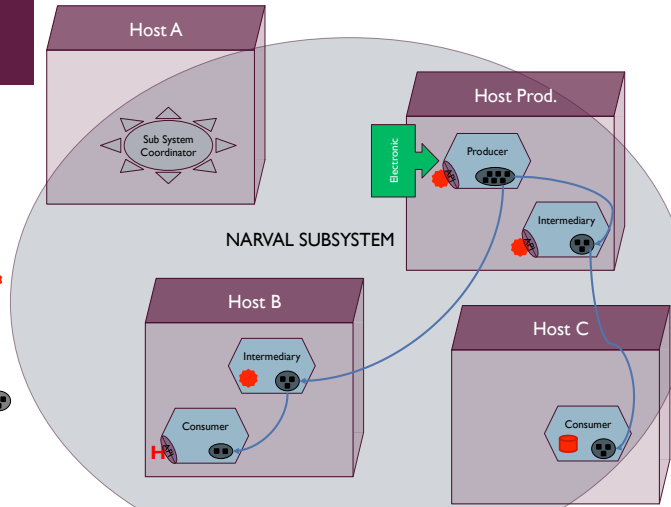
- For the future, it is planned the integration of the distributed system “DCOD”
- It is as well planed to test the new software trigger.
- The new CEPH Cluster (replacing the old disk storage) has been tested in Orsay and installed at GANIL. We have now 122 TeraBytes available and the disks seem to function correctly. The performance figures for the CEPH Cluster will be precisely characterized now that the system is fully operational and available.



# Phase 1 AGATA Data Flow NARVAL at GANIL

## WITH NARVAL 1.14

- Edge
- Distributed
- Modular
- EC outsourced
- Library for domain code
- Rewritten in english
- Flaw
- **Improvement** on buffer handling

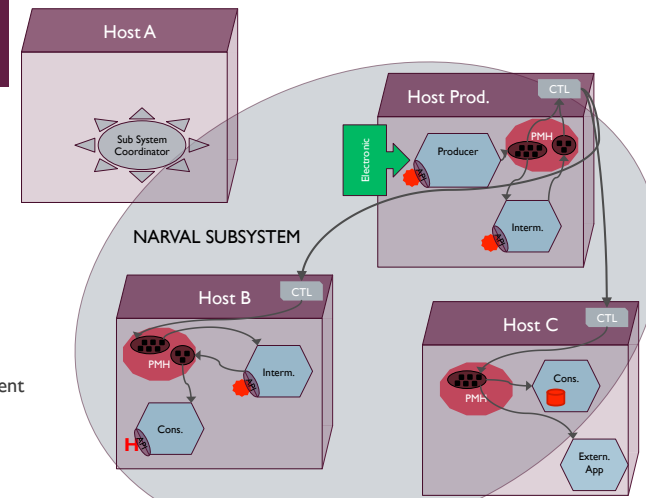


CSNSM - N. DOSME / X. GRAVE / E. LEGAY

## WITH DCOD

- Edge
- Distributed
- Modular
- EC outsourced
- Library for domain code
- Rewritten in english
- New features
- Numerous buffering politics
- Network: data flow management
- Friendly external application

CSNSM - N. DOSME / X. GRAVE / E. LEGAY

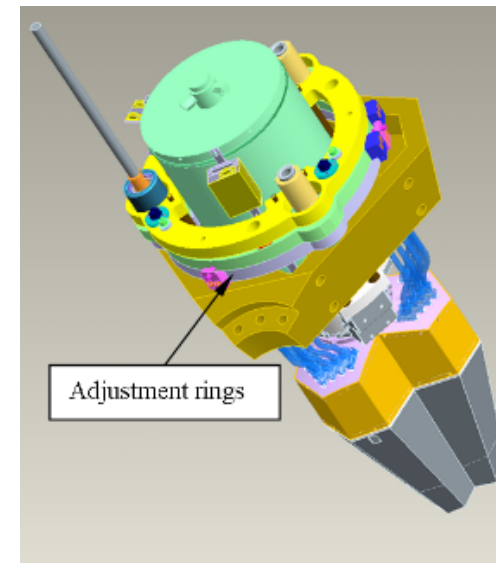


- NARVAL distributed Data Flow system dealing with the complexity of AGATA. Large number of data producers supported now. Next step DCOD.
- The Event-Builder and Merger tested and available for the users. Some problems with the watchers.
- Long Stop/Start procedures due to interplay between GANIL RCC ( Run Control Core) and AGATA RC: team trying to find solutions.
- RCC and Topology Manager (TM) interconnected -a major step in the data flow tasks- thanks to a huge improvement of the TM.
- Software Trigger Processor under study.



# Mechanical Infrastructures

- I. Burrows STFC together with local GANIL team checked the coherence of the detector positions between CAD numbers and on-site measurements. Report from surveyor team has been delivered.
- A new tool to mount the ATC in the honeycomb under discussion in the Working Group.
- Production of the last 3 alignment completed and they are delivered to GANIL. Mechanics completed up to 1p





# AGATA PSA & Data Analysis

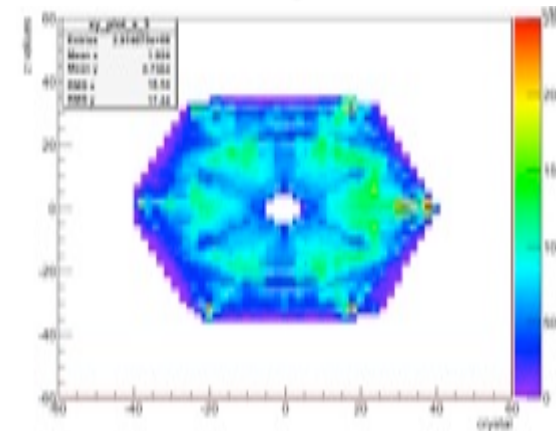
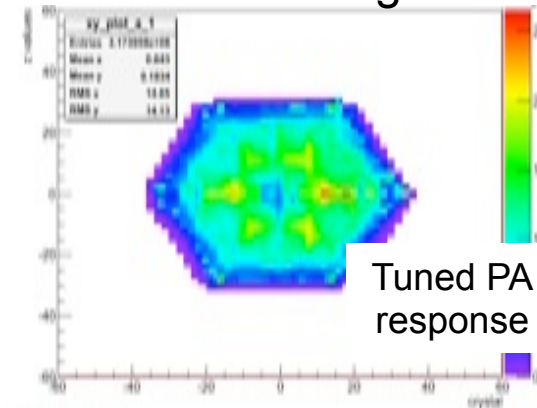
## Pulse Shape Analysis and *Detector Characterization*:

- L. J. Harkness started as PSA team leader. Already 2 meetings, getting the status and organizing the team.
- IKP are able to provide databases using ADL3
- CSNSM and IPHC working at the integration of the experimental PSCS databases in the PSA analysis.
- Any work related to the clustering issues is now focussed on the PSCS databases, that are expected to improve the performance of AGATA detectors
- No recent significant PSA algorithm development reported. Mainly parameter optimisation. Liverpool taken over with the Particle Swarm PSA.

## Data Analysis

- Data Analysis: VAMOS fully integrated and working!
- Efforts to improve the coordination on the Data Analysis W.G. regarding the ongoing data analysis, in particular for the GANIL campaign, are ongoing.
- Meeting being organised to share questions and experience on data analysis.

Position Clustering under investigation





# Simulations, Experimental Commissioning and Performance

## Experimental Commissioning and Performance:

Efforts from several collaboration members to understand and improve the performance of AGATA.

The new appointed Performance Team leaded (C.Michelagnoli) Performance source measurement previous to the in-beam March VAMOS-AGATA commissioning.

New measurements with  $^{22}\text{Na}$  performed between experiments.

An ambitious programme has been prepared with measurements with  $^{60}\text{Co}$ ,  $^{152}\text{Eu}$  and  $^{133}\text{Ba}$ : detector status, n damage correction, peak to total, efficiency with sum peak method (effi and P/T with 1% precision), fixing thresholds and timing, efficiency with external detector, linearity studies and angular correlations/polarization.

See contributionn of A.Korichi understanding the AGATA data processing issues by comparing with GRETA performance.



# Simulations, Experimental Commissioning and Performance

## AGATA Simulations

Simulation of the geometry, integrating the target chamber have been performed by M.Labiche.

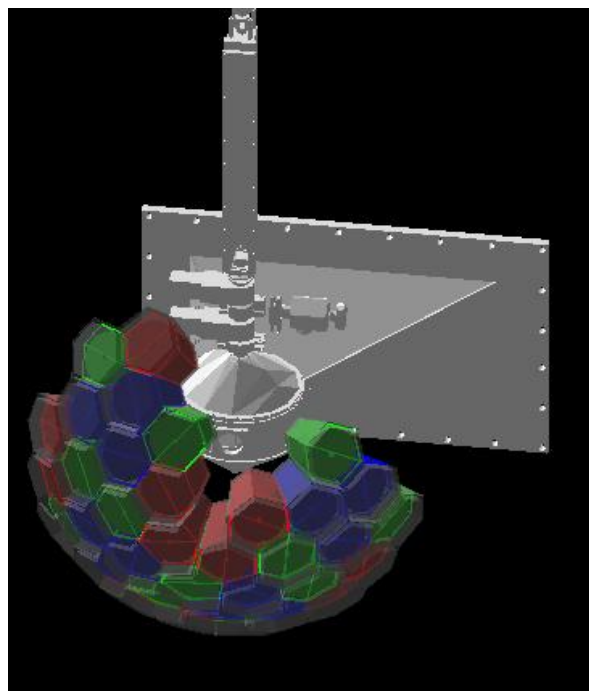
Bbug in the GEANT4 low energy EM libraries, now corrected.

This new simulations will be used to compare with measured data and see if the included details are sufficient to reproduce them.

Next step involves the work of the Detector Module Working Group. All information on the mechanical elements of the detectors, that are relevant for absorption will be provided. Also the geometry of ACT11 is being carefully measured to get a better understanding on how the detectors are located in the setup.



# Simulated performance of AGATA 10ATC+1ADC

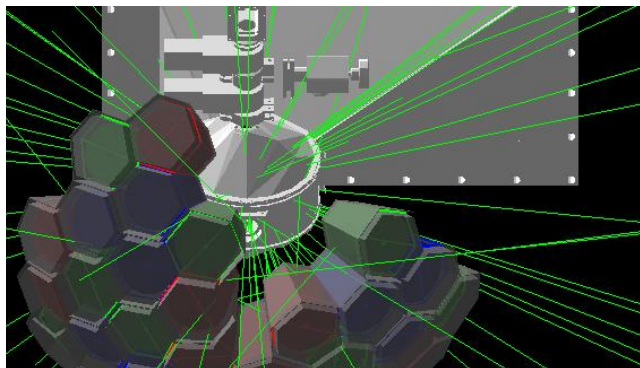


**Before tracking (./mgt –nt)**

	Without Chamber		With Chamber	
Energy [keV]	Efficiency	P/T	Efficiency	P/T
1332	5.3%	42%	4.8 %	38 %

**After tracking (./mgt)**

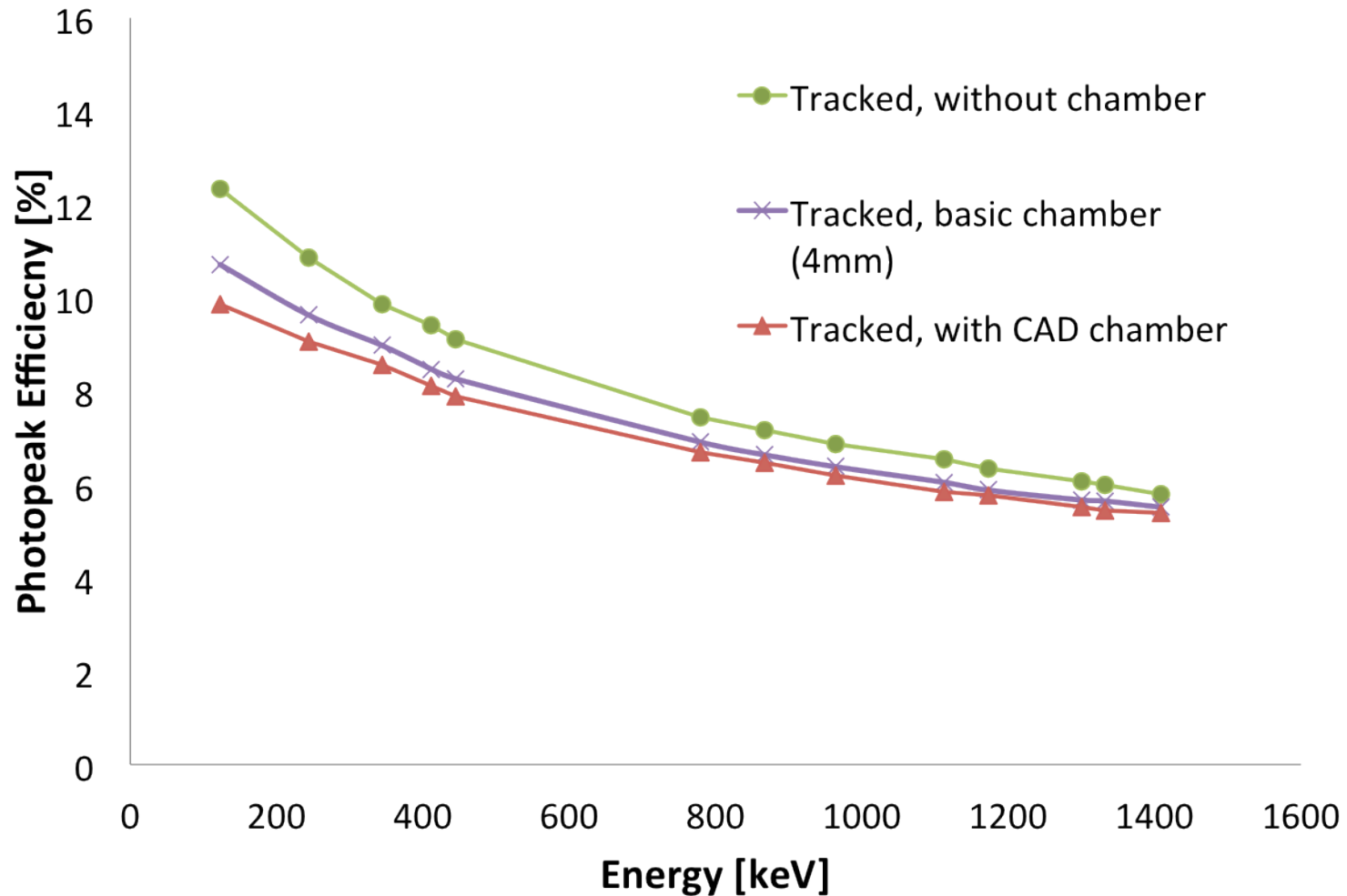
	Without Chamber		With Chamber	
Energy [keV]	Efficiency	P/T	Efficiency	P/T
1332	5.8 %	48 %	5.3 %	44 %



Simulations by M.Labiche

# Simulated efficiency curve

## 10 ATC + 1ADC



# **17th AGATA Week**

## **1st Position Sensitive Germanium Detectors and applications Workshop**

### **CSNSM - IPNO Orsay, 3rd – 7th October 2016**

The meeting is being organized by our CSNSM - IPNO Orsay, France collaborators and will be held in the conference room of the IPNO.

The firsts 1 + ½ days will be devoted to the 1<sup>st</sup> Position Sensitive Germanium Detectors (PSeGe) technology and application Workshop. PSeGe is a JRA

within the ENSAR2 –EC- project, aiming to develop position sensitive Ge detector technologies and to the demonstration of Ge detector imaging applications and associated detector technologies.

The Wednesday, Thursday and Friday will be devoted to the 17<sup>th</sup> AGATA week. For this part of the meeting, the programme will include reports and the regular working group and team meetings.





## Summary and Outlook

- The Construction of AGATA is progressing slowly due to budget limitations on research in several countries. MoU for 60 Capsules extended to 2020 now under signature.
- Upgrade to 32 capsules now installed at GANIL. Installation of the electronic channels ongoing. After summer probably 35 channel available –close to the maximum if spares are kept–. Planning about 45 capsules for 2018.
- The third implementation of AGATA is ongoing with the experimental campaign at GANIL 2015-(2019). The PSA & Tracking provide impressive performance at large v/c (tested from ~10% to ~50%)

# Thank You!



UNIÓN EUROPEA  
Cofinanciado  
por el Fondo Europeo de  
Desarrollo Regional  
Una manera de hacer Europa

Supported by MINECO, Spain  
Grant n. FPA2014-57196-C5

