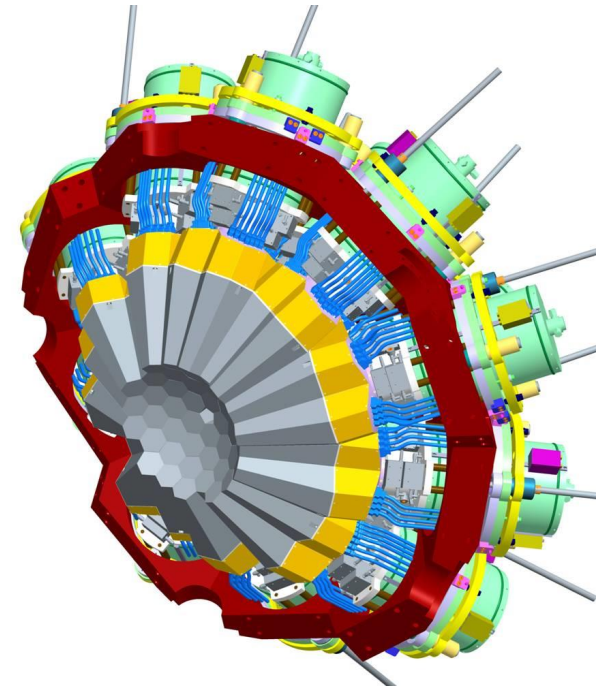


Status of the AGATA Project

Andres Gadea (IFIC-CSIC, Spain)
on behalf the AMB

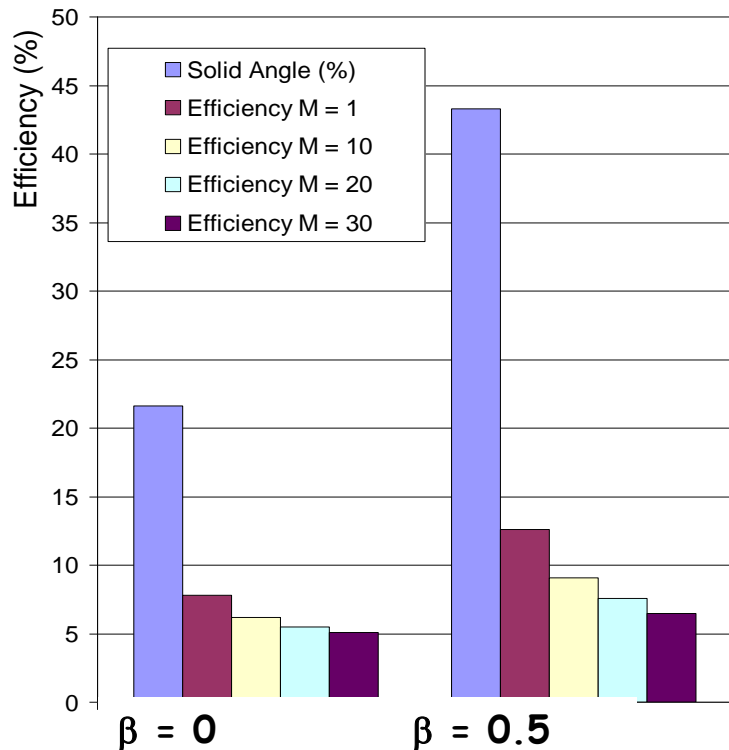
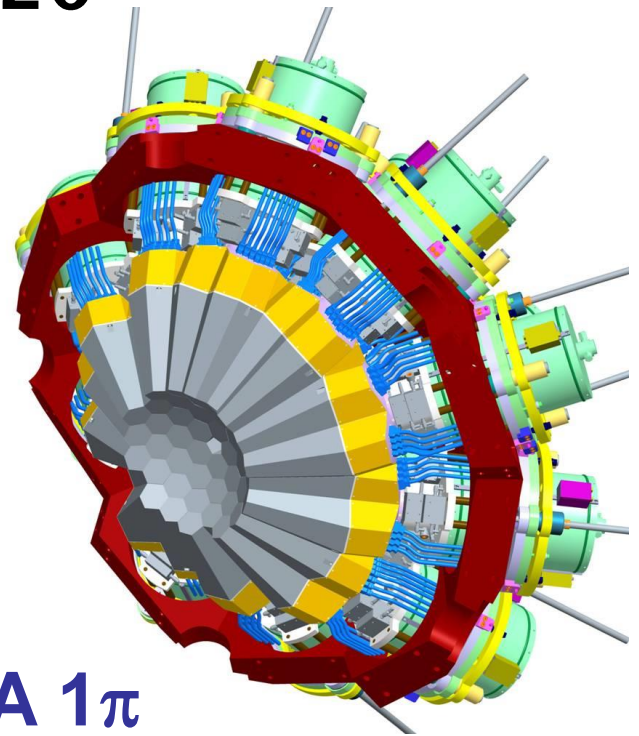


NUSPIN Workshop, GSI Darmstadt, Germany 26th – 29th June 2017

The AGATA Phase 1

2009–(2015) 2020

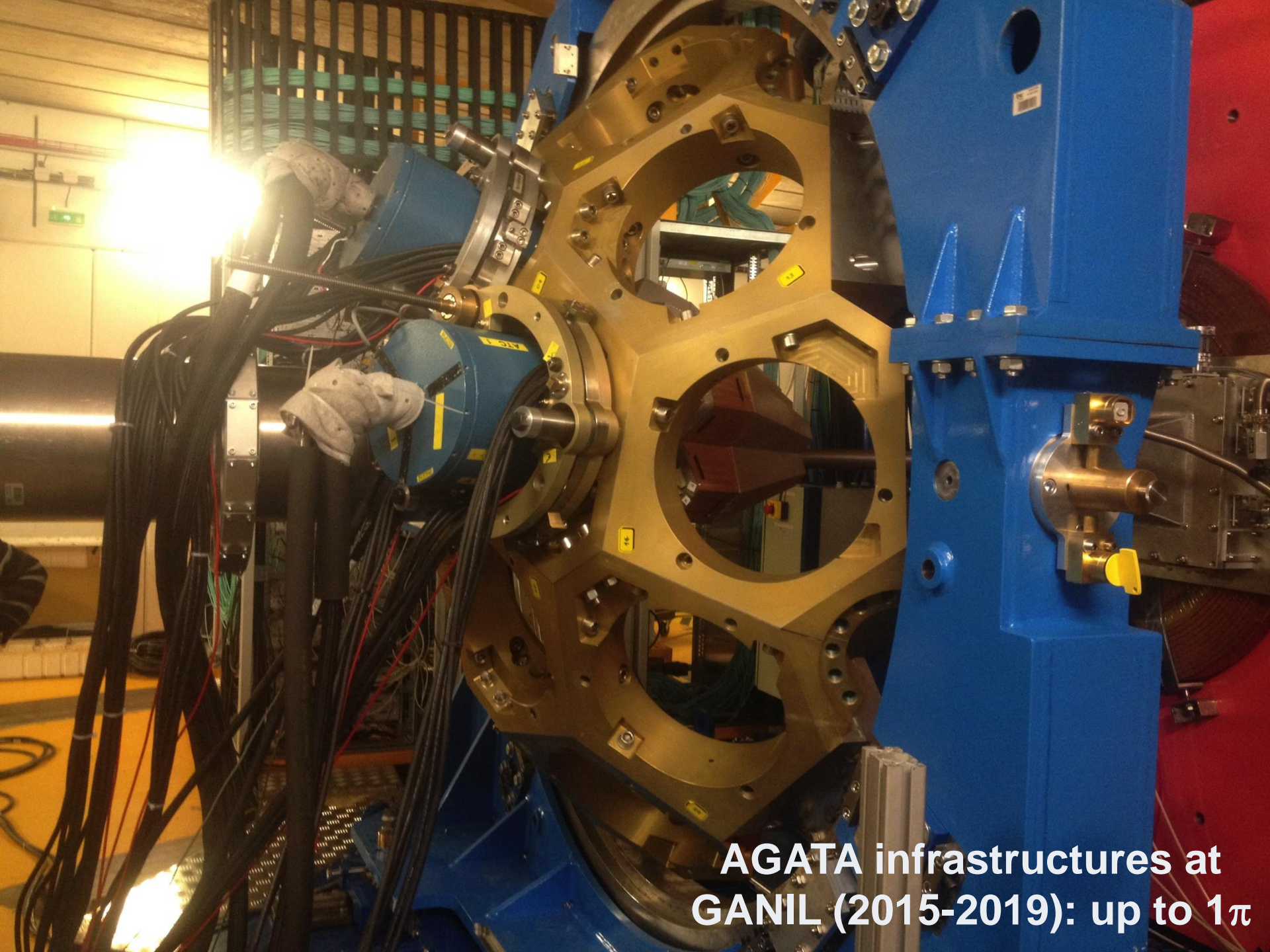
- Phase 1 of AGATA ($>1\pi$) \rightarrow 60 crystals
- **MoU ongoing, only 70% achieved, decided prolongation till 2020**
- Triple and Double clusters
- The first “real” tracking array



AGATA 1π

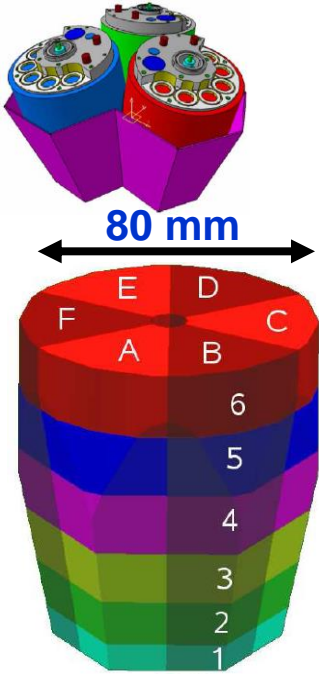
To be used at RIB and High Intensity Stable beam facilities
(FAIR-HISPEC, SPIRAL2, SPES, GSI, LNL, GANIL, ...)

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



AGATA infrastructures at GANIL (2015-2019): up to 1π

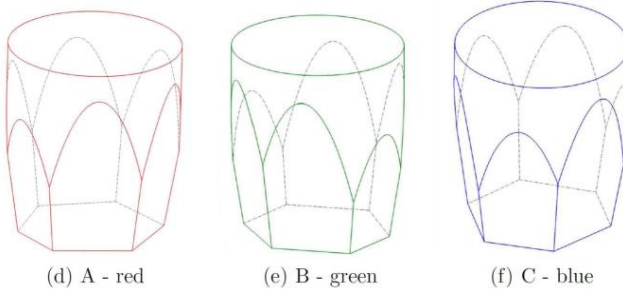
AGATA Detectors & Cryostats



6x6 segmented

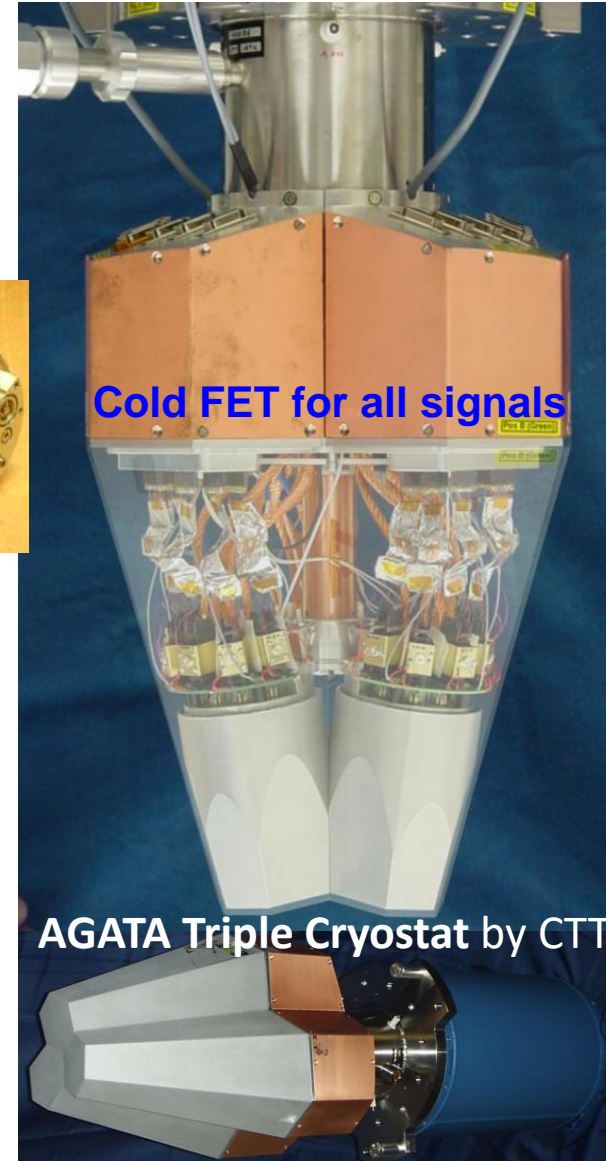
- AGATA capsules procured at Canberra/Mirion-Lingolsheim. AGATA Cryostat provided by CTT
- 111 high resolution spectroscopy channels
- Cold FET technology for all signals

FWHM @ 1332 keV
 Core: 2.35 keV
 Segments: 2.10 keV



AGATA capsules by Canberra-Lingolsheim

- Mounted on Triple & Double cryostats
- 43 detectors delivered / 40 available / 47 Ordered
- 35 capsules setup in 2017 (45 is 1π)
- New encapsulation technique by IKP-Cologne
- R&D detector technology ongoing ENSAR2 JRA.



AGATA Triple Cryostat by CTT

AGATA Capsules Summary

October 2016



43 detectors delivered:

A001 , A002 , A003 , A004 , A005 , A006 , A007 , A008 , A009 , A010 , A011 , A012 , A015
 B001 , B002 , B003 , B004 , B005 , B006 , B007 , B008 , B009 , B010 , B011 , B012 , B013 , B014 , B016
 C001 , C002 , C003 , C004 , C005 , C006 , C007 , C008 , C009 , C010 , C011 , C012 , C013 , C014 , C016

A013, A014, B015 and C015 ordered

The 4 detectors being produced: 1 France (late 2017) + 3 Germany (expected on 1st semester 2017).

Three detectors with leakage current C003, C013, B009 and S003

New Detectors being financed by Hungary and most likely by Finland

Colorcode:
 Working
 broken
 CAT pending

Usage of the available detectors:

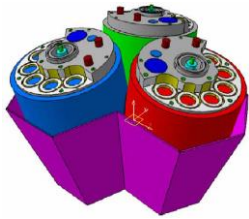
| | | | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|-------|-------|-------|------|
| A012 | A003 | A002 | A007 | A005 | A001 | A006 | A009 | A004 | A010 | A011 | A014 | |
| B001 | B003 | B010 | B007 | B002 | B004 | B013 | B005 | B008 | B012 | B006 | B016 | B011 |
| C004 | C005 | C001 | C007 | C009 | C010 | C006 | C008 | C002 | C014 | C012 | C016 | C011 |
| ATC1 | ATC2 | ATC3 | ATC4 | ATC5 | ATC6 | ATC7 | ATC8 | ATC9 | ATC10 | ATC11 | ATC12 | ADC3 |

38 Capsules in detectors at GANIL, 40 available. ATC12 delivered March 2017, next to be mounted ATC13.

ATC1 major maintenance (neutron damaged) and ATC9 repaired on-site of a severe HV failure by IKP-Cologne, IRFU-Saclay and GANIL teams.

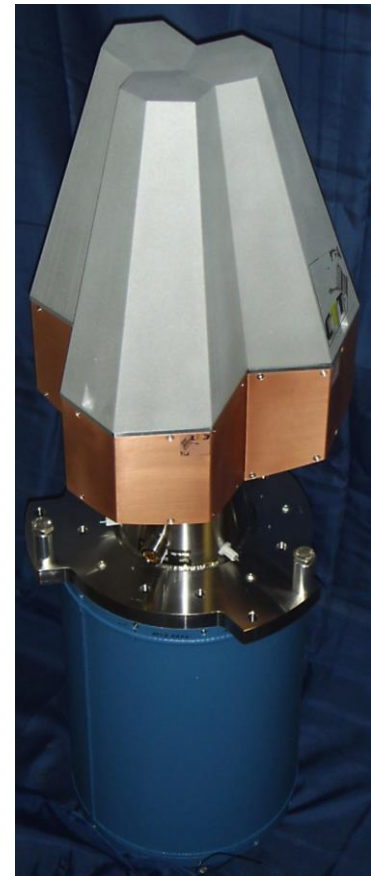
CAT done at IKP-Cologne, CEA-IRFU Saclay, test performed at IPHC-Strasbourg
 Excellent working together H.Hess, IKP, IRFU and GANIL teams: efficient

maintenance work. IKP-Köln, Uni. Liverpool, CEA IRFU-Saclay, GANIL, **IPHC-Strasbourg**



AGATA Cryostats

- 11 Triple + 3 Double Cluster Cryostats “Comissioned by CTT
- 2 Triples ACT11, ATC12 delivered in 2016 and early 2017
- ATC11 is ADC2
- ATC1 maintenance: feedthroughs replaced by Ti ones and vacuum getter moved to a new location to facilitate regeneration.
- Spare end-cap procured for ATC7 (O.C.)
- 1 ATC cryostats ordered by Germany ready for mounting
- 2 ATC cryostat to be order by France (2017) and Italy (2018)
- Expected in 2018-2019: 15 ATC + 2 ADC
- Only 15 in total ATCs + ADCs could be installed at GANIL
- Symmetric Triple Cluster
Not completed due to the CAT failure of S003



Detector Characterization

- Restarted the Scanning activity. Scanning sites: University of Liverpool, CSNSM Orsay, GSI, Uni. Salamanca (commissioning)
 - The IPHC Strasbourg Scanning table based on the Pulse-Shape Comparison Scanning fully operational. First experimental pulse databases.
 - Necessity of new collimated scanning data to provide integrated data sets for two interactions per segment.
-
- The University of Salamanca scanning table commissioned with B014 (follows the GSI design with PSCS + ^{22}Na source).
 - Characterization measurements are ongoing with the aim to get as much position values as possible. Taking into account that the Salamanca scanning table does not measure just in a 1mm resolution grid but will try a sub-mm resolution.
 - Automatic LN2 filling system installed and under commissioning



AGATA Electronics Phase 0/ Early 1

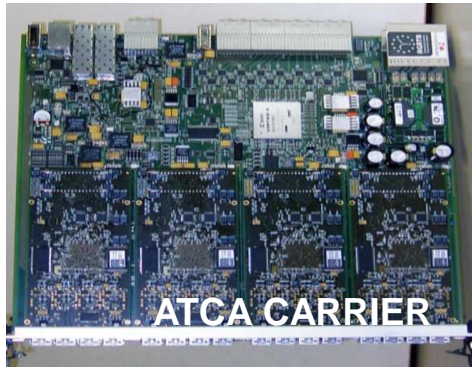
DIGITIZERS:

Available 26 GANIL + 1 CSMSN. Repairs performed at STFC. CSMSN Cards repaired March 2017. Stocks of spares are running out since design is over 10 years old.



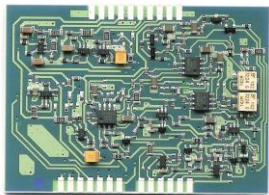
ATCA CARRIER:

24 pairs at GANIL gained stability by fuses upgrade by CSNSM. 1 set of cards to be repaired at CSNSM/IPNO. Maintenance Center at CSNSM V4 and IPNO V3. Test system now under maintenance. Severe issues for the personnel reduction at CSNSM.



SEGMENT & CORE MEZZANINES:

181 (seg) functional. 25 Core Mezzanines on stand-by



PRE-AMPLIFIERS

GANIL, IKP-Köln, INFN-Milano

TCLK CARDS: 25 available

GTS MEZZANINES: 37 available

LINCO2 CARDS: 27 available.

Repairing of 2 ongoing

GTS VME CARRIERS: 20 available

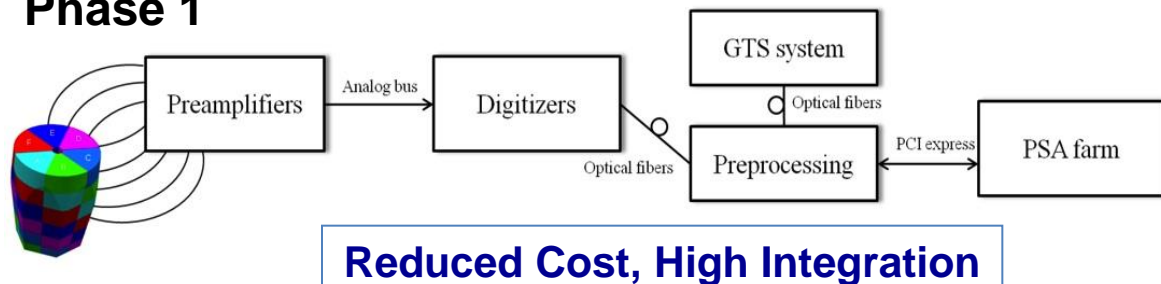
AGAVA VME Interface: 8 available



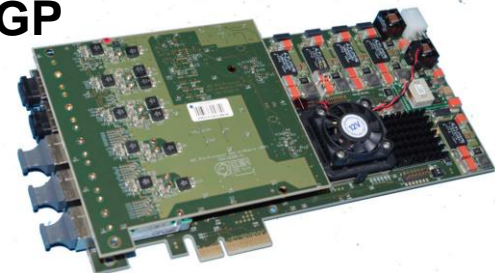
CSNSM Orsay, INFN Padova, STFC Daresbury/RAL, IPN Orsay, IFJ-PAN Cracow

Advanced Phase 1 Electronics

Phase 1



PCI Pre-Processing Card GGP



ADC Card



Control Card



- Electronics shared with GALILEO.
- GTS first Integration of 23 ATCA channels + 7 GGPs completed on 4th March 2016.
- Presently 12 Digitizers + 13 GGP at GANIL (few borrowed from GALILEO). In total 13 channels produced.
- The 13th DIGITIZER being repaired.
- 3 GGP to be repaired → FPGA exchange.
- Observed Validation loses issue at high counting rate.
- Firmware Improvements in the synchronization procedure and in the Validation timeout installed by INFN-Padova on March 2017.

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

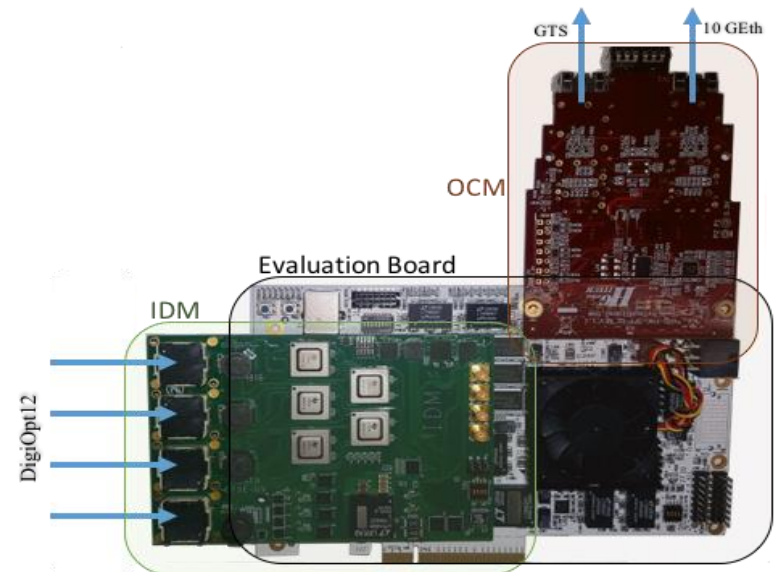
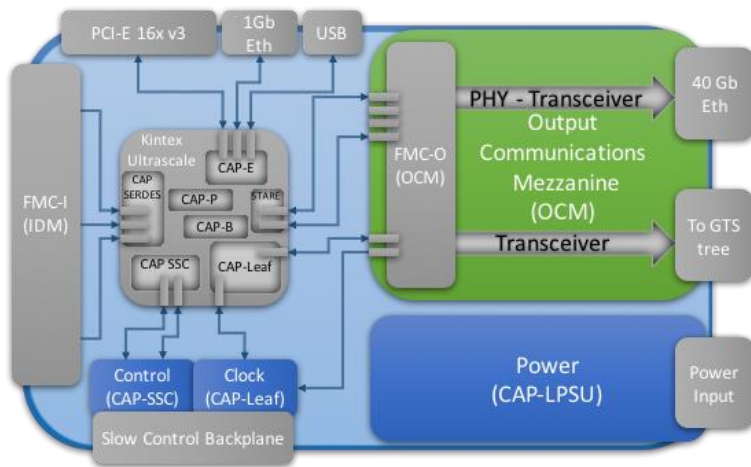
INFN-Padova INFN-Milano INFN-LNL
IFIC-Valencia ETSE-Uni.Valencia

Electronics production and R&D

-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. Production on-going or completed for several items , target schedule for production: end 2017 (if possible)

-The AMB encouraged the R&D of a medium term Electronics (~2020) proposed by CSNSM-Orsay, ETSE-Valencia and INFN-Milano. Goal: low costs, higher processing capability and with Ethernet readout.

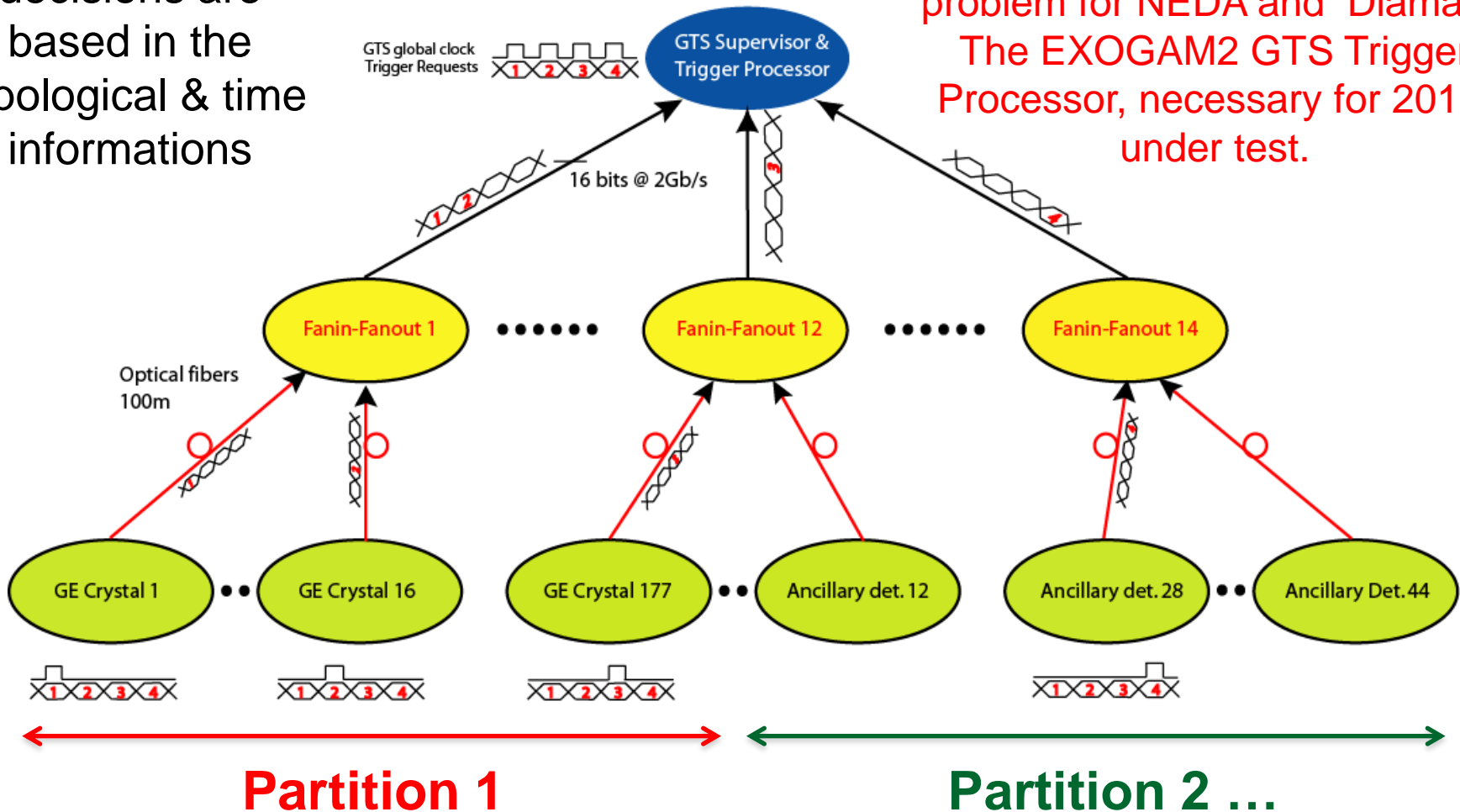
-Working document under preparation



GTS Trigger & Synchronization Structure

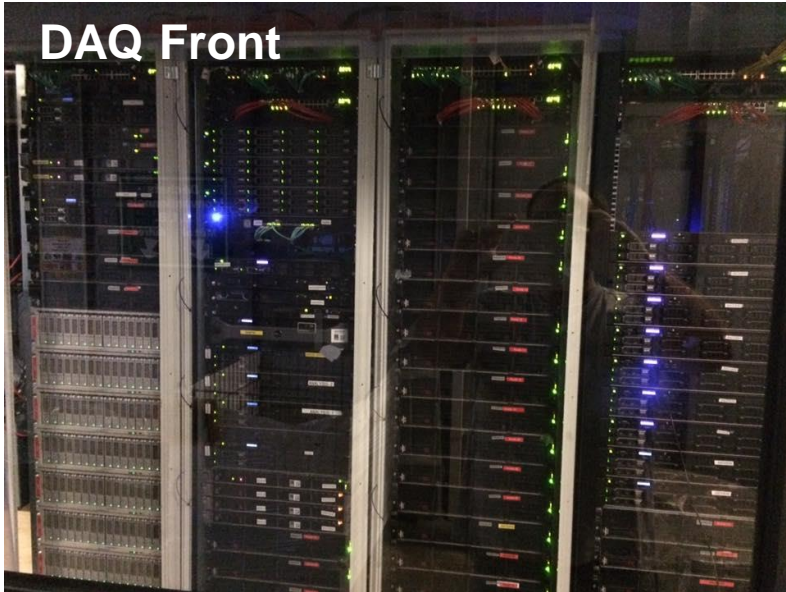
GTS Trigger decisions are based in the topological & time informations

AGATA GTS Trigger Processor strong limitation to 40 TR. Severe problem for NEDA and Diamant. The EXOGAM2 GTS Trigger Processor, necessary for 2018, under test.



Phase 1 AGATA Data Flow NARVAL at GANIL

DAQ Front



DAQ Back



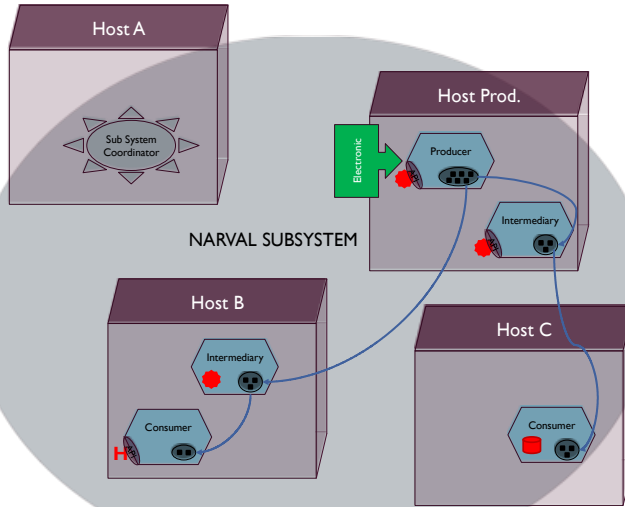
Hardware:

- New Hardware available, 7 servers devoted to GGP's are at GANIL, 3 at CSNSM. Control servers and switches also renewed.
- CEPH Cluster 122 TB & bandwidth x 6
- Backup for disk server. Low cost Spare disk storage system purchased. Compatible with the existing CEPH
- Investment funds required in 2017 to increase the number of channels from 35 to 45
- LINCO driver in the last version of the Debian Operating System. Almost all ANODEs are upgraded using the latest OS and made them all identical for an easier management.

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 ●

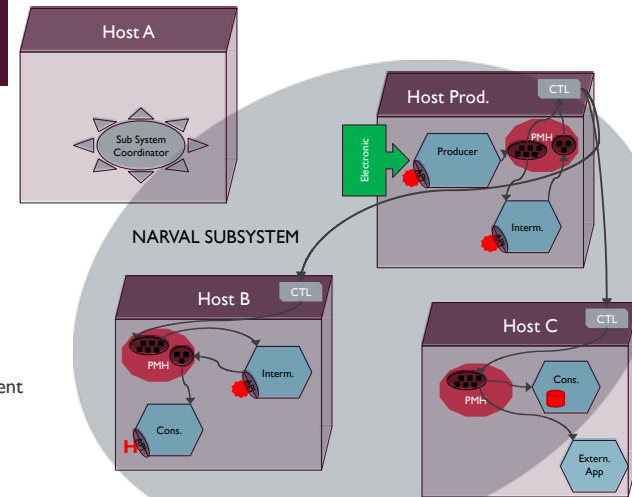


CSNSM - N. DOSME / X. GRAVE / E. LEGAY

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



DAQ Software:

- Upgrade of the DAQ system to DCOD ongoing.
- Now PSA data bases uploaded very fast (less than 10 second to load 32 crystals) is a feature of DCOD.
- A comparison between data with NARVAL and DCOD has been performed (by Li Hogjie and A.Korichi) to check the data Integrity with source runs.
- Update of the actors in the VAMOS system in order to perform a new test with VAMOS+AGATA under DCOD will be performed in the next coming months.
- Completion of the installation of DCOD at GANIL postponed due to the starting of the 2017 campaign.

GEC, GCC and Topology Manager

Display And Control Web Page

Topology Manager / SC Digitizer

Display full logs

| Cluster | Crystal | Color | Digitizer | Master | Anode | GGP | GTS |
|------------|---------|-------|--------------|-------------|---------|--------|-----|
| adc03 (9) | c011 | C | - | - | anode56 | ggp015 | ??? |
| | b011 | B | digitizer027 | carrier-063 | anode26 | - | ??? |
| | c013 | C | digitizer024 | carrier-074 | anode16 | - | ??? |
| atc09 (4) | a004 | A | digitizer011 | carrier-039 | anode01 | - | ??? |
| | b008 | B | digitizer025 | carrier-013 | anode05 | - | ??? |
| atc08 (2) | a009 | A | digitizer026 | carrier-069 | anode23 | - | ??? |
| | b005 | B | digitizer023 | carrier-057 | anode22 | - | ??? |
| atc07 (11) | c006 | C | - | - | anode57 | ggp017 | ??? |
| | c010 | C | digitizer005 | carrier-005 | anode12 | - | ??? |
| | a001 | A | digitizer022 | carrier-025 | anode14 | - | ??? |
| | b004 | B | digitizer006 | carrier-062 | anode21 | - | ??? |
| | c009 | C | digitizer009 | carrier-041 | anode09 | - | ??? |
| atc05 (3) | a005 | A | digitizer020 | carrier-006 | anode18 | - | ??? |
| | b002 | B | digitizer018 | carrier-023 | anode08 | - | ??? |
| | c007 | C | digitizer014 | carrier-036 | anode20 | - | ??? |
| atc04 (13) | a007 | A | digitizer003 | carrier-015 | anode10 | - | ??? |
| | b007 | B | digitizer019 | carrier-071 | anode07 | - | ??? |
| | c001 | C | digitizer007 | carrier-010 | anode03 | - | ??? |
| atc03 (12) | a002 | A | digitizer012 | carrier-015 | anode25 | - | ??? |
| | b010 | B | digitizer015 | carrier-035 | anode04 | - | ??? |
| | c005 | C | digitizer017 | carrier-014 | anode11 | - | ??? |
| atc02 (10) | a003 | A | digitizer008 | carrier-055 | anode16 | - | ??? |
| | b003 | B | digitizer013 | carrier-070 | anode17 | - | ??? |
| | a012 | A | digitizer010 | carrier-061 | anode13 | - | ??? |
| atc01 (14) | b009 | B | - | - | anode06 | ggp016 | ??? |
| | c014 | C | - | - | anode29 | ggp000 | ??? |
| atc10 (1) | a010 | A | - | - | anode55 | ggp005 | ??? |
| | b012 | B | - | - | anode24 | ggp020 | ??? |

Table key:

Stopped Going Undefined Error Reset Setup

Device Message

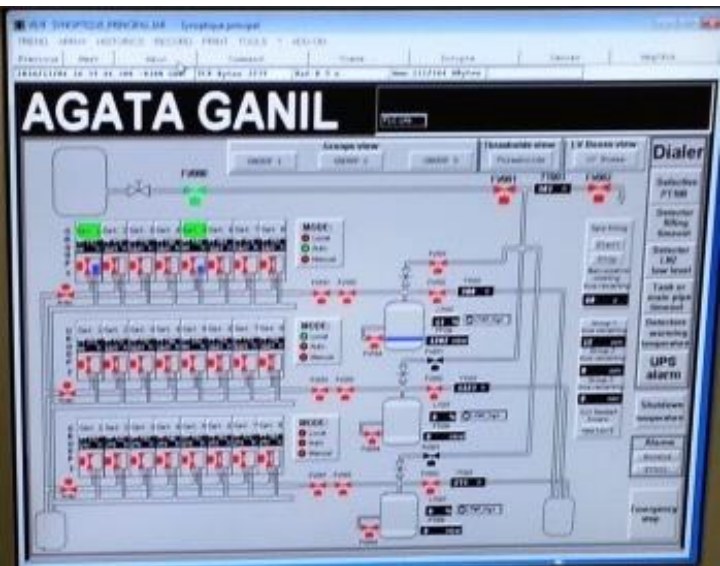
```

anode06can't reach launcher
ggp000 Get GGP State Error -> GGP server is not reachable
anode29can't reach launcher
ggp005 Get GGP State Error -> GGP server is not reachable
anode55can't reach launcher
ggp017 Get GGP State Error -> GGP server is not reachable
anode57can't reach launcher
  
```

- Global Electronic Control and Topology Manager are being upgraded.
- Implementation of new software, removing the use of scripts (user friendly).

- A general AGATA display and AGATA control has been produced. The electronics status will be included (See figure). It Includes GTS interface, Anode interface (Add launch /kill/restart DCOD, reboot, show status etc...), Reload topology ATCA Carrier interface, GGP interface
- Ongoing the modification of the RCC and TM in order to control DCOD with the RCC.

Infrastructure: Detector and Mechanical



Muscade GUI for the Autofill system

• **LN2 Autofill system:**

Excellent stability of the system.

LN2 Autofill system is working stable including the last Detector PT100 readout upgrade.

A major upgrade will be needed in the autofill for Phase 2. Estimated development time: ~ 2 year

• **HV system**

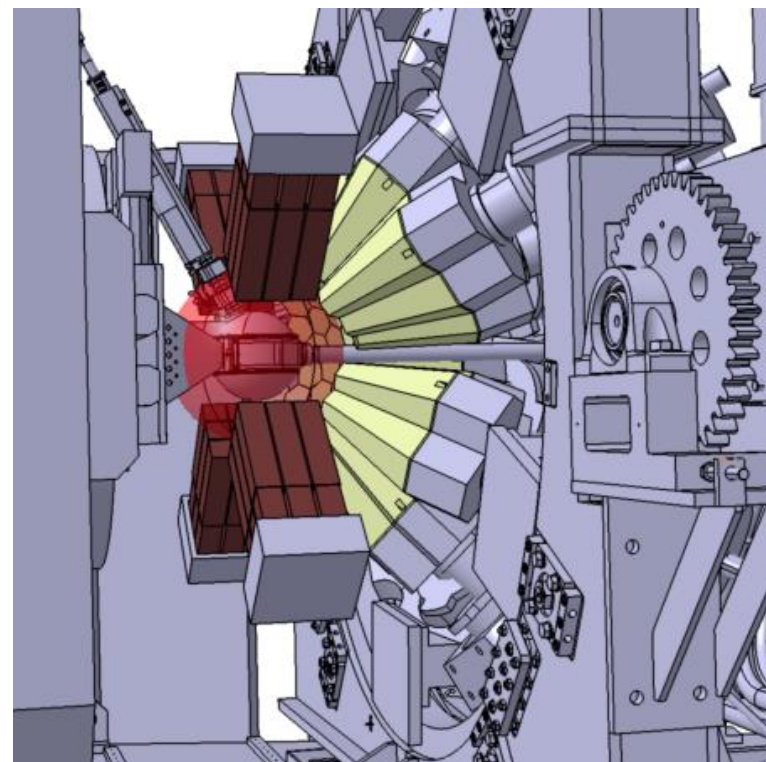
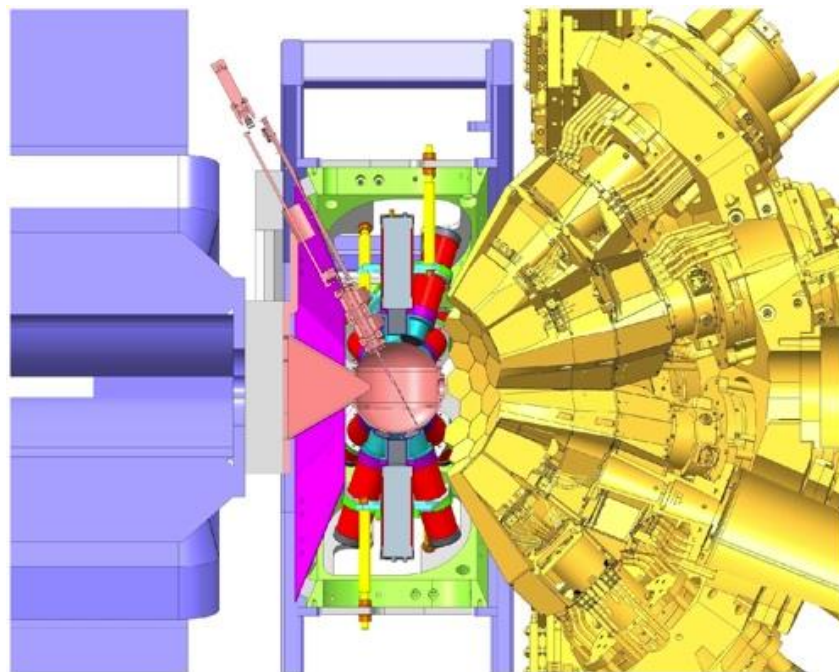
We are using >20 years old CAEN mainframes and HV cards.

HV upgrade on Stand-by until funds are available.

- Detector and Mechanical infrastructures almost ready for 15 ATCs.
- Few LVPS are needed to complete the 15 Cluster infrastructures. Procurement started
- Issue with LVPS cables: these cables are rigid and heavy, they are an issue now that the number of detectors is increasing in the set-up. Problems with the big Jaeger connectors that get unsoldered due to the cable stiffness and their weight. IRFU is leading discussions that are ongoing with the producer company.

IRFU-CEA Saclay, INFN-Padova, INFN-Milano, GSI, CSNSM-Orsay
STFC-Daresbury, IPHC-Strasbourg, GANIL, INFN-LNL, JYFL-Jyvaskyla,

Complementary Detectors Coordination



- The integration work of FATIMA and PARIS has been followed by the team.
- Now focussing on the status of the integration of NEDA and DIAMANT for the 2018 campaign.
- Mechanical Infrastructures Team (STFC) working with the Complementary instrumentation collaborations for the integration into the AGATA set-up

AGATA PSA & Data Analysis

Pulse Shape Analysis and *Detector Characterization*:

- Regarding ADL, work ongoing at Uni.Liverpool and IKP-Cologne. Using different detector geometries -i.e. Segmented well detector- gives a good insight on mobility parameters.
- Following the outcome of the AGATA-GRETINA Workshop, scanning data is to be used to integrate two interactions in a segment from single interaction data.
- An AGATA simulated basis data set is being generated with the GRETINA methodology.
- This will allow AGATA data to be replayed through the GRETINA signal decomposing algorithms in order to facilitate multiple interaction in a segment PSA.

Tracking:

- Discussion on-going with the PSA team the tracking on AGATA and the impact of position uniformity on the algorithm performance.
- Planned to include the position determination unaccuracy in the tracking procedure.

AGATA PSA & Data Analysis

Data Analysis

- Online and Offline Watchers working and stable
- The “Cubix” software is now available. Cubix is an adaptable spectroscopy analysis tool based on Root and developed by G. Macquart, J. Dudouet. It is an “automatic” data analysis software toolkit, originally developed for AGATA-VAMOS data, can be used for AGATA gamma data alone as well.
- O. Stezowski is working on the GRETINA to AGATA data format translation. The work being done by T.Lauritsen, A.Korichi and O. Stézowski will make possible to share the analysis software of AGATA and GRETINA.
- The AGATA-VAMOS campaign Data Analysis meeting took place at GANIL on October 17th 2016. It was organized by Emmanuel Clement and major contributions came from the local GANIL team. There were approximately 6 attendees at very different stages of the analysis. Very positive response, it will be necessary to have another meeting, possibly in 2017.



AGATA-GRETINA Workshop on Data Analysis



The AGATA-GRETINA Data Analysis Workshop was organized by A.Korichi from the AGATA collaboration and T.Lauritsen from the GREtINA.

Programme and Slides are available on web site:

<https://indico.in2p3.fr/event/13409/other-view?view=standard>

- Reports on the status and plans for the instruments were presented but, most important the status of PSA and Tracking, Simulations and Data Analysis. Time devoted to discussions and decisions to collaborate, was a major achievement of the workshop.
- Distributed the conclusions of the Workshop and definition of a plan for “Working Together” is ongoing.
- Next Workshop announced on 4th to the 6th of April 2018 in Paris, France.

General Documentation for the AGATA users

- Activity taken by the Data Flow and Data Analysis Working Groups. The goal is to have a document that allows AGATA users to run an experiment and perform the data analysis in a coherent manner.
- Presently revising the existing documentation: Installation of the software and actors, data analysis programs etc... For example:
 - D. Bazzacco documentation (AGATA @LNL campaign) has sections on how to extract the x-talk coefficients etc.
 - Hongje Li and R. Perez-Vidal produced document on the calibration, cross-talk coefficient generation and treatment of missing segment.
 - N.Lalovic has produced notes on the difficulties encountered with the AGATA system and some specifics on issues with ancillary systems such as the PRESPEC packages, also produced a document on n-damage correction.
- J.Ljungvall and O. Stézowski will collect and merge existing documentation.
- A. Korichi and A. Boston are involved in producing this document. Soon a draft document will be circulated to experts.

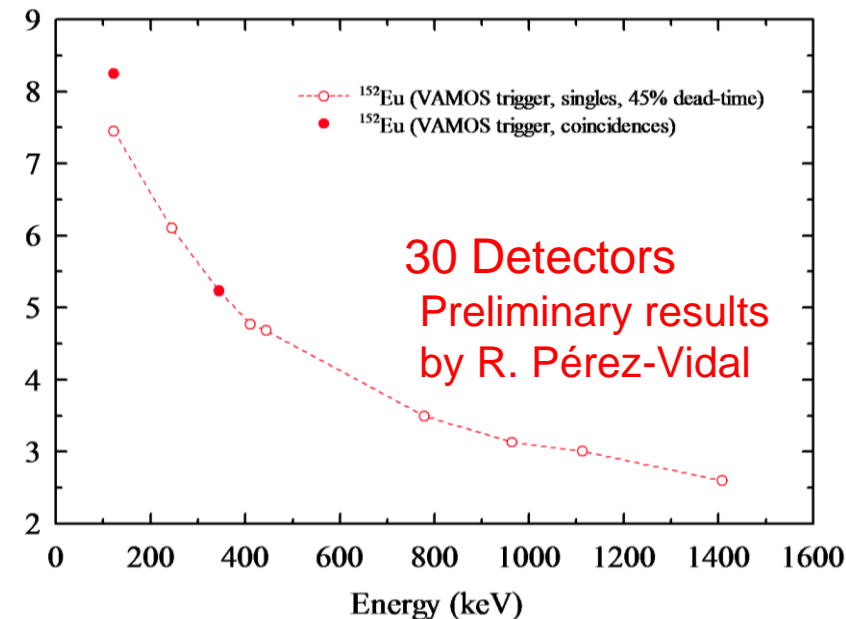
Simulations, Experimental Commissioning and Performance

Experimental Commissioning and Performance:

- The performance team aims to finalize, write a report on the last performance source measurements performed at GANIL.
- Still issues comparing measured and simulated efficiencies.
- Efficiencies mismatch with in-beam experiments with high multiplicity

| | Eff(%) Nominal | Eff(%) Compact |
|-------------------------|----------------|----------------|
| Core Common singles | 2,97 | 5,42 |
| Core common gating 13C | 3,11 | 5,37 |
| Core common Sum peak | 3,36 | 6,63 |
| Core Common Simulation* | 3,63 | 6,90 |
| Calorimeter singles | 3,77 | 5,84 |
| Calorimeter gating 13C | 4,43 | 7,59 |
| Calorimeter Sum peak | 5,08 | 10,55 |
| Calorimeter Simulation* | 5,50 | 10,57 |

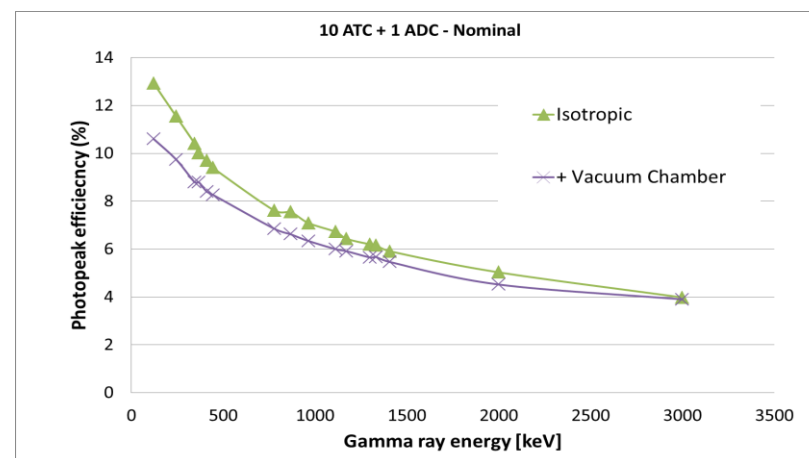
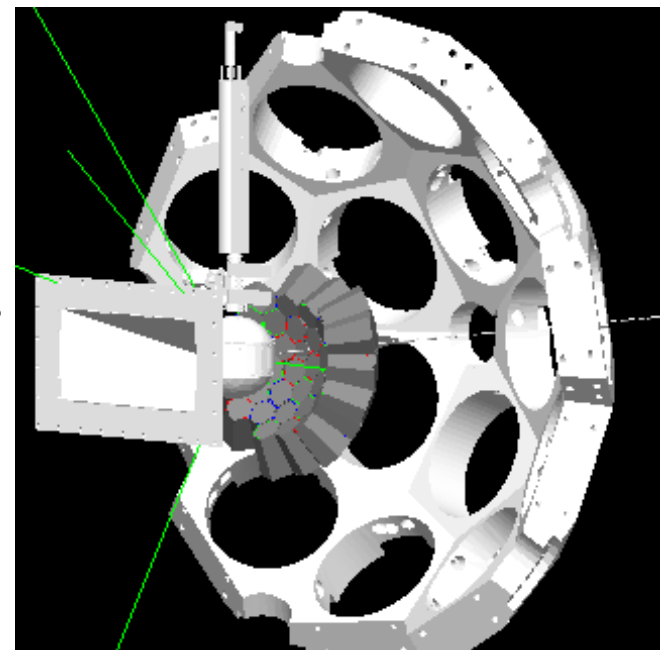
* Simulations performed by M.Labiche



Simulations, Experimental Commissioning and Performance

AGATA Simulations

- Simulated efficiency & P/T curves for GANIL Configurations integrating the target chamber have been performed by M. Labiche. Angular distributions being included.
- Implementation of General Particle Source and the Geometry Description Markup Language (CAD) Modules to the AGATA Code.
- New simulations performed about efficiency and P/T, to be compared to GSI and GANIL Data, including dead layers.
- On-going more realistic implementation of the detector geometry and the discussion on the effect of the segmentation and the fields due to the segmentation and pasivated zones between segments.



Summary and Outlook (I):

- Subsystems of AGATA with no major issues Detectors being provided with new encapsulation. 38 detectors available at GANIL. 3 Detectors to be repaired C003 not under warranty.
- ATC maintenance: ATC1 & ATC9
- Existing sufficient infrastructure to have 13 ATCs and up to 2 ADCs. Procurement of 14th ATC cryostat on-going (Fr).
- Early electronics now very stable, GGP pre-processing cards improved.
- New batch of electronics under production 10 + Spare channels. Aiming to have the electronics available for 2018
- Upgraded NARVAL to the DCOD version. Large Improvements in GEC and Topology Manager. Now better electronics control and GGP under GUI.
- New Spare disk server to insure the experimental activity.

Summary and Outlook (II):

- Infrastructures performing well.
- Progress on characterization, PSA, tracking and Data Analysis also in connection with the started AGATA-GRETINA collaboration.
- Ongoing the 2017 measurements and the preparation for the 2018 campaign.
- Simulations are being improved with more realistic description of our detectors.
- Improving the collaboration with GRETINA, Workshops on Data Analysis and technical team being established.



AGATA MANAGEMENT BOARD AND TEAMS

A. Gadea (Project Manager)
A. Boston, B. Million, A. Korichi, F. Recchia, G. Duchêne, (ASC) and J. Nyberg (ACC).
J. Gerl (LCM-GSI), E. Clement (LCM-GANIL)

AGATA Working Groups

AGATA Teams

**AMB Chairman
Project Manager
A. Gadea**

**Resource
Manager**

| | | | | | |
|--|--|---|--|---|--|
| | 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 | |
| | Data Flow A. Korichi | Hard/Software DAQ Support G. Lalaire | Slow Control & FEE Monitoring E. Legay | | |
| | 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 P.R. John | 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**



Acknowledgement to all the AGATA Collaborators

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

