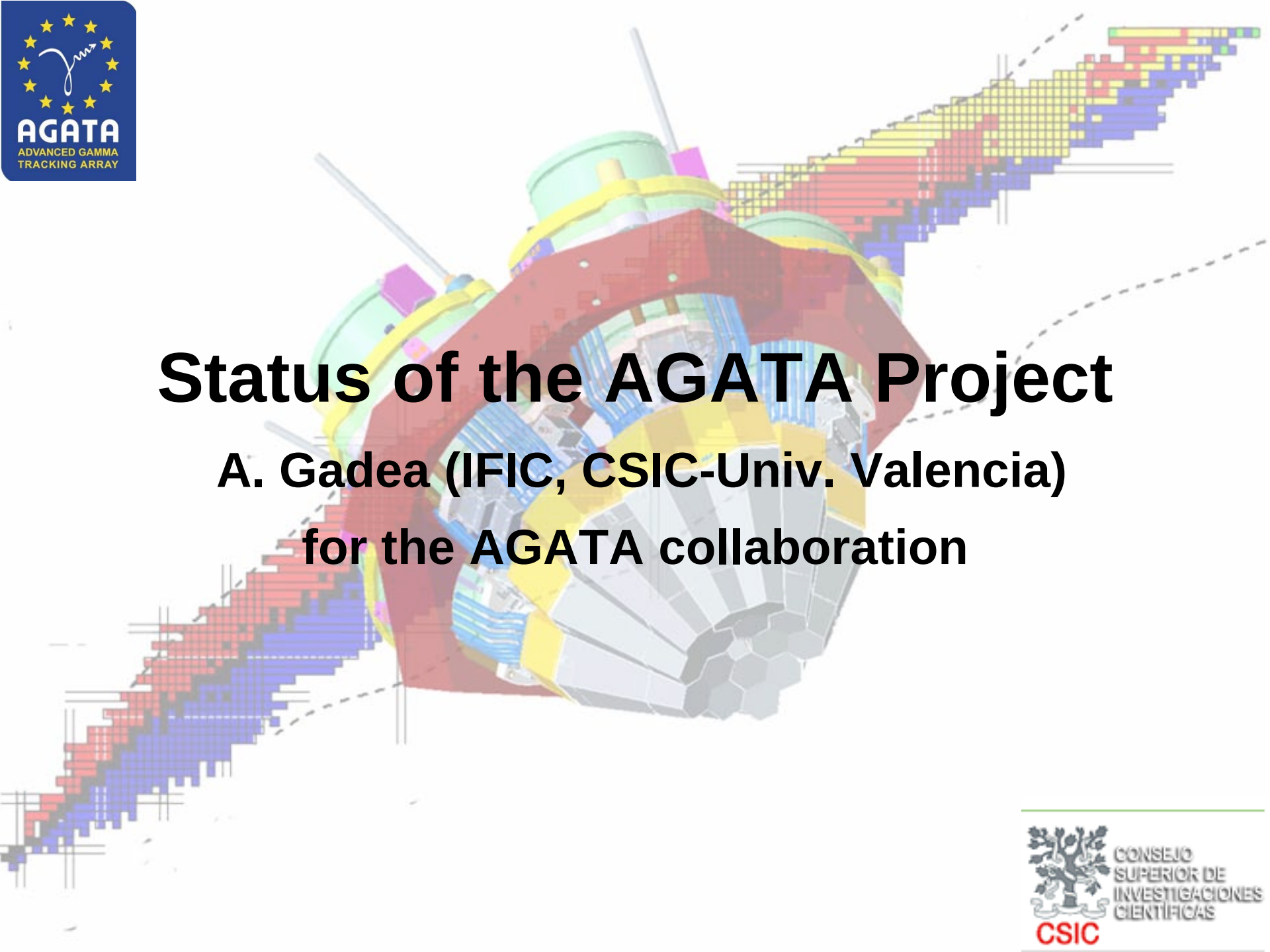


Status of the AGATA Project

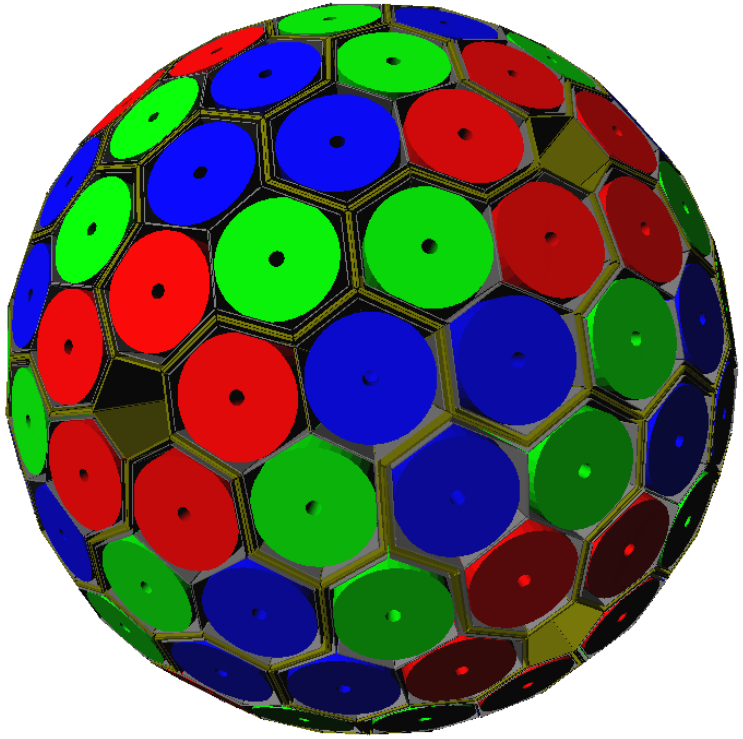
A. Gadea (IFIC, CSIC-Univ. Valencia)

for the AGATA collaboration

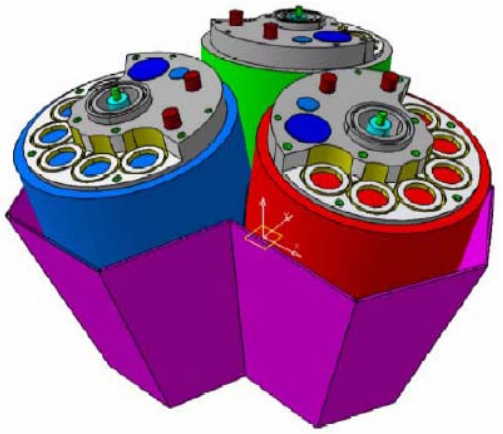
AGATA

(Advanced GAmma Tracking Array)

Encapsulation



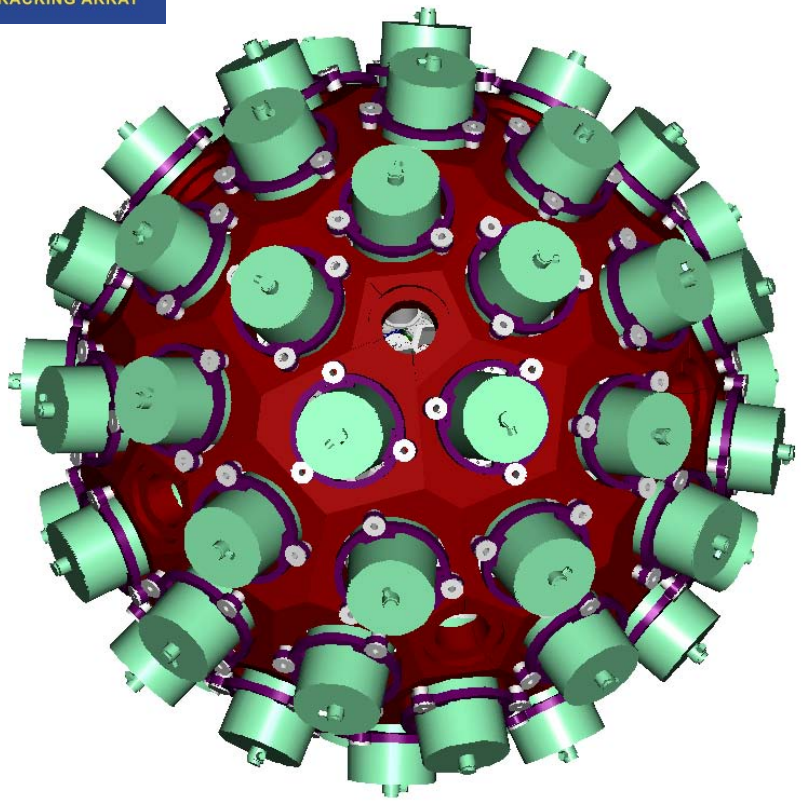
180 hexagonal crystals	3 shapes	
60 triple-clusters	all equal	
Inner radius (Ge)	23.5 cm	
Amount of germanium	362 kg	
Solid angle coverage	82 %	
36-fold segmentation	6480 segments	
Singles rate	~50 kHz	
Efficiency:	43% (M_γ=1)	28% (M_γ=30)
Peak/Total:	58% (M_γ=1)	49% (M_γ=30)



AGATA

(Advanced GAmma Tracking Array)

Encapsulation



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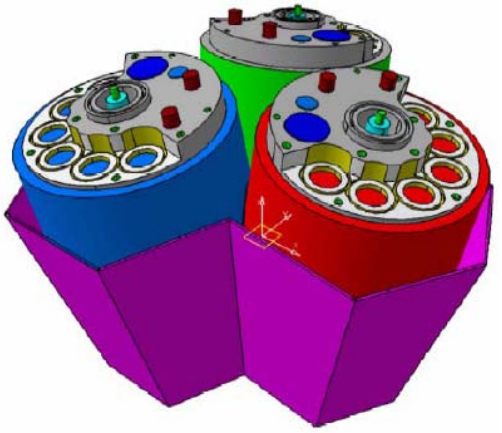
Probably the most challenging project in the NS community

6660 high-resolution digital channels, High throughput DAQ

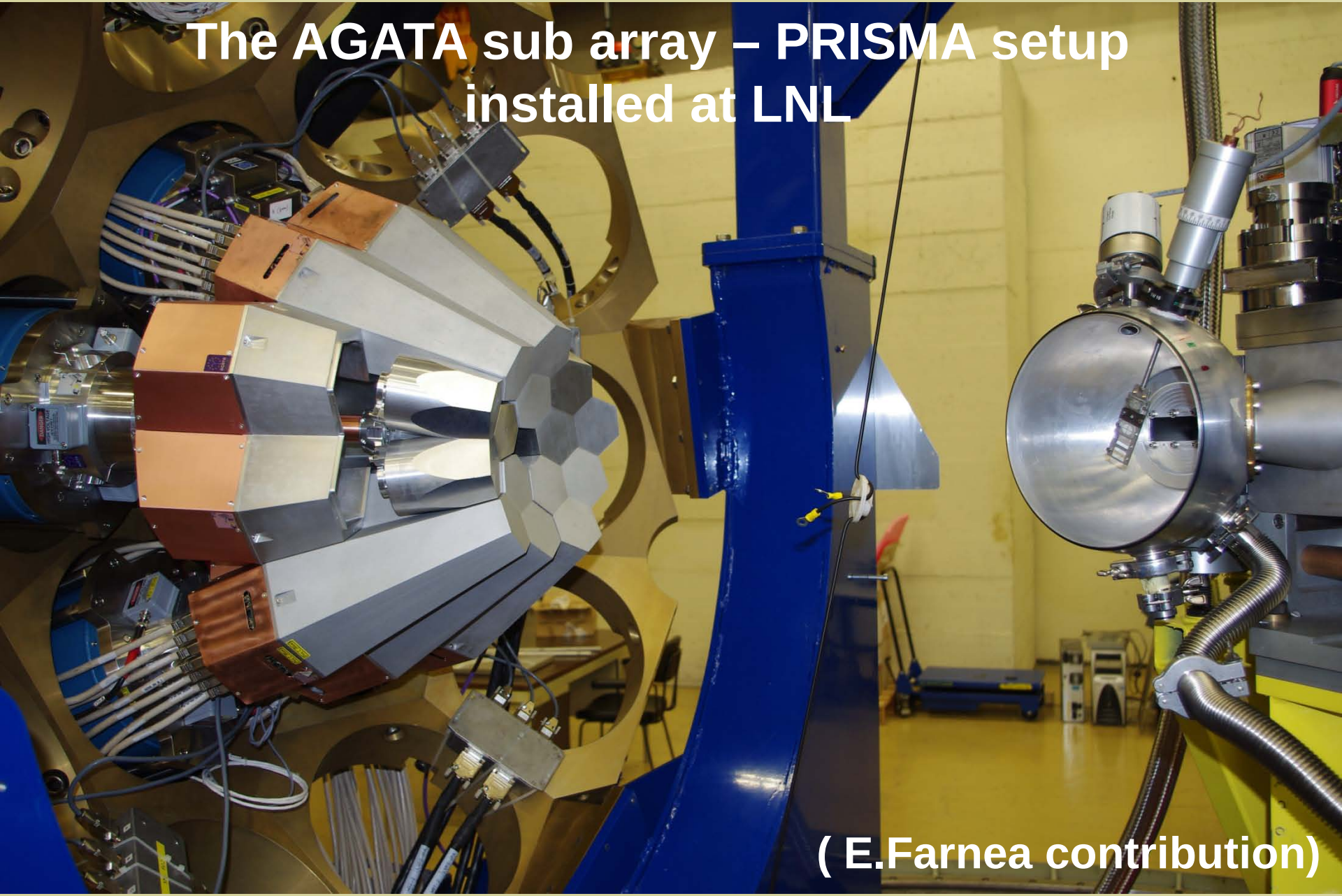
Pulse Shape Analysis → position sensitive operation mode

γ-ray tracking algorithms to achieve maximum efficiency

Specifications reached→ position resolution, rate >50kHz



The AGATA sub array – PRISMA setup installed at LNL

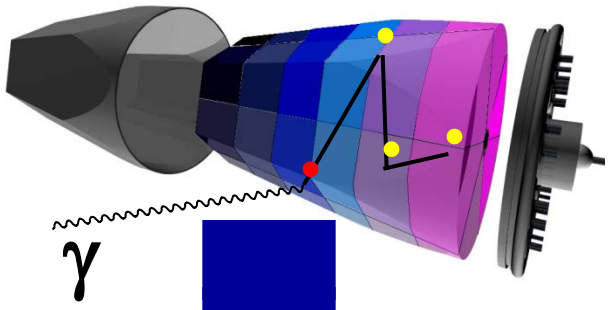


(E.Farnea contribution)

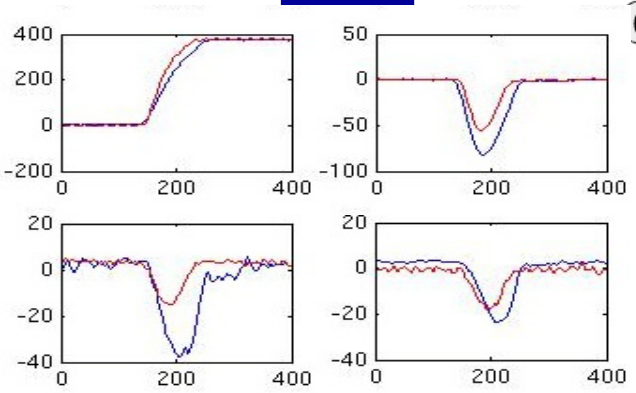
Concept of γ-Tracking

AGATA
ADVANCED GAMMA TRACKING ARRAY

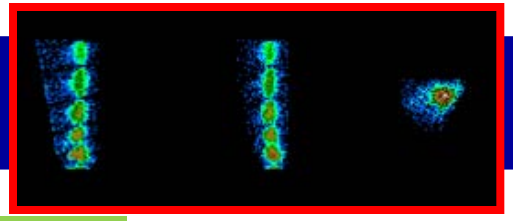
Highly segmented HPGe detectors NOVEL PRE-AMPS



Synchronized digital electronics record and process the segment signals DIGITIZERS + PRE-PROCESSING



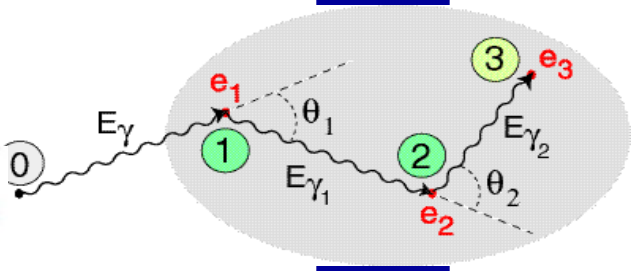
Pulse Shape Analysis to de-convolute the recorded waves DAQ PSA - FARM



Identified interaction points

$(x,y,z,E,t)_i$

Reconstruction of interaction tracks (tracking algorithms on interaction points) DAQ TRACKING-FARM



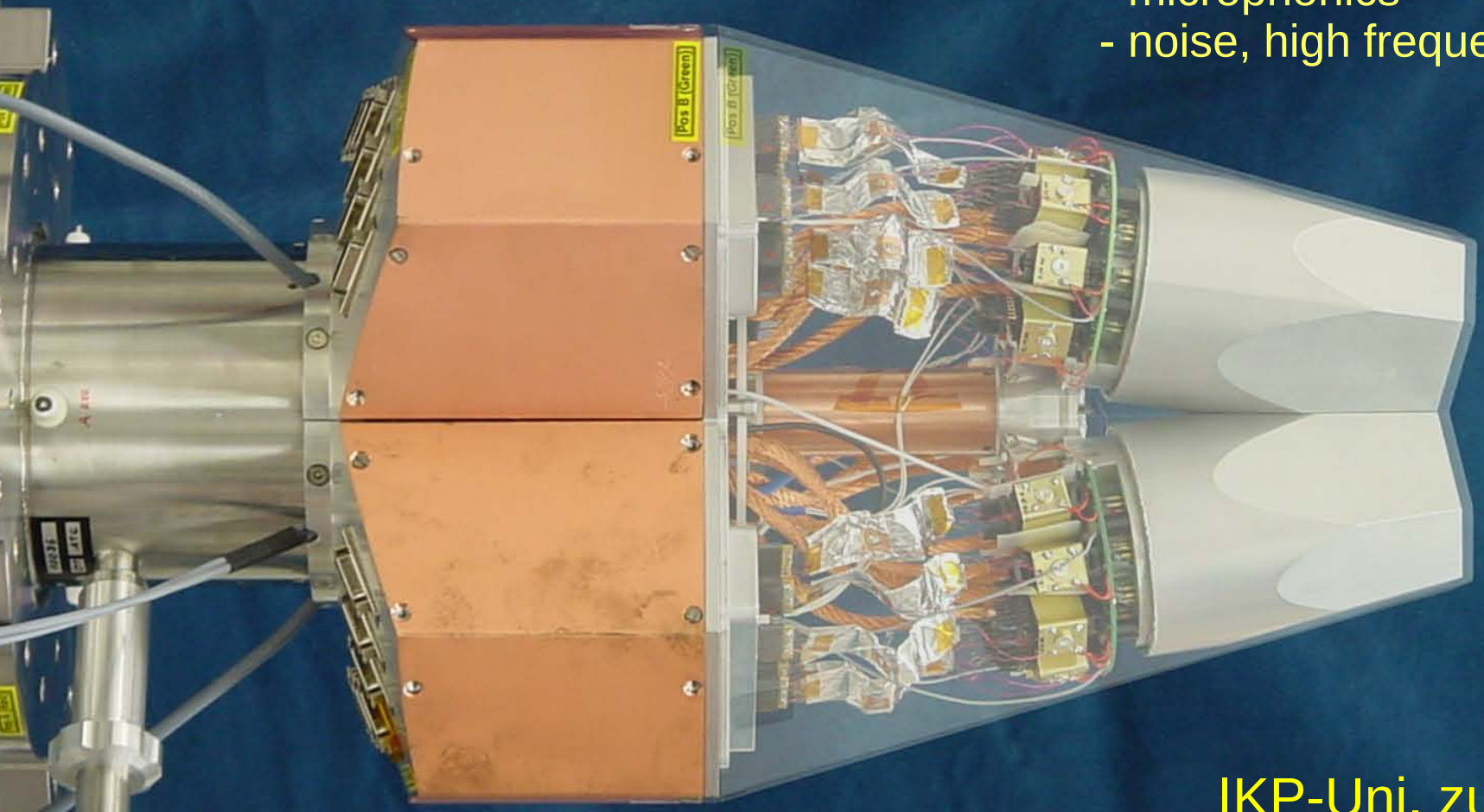
On-line reconstruction of γ-rays

Asymmetric AGATA Triple Cryostat

- integration of 111 high resolution spectroscopy channels
- cold FET technology for all signals

Challenges:

- mechanical precision
- heat development
- LN2 consumption
- microphonics
- noise, high frequencies



IKP-Uni. zu Köln

AGATA Capsules Deliveries

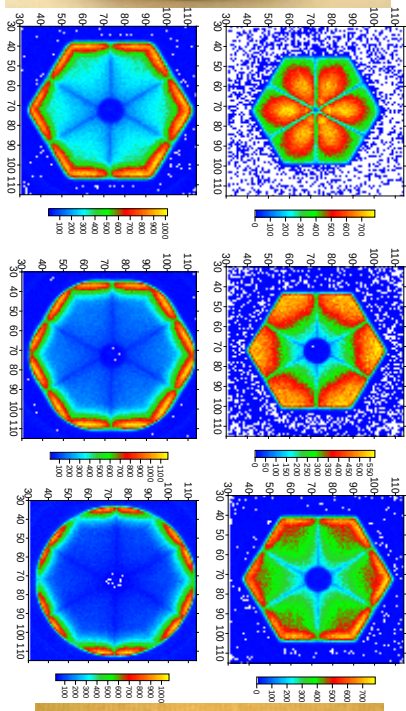
S/N attribution for AGATA detectors						
S/N	Owner	Date order registration	Date due delivery	Status	Comment	Canberra ref.
A006	Italy			OK	ATC4	
B006	Italy			Repair	CAT fail	
C006	Italy			Repair	CAT ok	
A007	Italy (INFN Legnaro)	21/02/2008		Repair	CAT fail	146057
B007	Germany (IKP Köln)	05/12/2008		Fab		149843
C007	Germany (IKP Köln)	05/12/2008		CAT		149843
A008	Germany (IKP Köln)	05/12/2008		CAT		149843
B008	Germany (IKP Köln)	05/12/2008		Fab		149843
C008	UK (Liverpool)	08/04/2009		Fab		151694
A009	UK (Liverpool)	08/04/2009		Fab		151694
B009	UK (Liverpool)	08/04/2009		Fab		151694
C009	France (CEA Saclay)	13/07/2010		Fab		157438
A010						
B010	Italy (INFN Milano)	29/12/2009		Fab		154902
C010	Spain		End of 2011			
A011						
B011	Italy (INFN Legnaro)	24/05/2010	29/10/2011	Fab		156819
C011						
A012						
B012	France (IPHC)	29/10/2009		Fab	initially A010	154132
C012						
A013						
B013	France (CEA Saclay)	13/07/2010		Fab		157438
C013						

- 17 asymmetric capsules ordered phase 1
- Severe problems with the delivery schedule (only 2 in the last year)
- Detectors are produced, encapsulation problems to be solved

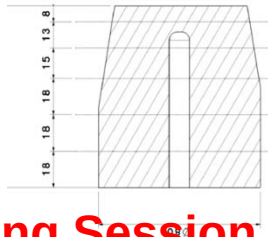
AGATA
ADVANCED GAMMA TRACKING ARRAY

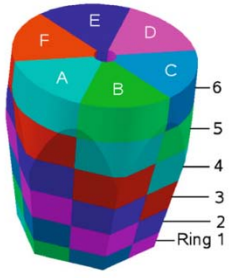
Detectors

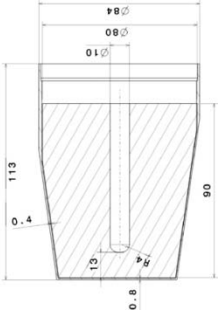
- 3 symmetric early detector R&D phase
- 15 asymmetric capsules R&D phase
- 17 asymmetric capsules ordered phase 1
- 14 operational now
- Delivery 17 capsules (total 32) due 2011
- 9 triple cryostats ordered 4(5) operational
- 5 test cryostats available
- Double cryostats for radioactive beams
- Detailed characterization of the detectors



IKP Cologne University
Liverpool University
CEA-Daphne Saclay
INFN-Milano, INFN-Padova

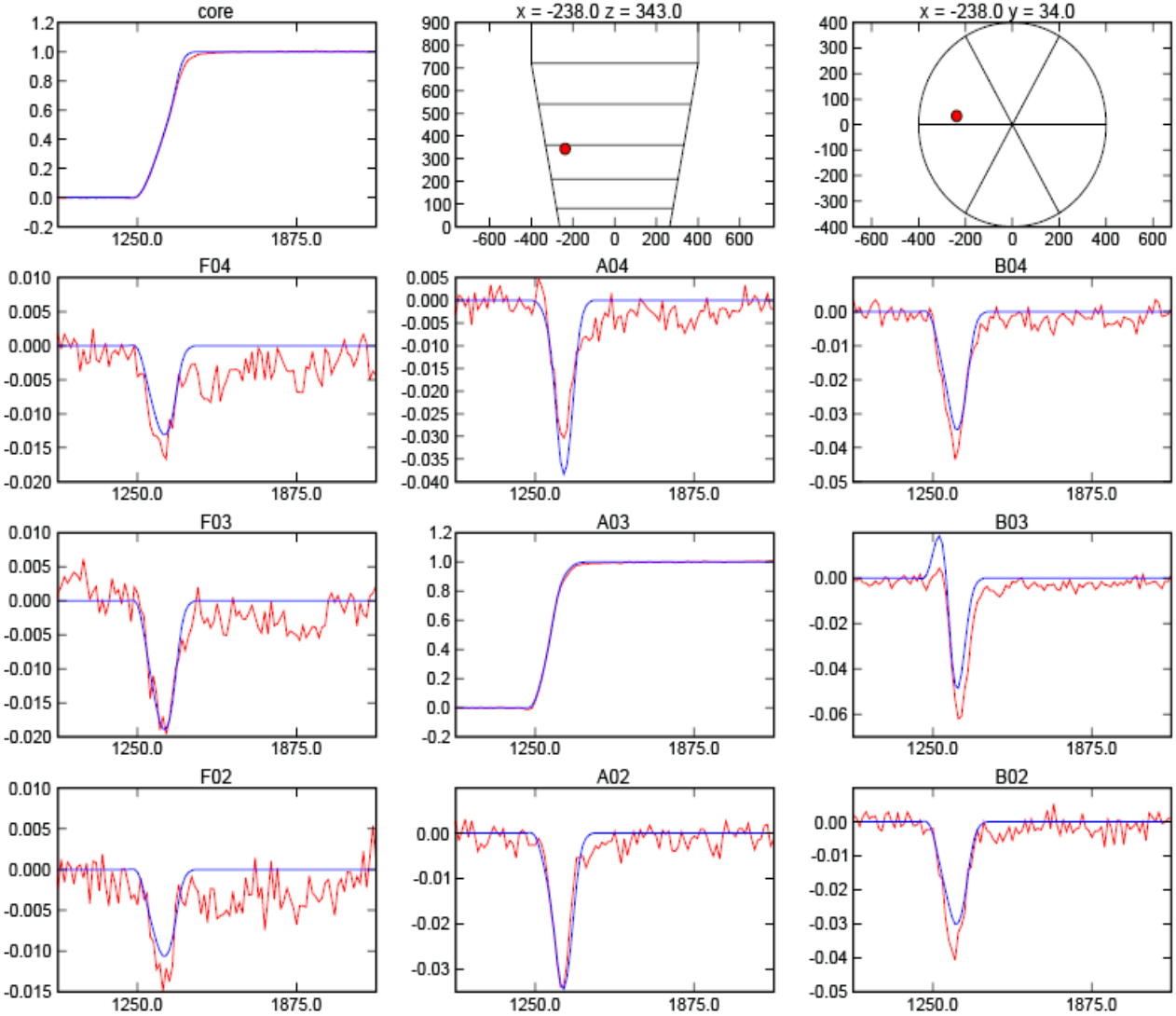


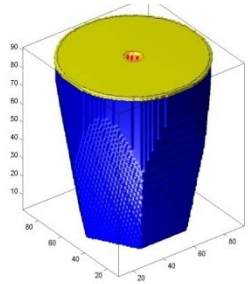




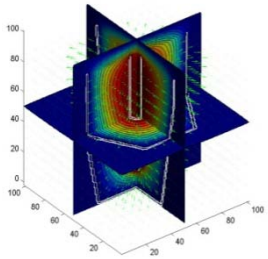
AGATA week Wednesday Morning Session

Scan data vs. detector simulation

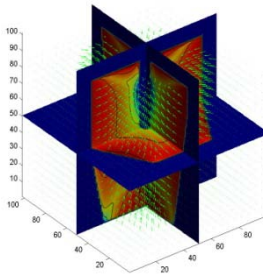




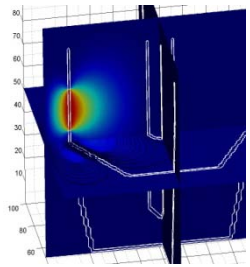
Geometry



Electric field

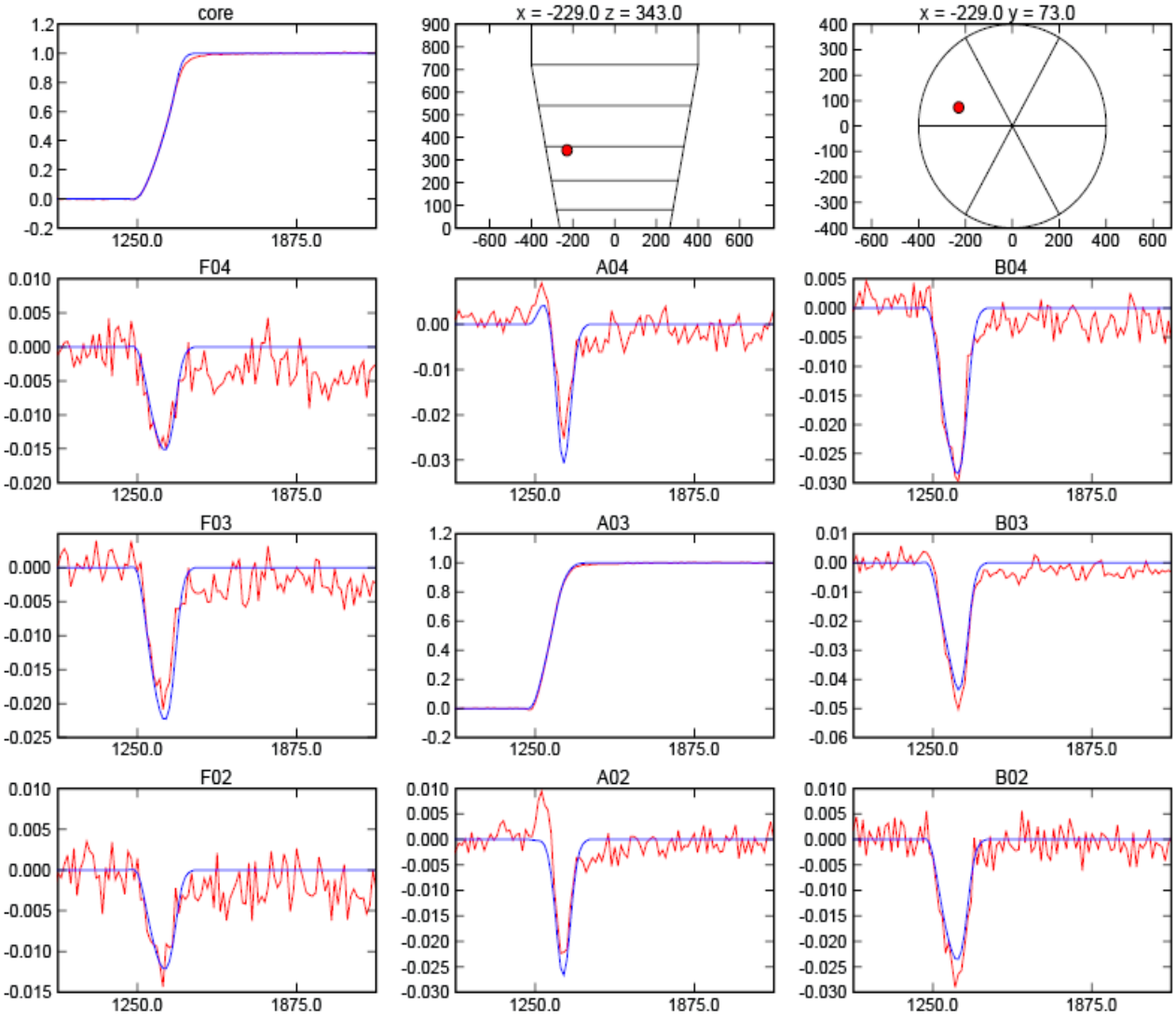


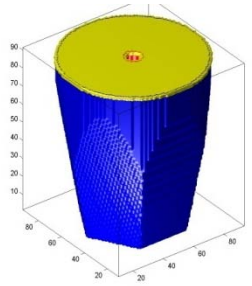
Drift velocities



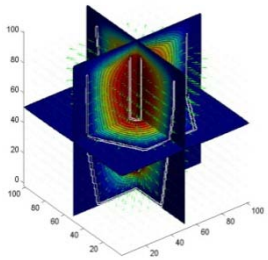
Weighting potential

Scan data vs. detector simulation

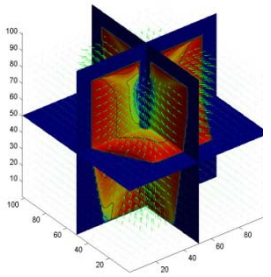




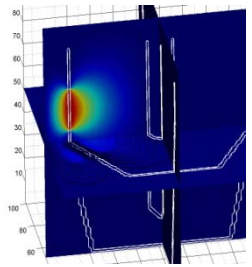
Geometry



Electric field



Drift velocities



Weighting potential

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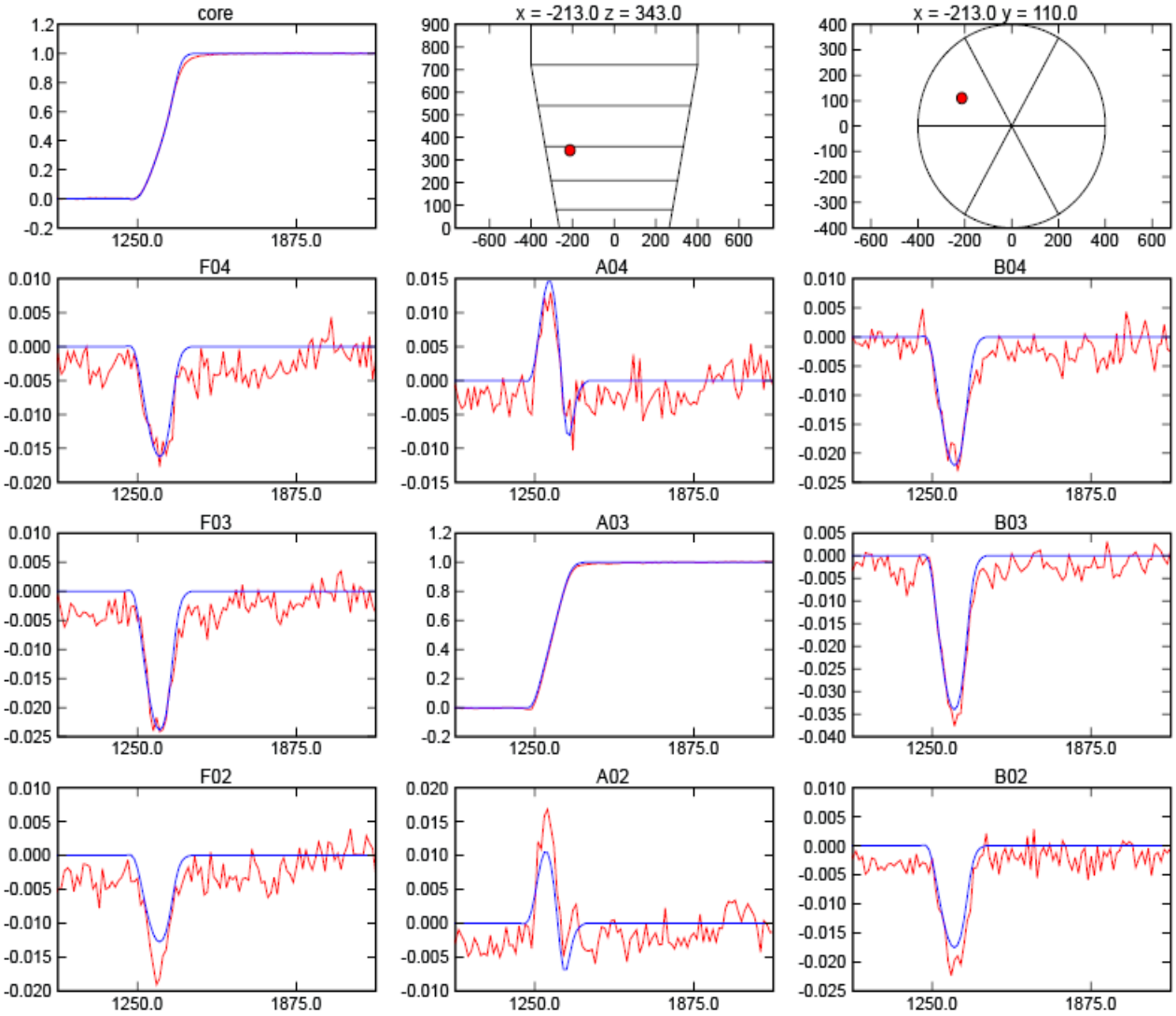
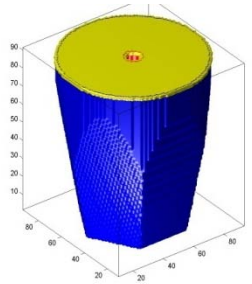
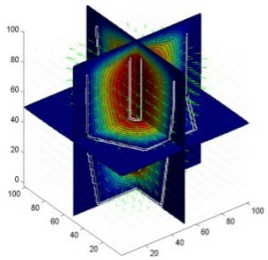




Geometry



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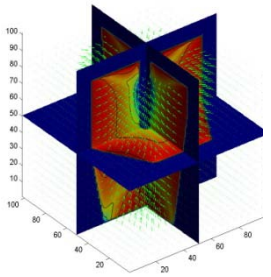

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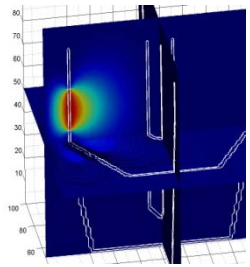
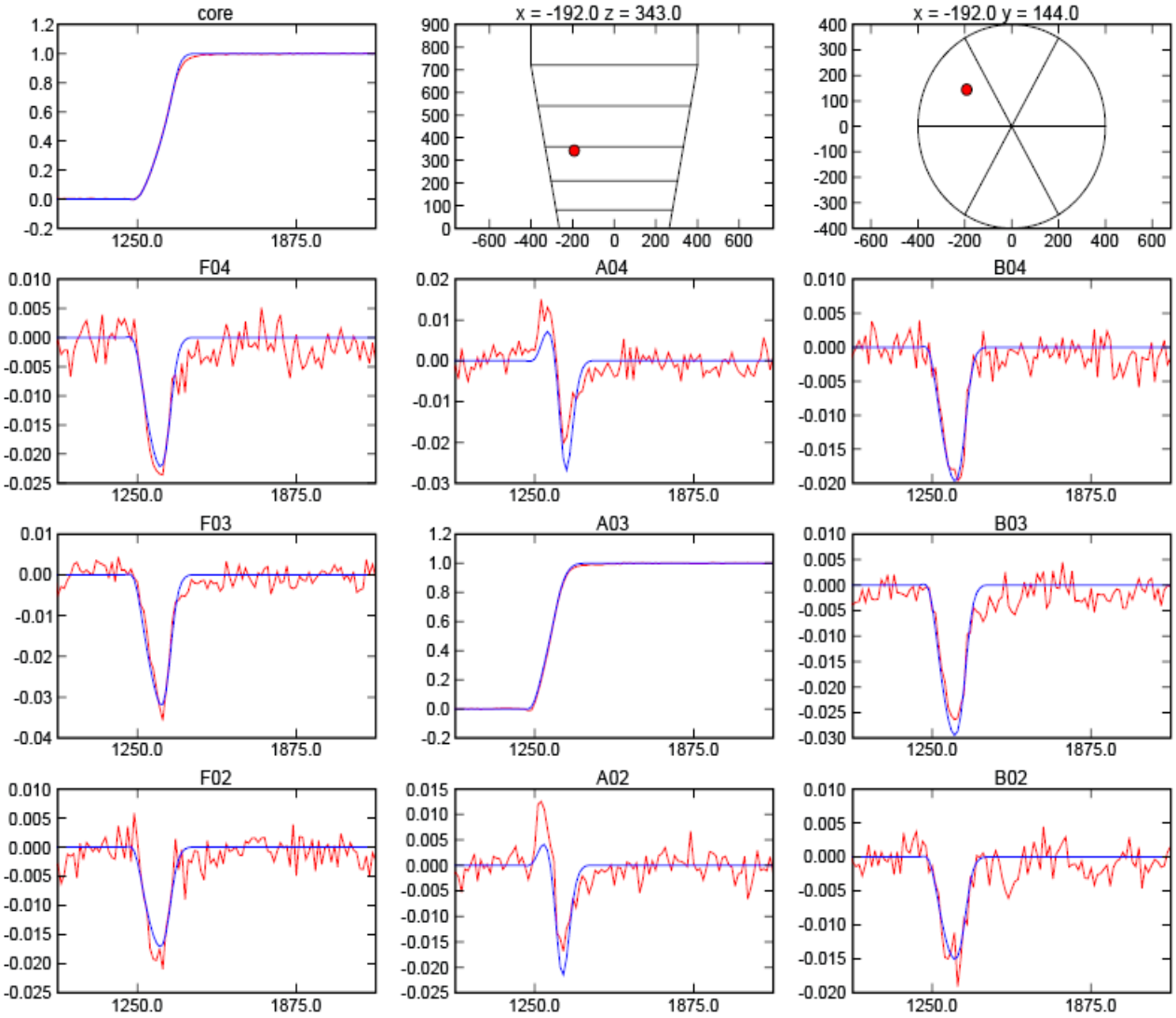
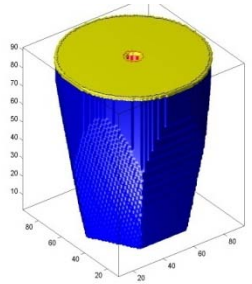


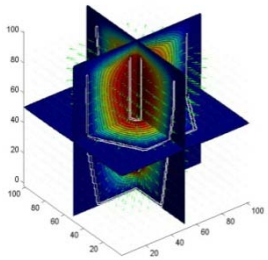
Weighting potential

Scan data vs. detector simulation





Geometry



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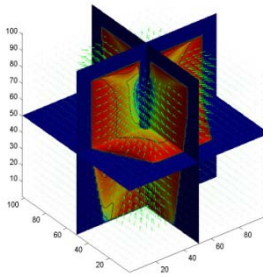
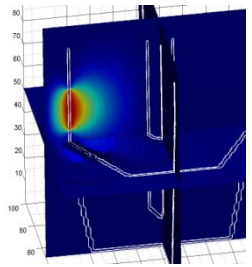
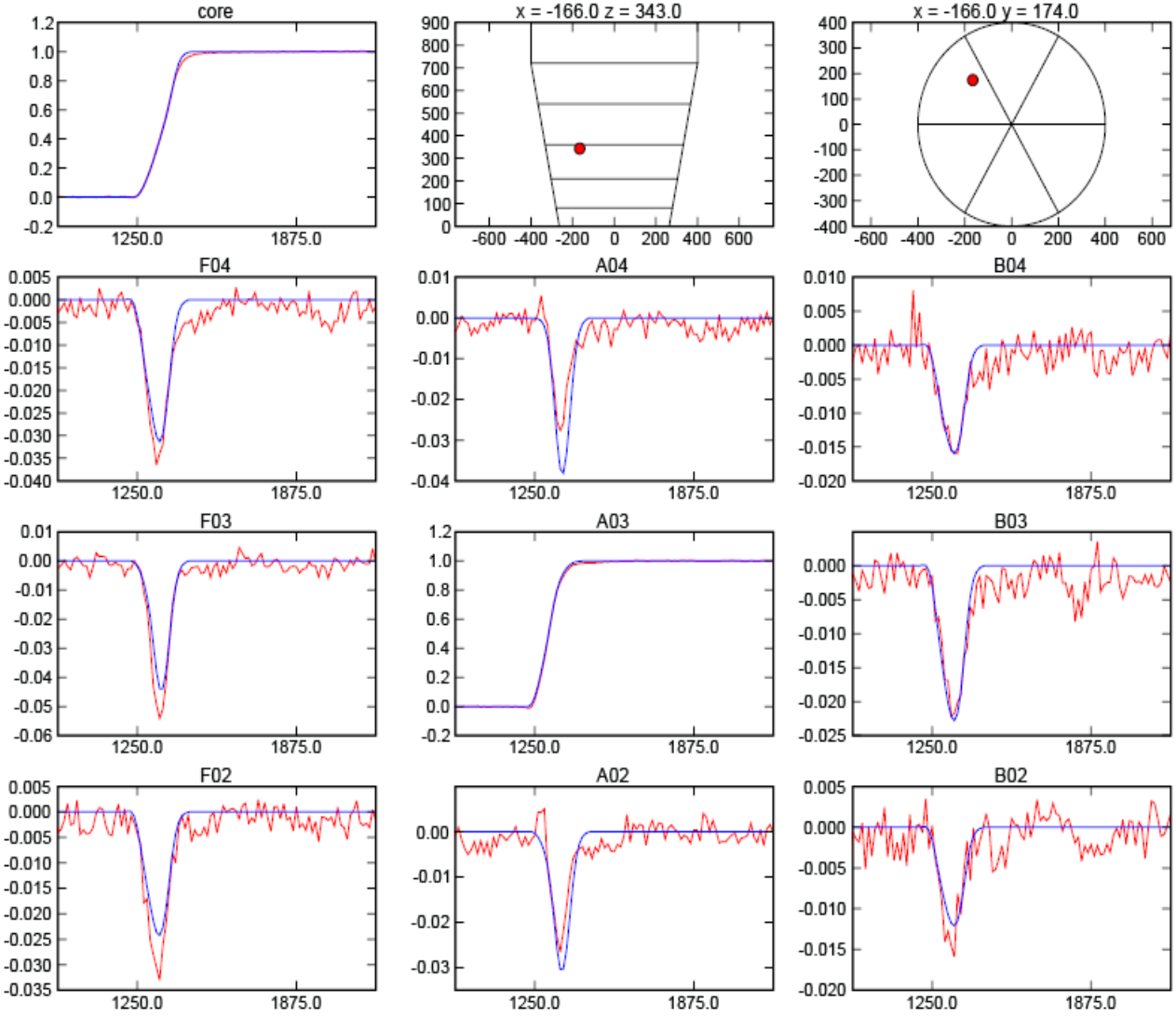


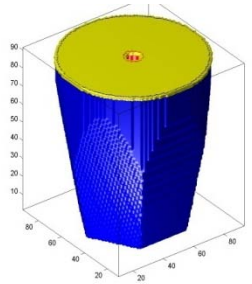
Drift velocities



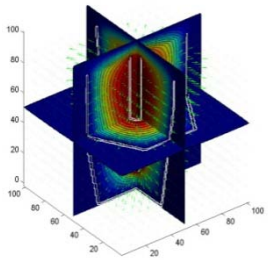
Weighting potential

Scan data vs. detector simulation

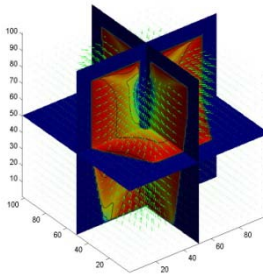




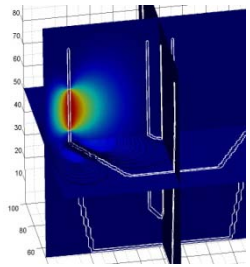
Geometry



Electric field



Drift velocities



Weighting potential

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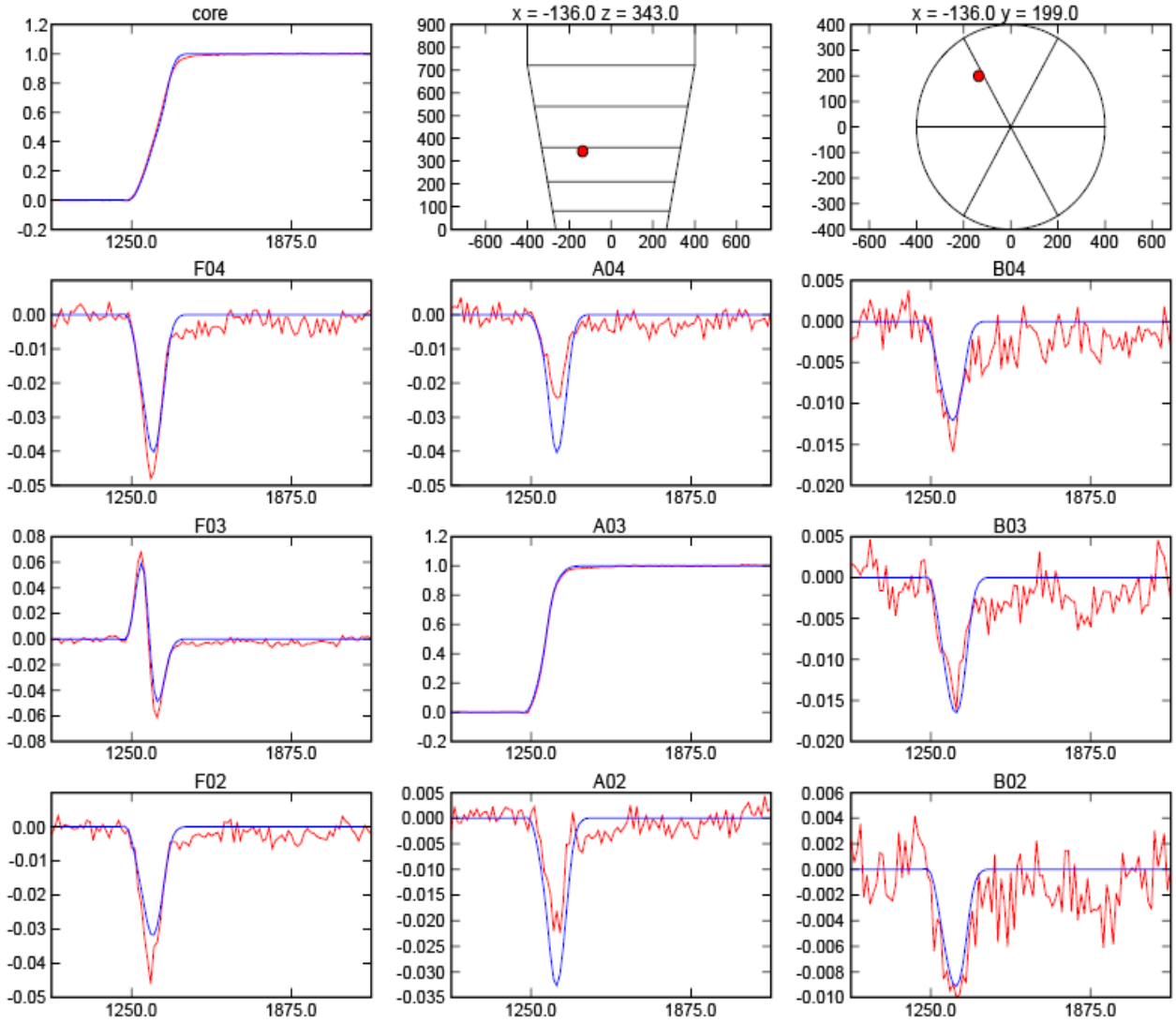
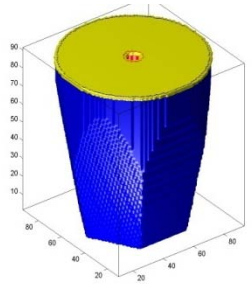
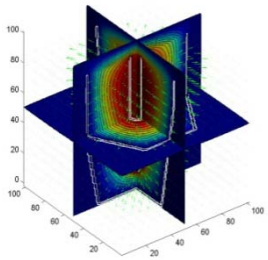
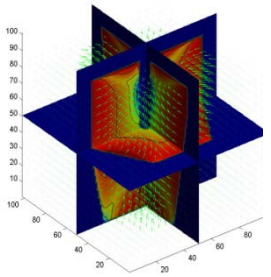




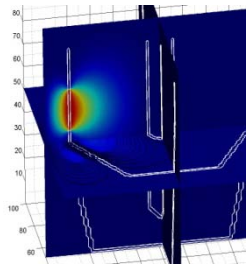
Geometry



Electric field



Drift velocities



Weighting potential

New Signal Basis calculation ongoing,
excellent overall agreement between simulation and scan data

Structure of Electronics and DAQ

Digital preamplifier concept

Fast 1st Level Trigger

Other Detectors

Diff. Fast-reset-TOT
INFN-MI/GANIL/KÖLN

75.5db SNR
IPHC/Liverpool/
STFC

12.2 ENOB

200MB/s/
segment

GL Trigger

Clock
100 MHz
T-Stamp

Other
detectors

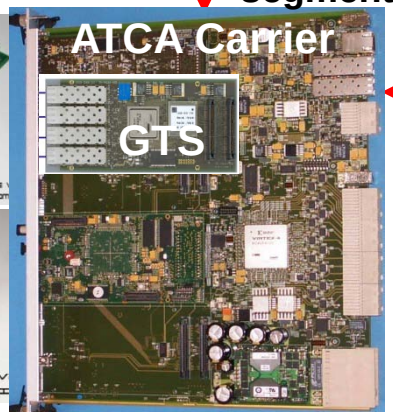
GTS
INFN-Pd

Detector
Level

PSA
FARM

Core +
36 seg.

100MB/s/
detector



HIGH THROUGHTPUT
PRE-PROCESSING
CARRIER / MEZZANINES
IPNO/CSNSM/INFN-Pd

Global Level

DAQ-NARVAL
RUN- & SLOW-Control

IPNO/CSNSM/
LNL/GANIL/IFJ-PAN

EVENT
BUILDER

TRACKING

Control,
Storage…

Other
detectors

interface to GTS, merge time-stamped data into event builder, prompt local trigger from digitisers

AGATA DAQ: NARVAL

AGATA Crystal

AGATA Crystal

Pre Processing

NARVAL Producer
Front End Electronics

Pulse Shape Analysis

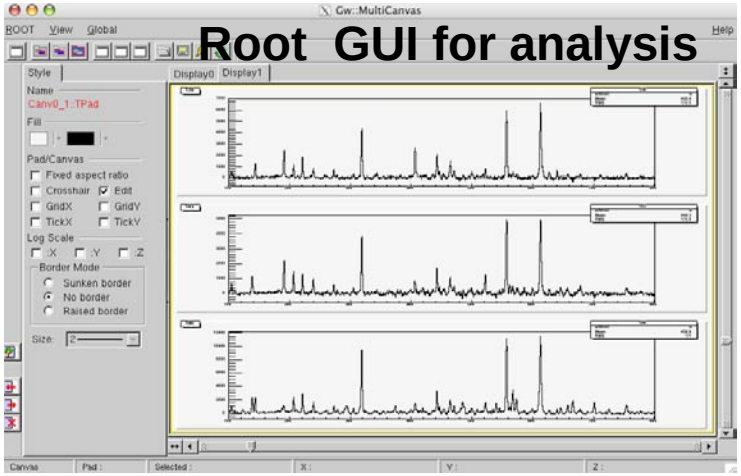
Event Building

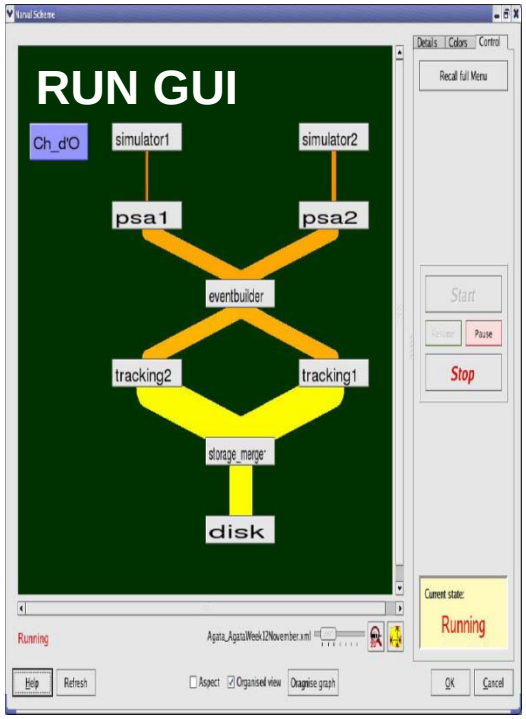
NARVAL Producer
Complementary detectors

Tracking

Consumer

Advanced Data Flow system developed in ADA





IPN-Orsay, CSNSM-Orsay
INFN-LNL,GANIL,
IFJ-PAN-Crakow,
IPN-Lyon

AGATA week Wednesday Morning Session

Front-End Electronics and Data Acquistion

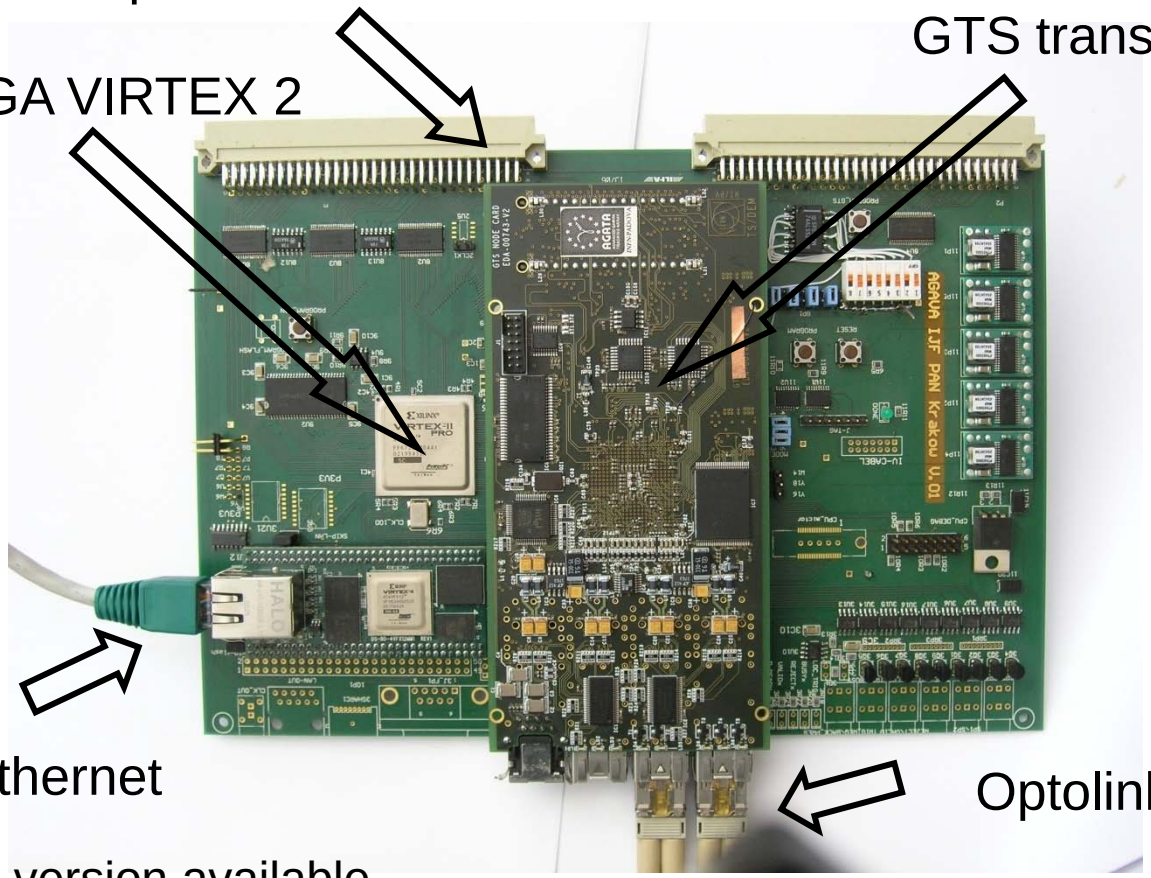
- Preamplifiers by GANIL and INFN-Milano available
- Digitizers available for 29 capsules end of 2011
- Pre-processing available for 25 capsules end of 2011
- Next version (1) of the VHDL firmware under commissioning
- Due to obsolescence and possibility of higher integration → R&D on the Digitizer and Pre-Processing elements of FEE. Future Digital-Preamplifier or Processing-Preamplifier
- Trigger and Synchronization (GTS). Development Completed. To be used in EXOGAM2, NEDA, etc
- NARVAL DAQ (Algorithm implementations, storage, GUI). Several improvements done. New versions Slow Control
- Ready for 5 x ATC and 5 x A2C by the end of 2011
- Commitment: all 32 detectors instrumented by end 2012

INFN-Padova, IPN-Orsay, CSNSM Orsay, IPHC Strasburg, Uni. Liverpool, STFC Daresbury INFN-Milano, GANIL, IKP-Köln INFN-LNL, IFJ-PAN Cracow

FEE: AGATA week Tuesday Afternoon Session

AGAVA VME card

IFJ-PAN, Kraków & INFN-Milano



Improved firmware version available

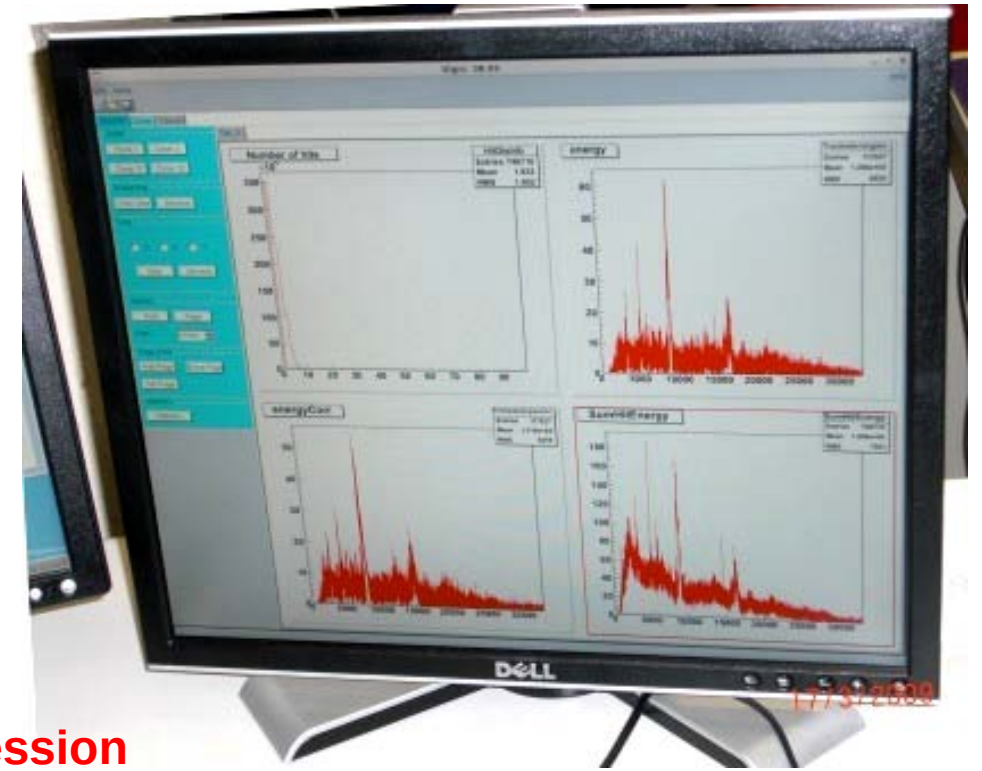
AGATA week Monday Afternoon Session

On-line and Off-line data Analysis

Root based analysis software, PRISMA included 06/2010

- ^{30}Si@70MeV + ^{12}C

11:42
17/03/2009

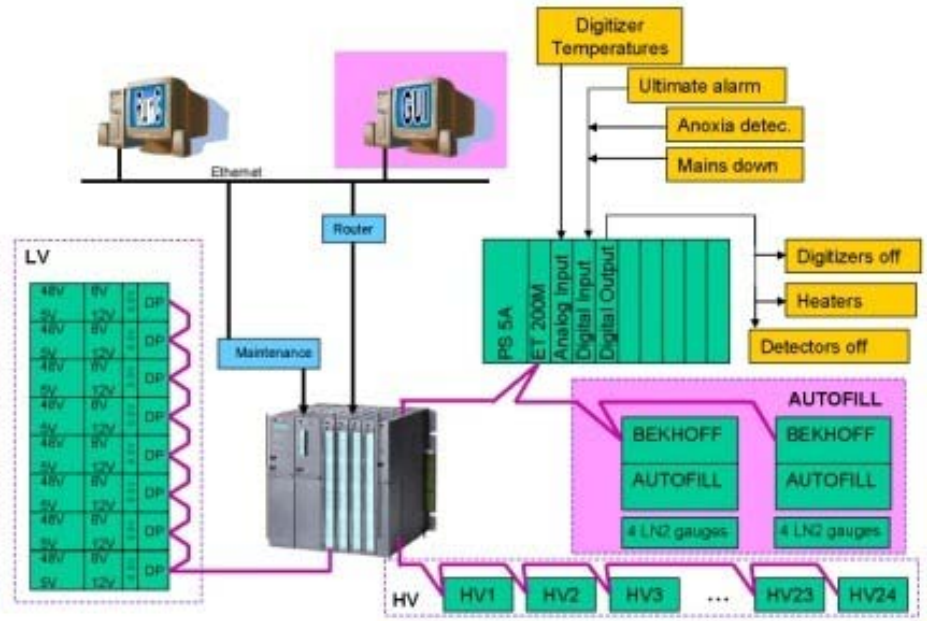


- **PSA**
- **Tracking**
- **Data Analysis**

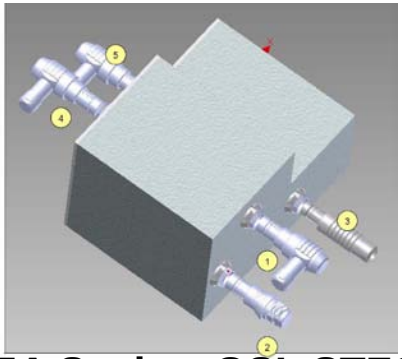
IPN-Lyon
CSNSM Orsay
INFN-Padova

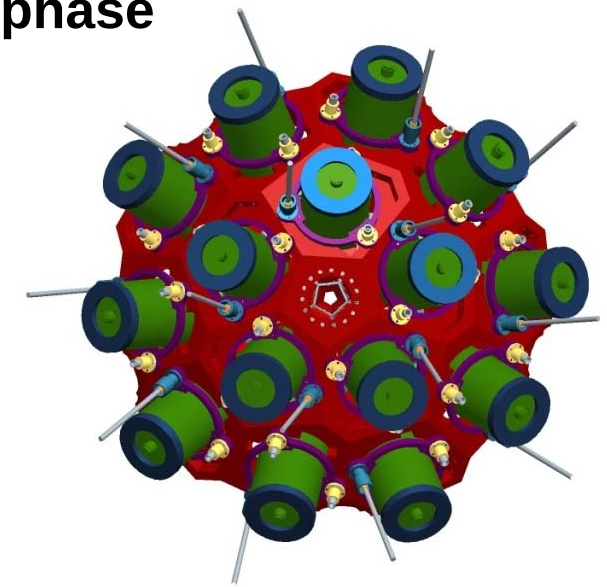
AGATA week Wednesday Afternoon Session

Infrastructure and Detector Support System



Low Voltage: Upgrade 48V modules readout, 14 modules soon ready
High Voltage: several problems ongoing discussion with ISEG
Control cryogenic & LN2 cycle: Fully working except VCC. Energency allarm system by CEA-Saclay to be installed early december
Mechanical design proceeding for the GSI phase

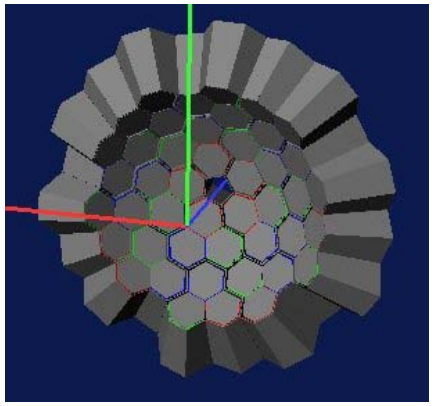


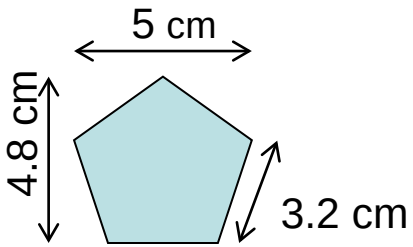


CEA Saclay, GSI, STFC-Daresbury, JYFL-Jyvaskyla, IPHC-Strasbourg, GANIL

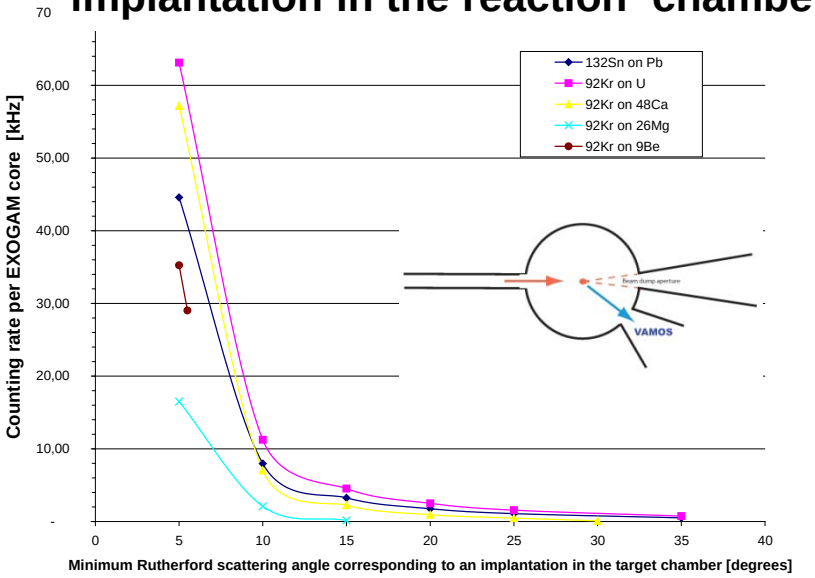
AGATA week Tuesday Morning Session

AGATA Double Cluster for Intense and In-Flight production RIBs

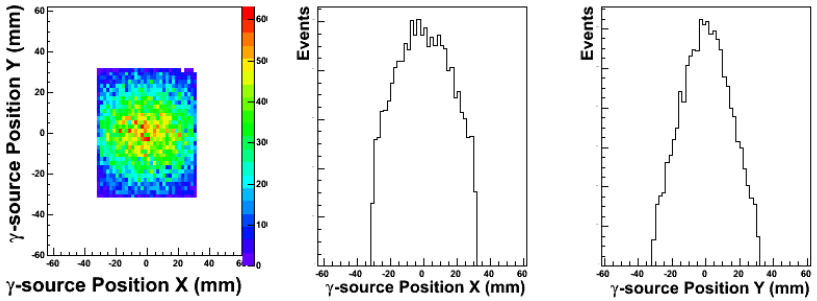




Rates at the EXOGAM Ge array due to implantation in the reaction chamber



Design of AGATA done to optimize the solid angle coverage. Modifications required on the beam input/output to fulfill requirements of RIB's Facilities



GSI FRS Beam $FWHM_x$ = 6 cm $FWHM_y$ = 4 cm

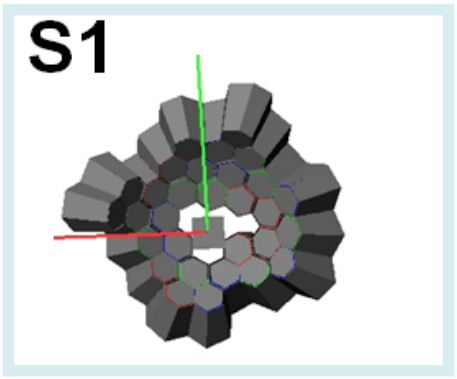
SPIRAL2

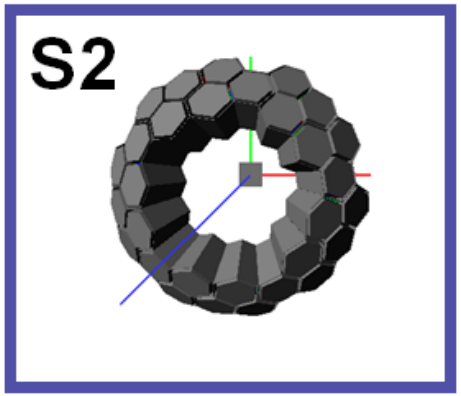
- min. Beam-dump angle 10° to 15 °
- 8 cm to 12 cm required at AGATA nominal distance

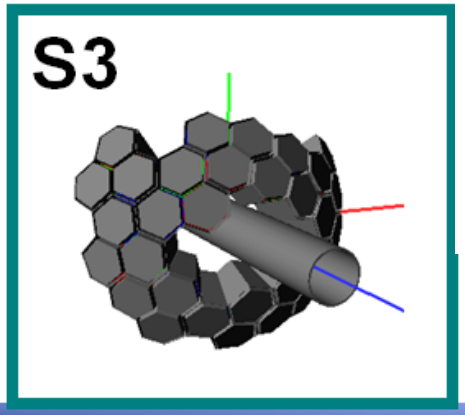
FRS / SFRS

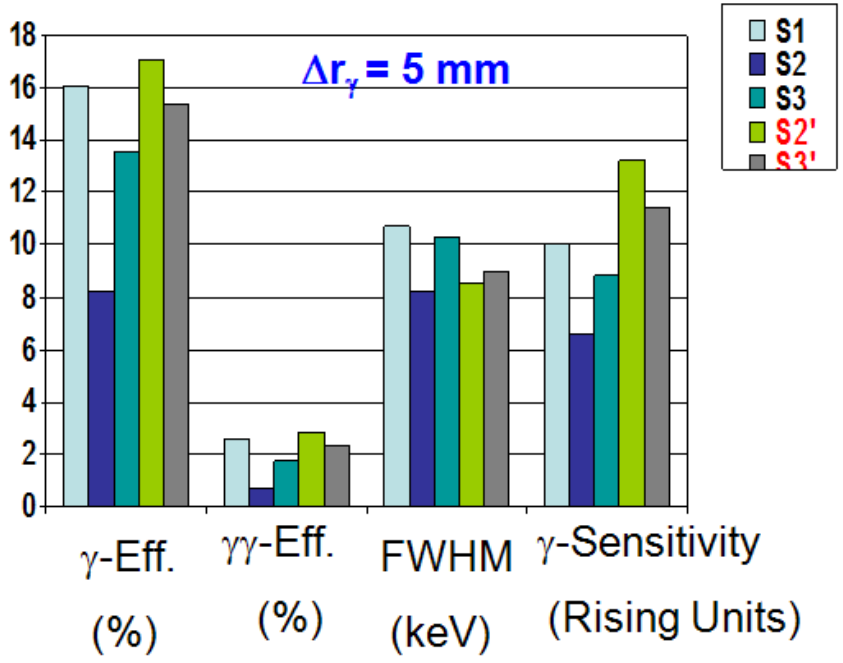
- 10cm to 12cm beam-line required after secondary target

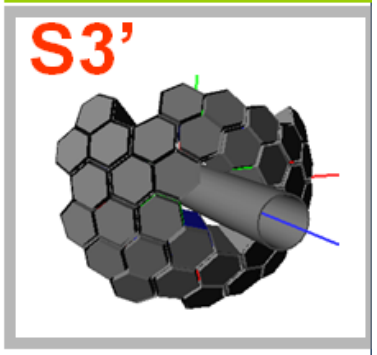
Simulations for the GSI set-up



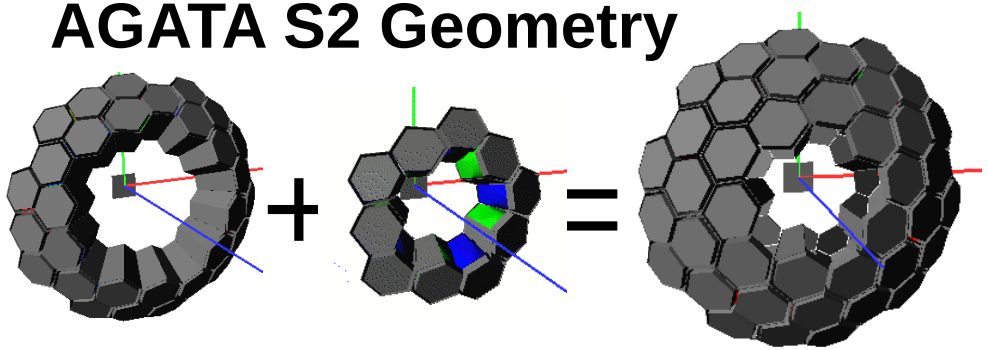








AGATA S2 Geometry

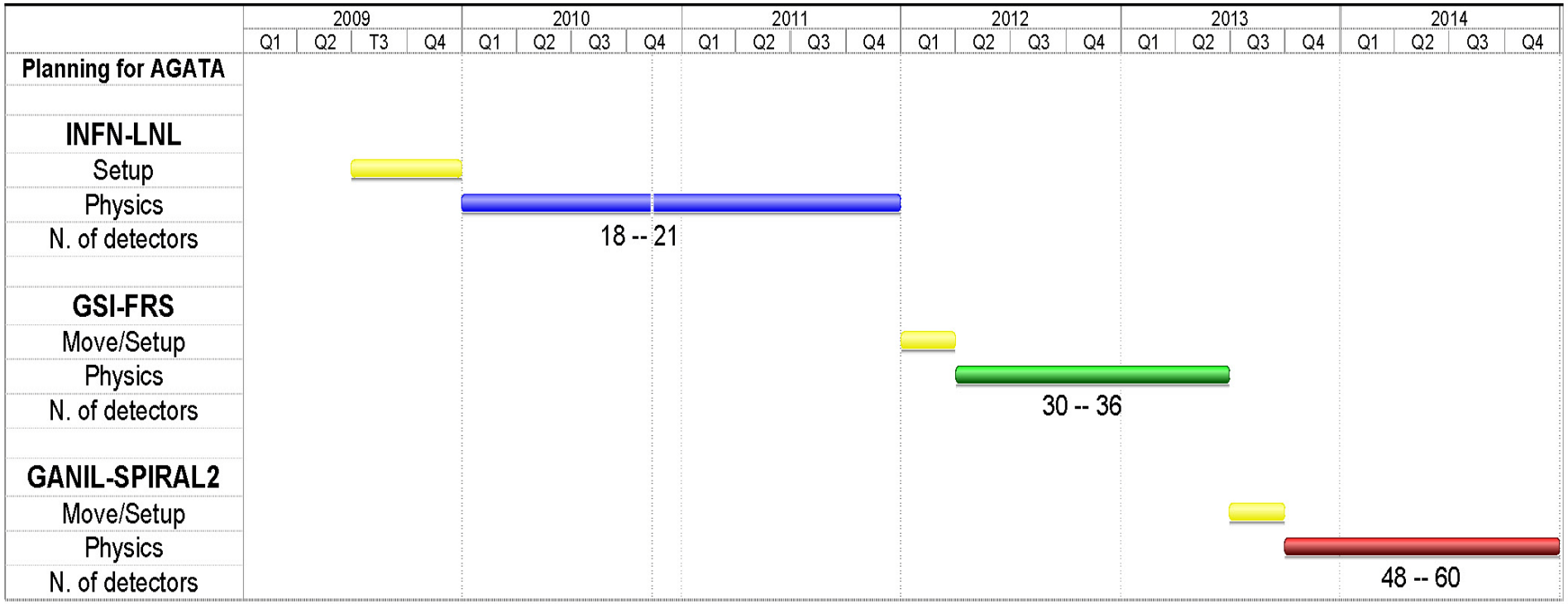


10 ATC + **5** **double** Cluster

AGATA week Thursday GSI Session

Shell Geometries performance comparison: Summary

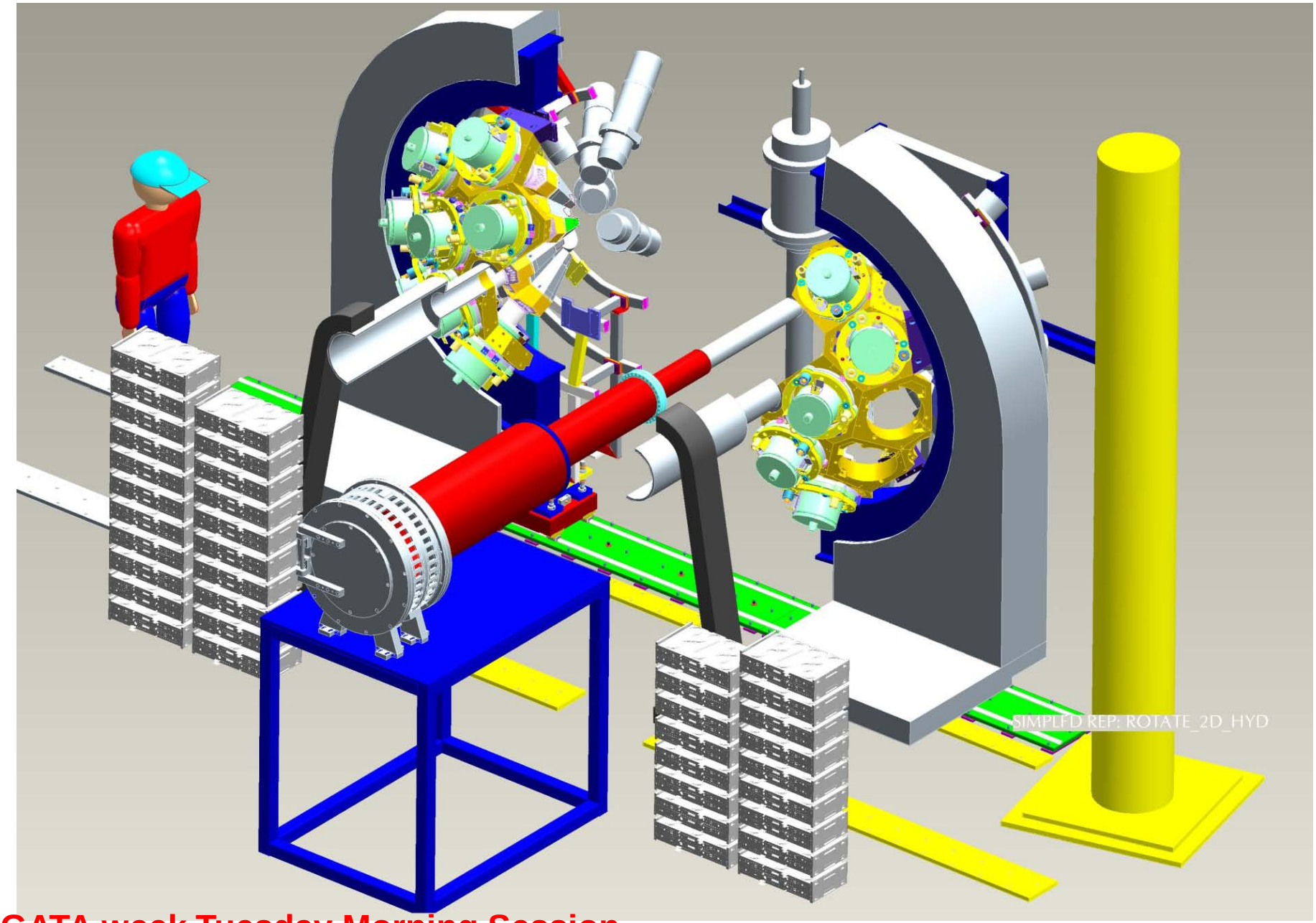
Current planning



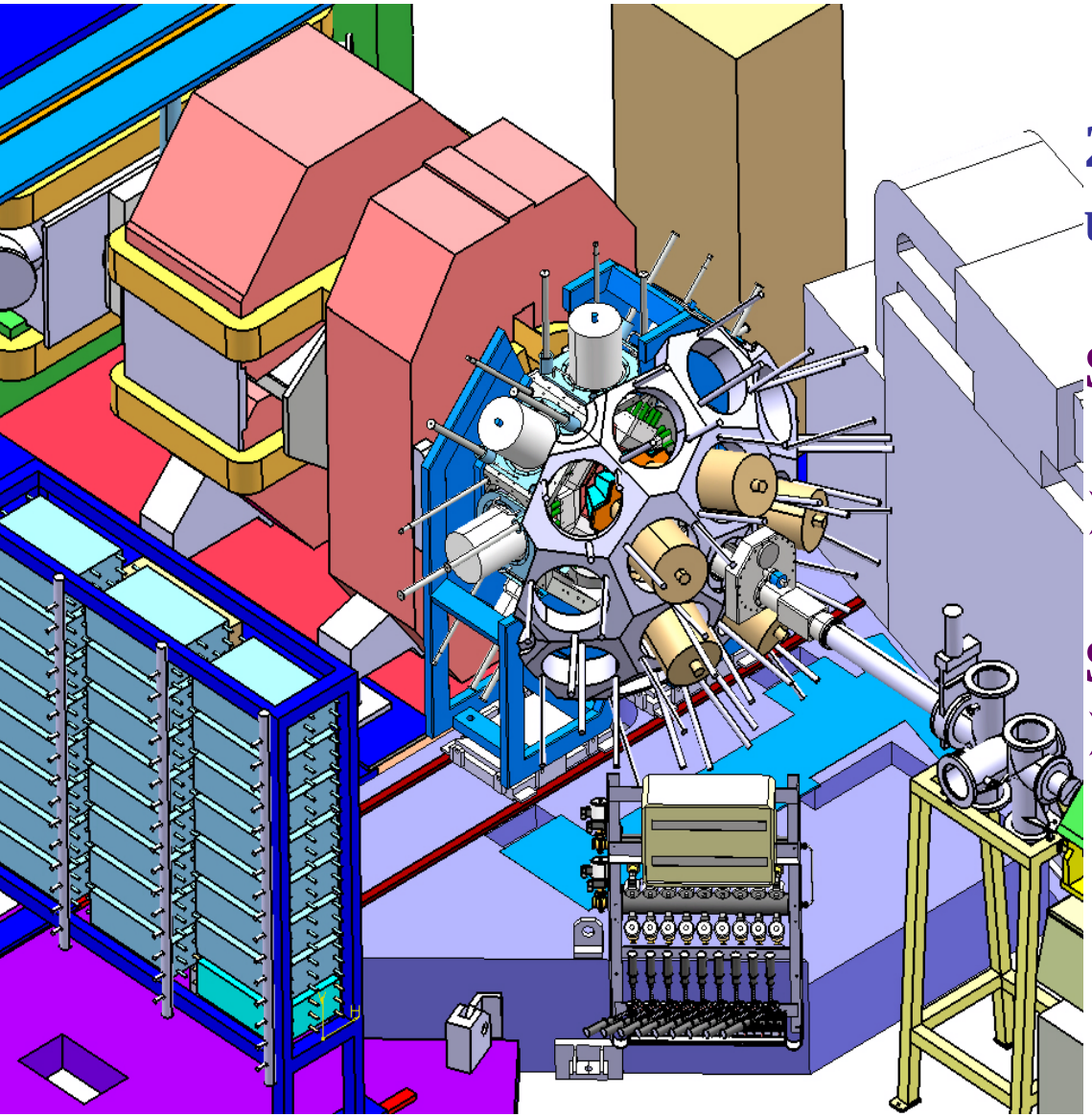
Proposed deployment of AGATA for the experimental campaigns at the three AGATA host Laboratories

AGATA week Thursday and Friday Session

AGATA at PRESPEC GSI-FRS



AGATA at GANIL



2013/14 :

up to 15 triple clusters at VAMOS

Stable ions (C-U) @ 5-100A.MeV

- **Deep-inelastic & fission products**

SPIRAL2 RIBs: 3-20A.MeV

- **Coulomb & inelastic excitation, transfer reactions, fusion-evaporation**

AGATA MANAGEMENT BOARD and AGATA TEAMS

AMB Chairman
Project Manager
A.Gadea

Deputy Project Manager
(Resource Manager)
G.Duchêne

Technical Coordinator
(Engineering Advisor)

AGATA W.G.

Detector Module	Front-end Electronics	Data Flow	Data Analysis	Infrastructure. Comp. Det.	Performance and Simulation
P.Reiter	(P.M.)	A.Korichi	A.Boston	E.Farnea	J.Nyberg

AGATA TEAMS

Detector & Cryostat	PreAmplifier	Data Flow and Algorithm Implementation	Data Analysis & TRACKING	Mechanical Infrastructure	Performance	Compatibility EMC, Interfacing
Detector Characterisation PSA Data Base	Digitizer	Run Control : DAQ Monitoring &Administration	GRID	Detector array Infrastructure	Experimental Commissioning	Specification control
Detector Acceptance and testing	Pre-processing		PSA Algorithm Development	Elec. and DAQ Integration	Physics & exp. Simulation	Quality Control
R & D on gamma Detectors & Applications	Global Trigger and Synchronization			Mechanical Integration		Documentation
	Slow Control & Front-End Monitoring			Complementary Detectors		

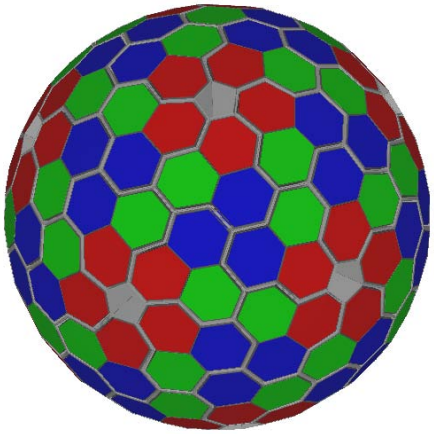
Implementation of the AGATA Deputy Project Manager role: The resource manager

- Produce an expenditure rolling plan to ensure the sustained construction and operation of AGATA over the next two year period.
- Suggest to the AMB the purchasing distribution of the AGATA subsystem series production over the institutes AGATA Collaboration in agreement with the available funds.
- Follow and facilitate funds transfers between countries when needed,
- Suggest to the AMB an annual running cost statement performed with the local campaign managers. This should include a statement of the current position and a request for running costs for the next calendar year and an estimate for future years.
- Collect and record the capital expenditure figures from the partners and the production of an annual capital financial statement.
- The AMB will propose the ASC to appoint a member to work-out the conditions to fulfil to build a common AGATA financial platform in order to enable grouping of orders. The AGATA Deputy Project Manager will be the liaison of the AMB on this task.
- The AGATA Deputy Project Manager, together with the relevant AGATA subsystem AMB member and when required by the Project Manager, will also be in charge to negotiate with the main providers of the AGATA project
- Participate to the Project Definition on expenditure/financial aspects,

Implementation of the AGATA Technical Coordinator role: the Engineering adviser

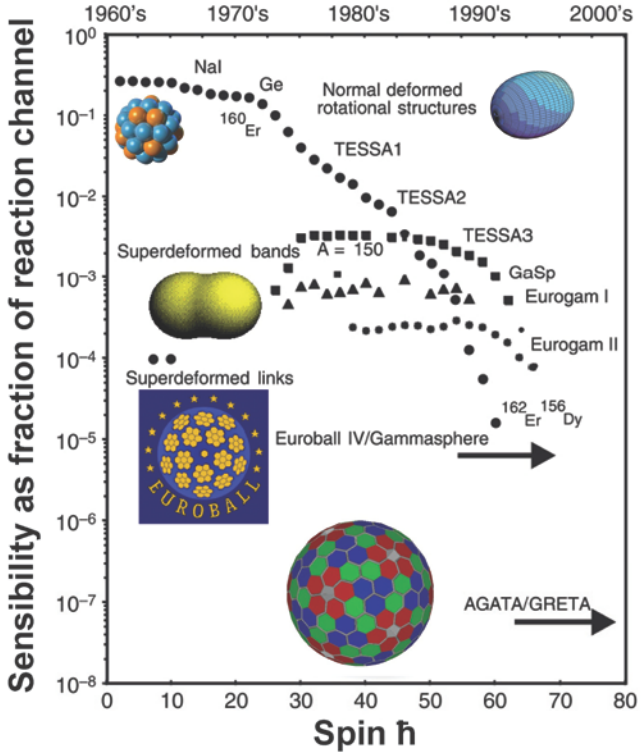
- Participate to the Project Definition on technical/ engineering aspects
- Check the Project Definition tasks lists and milestones
- Advice on the adequacy of commitments and dedicated efforts
- Manage and advice on quality control issues,
- Suggest actions to increase the reliability and robustness of the AGATA subsystems
- Recommend actions in case of delays on fulfilling milestones
- Survey overall technical issues, within the setup elements and in the host laboratories
- Ensure that there is appropriate documentation on all subsystems,
- Advice the AMB on technical issues and engineering aspects.
- To contribute to define, in an early stage of the subsystem R&D phases, the criteria for a technical choice, especially if more than one group are involved.

Implementation AGATA Performance and Simulations task:



- **AGATA Performance and Simulations teams:**
  - **Simulations**
  - **Experimental commissioning**
  - **Performance evaluation**

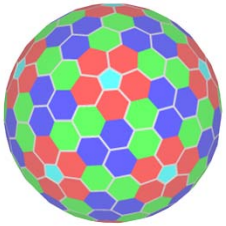
Coordination of all simulation activities within the AGATA collaboration. Simulations of the physics (event generators), of realistic experimental conditions and of complementary instrumentation coupled to AGATA for past, present and future experimental campaigns. Comparisons with real experiments.
Coordination and planning of AGATA commissioning experiments needed for each major new experimental condition. Responsible for the evaluation and reporting of the results of the commissioning experiments.
Coordination of the performance of AGATA along the scientific campaigns. Define goals for the performance numbers of AGATA for each experimental campaign.
Evaluate and report the performance numbers on a regular basis.



Summary:

- **AGATA is a challenging project in many aspects: Detectors, Front-End Electronics, etc…**
- **AGATA has proved to work within specifications during the commissioning and early experiments of the LNL physics campaign**
- **The experience acquired in the phase 0 will allow now to develop a new versions of several subsystems (especially FEE) with higher integration keeping the outstanding performance**
- **The development of Cryostats to host two Capsules is necessary for High Intensity as well as for In-Flight RIB Facilities.**
- **The new Management board commits to maintain and promote the AGATA high quality standards in the new R&D and production phases**

The AGATA Collaboration



>12 Countries
>40 Institutions

Bulgaria:	**Univ. Sofia**
Denmark:	**NBI Copenhagen**
Finland:	**Univ. Jyväskylä**
France:	**GANIL Caen, IPN Lyon, CSNSM Orsay, IPN Orsay, CEA-DSM-DAPNIA Saclay, IPHC Strasbourg, LPSC Grenoble**
Germany:	**GSI Darmstadt, TU Darmstadt, Univ. zu Köln, TU München**
Hungary:	**ATOMKI Debrecen**
Italy:	**INFN-LNL, INFN and Univ. Padova, Milano, Firenze, Genova, Napoli,**
Poland:	**NINP and IFJ Krakow, SINS Swierk, HIL & IEP Warsaw**
Romania:	**NIPNE & PU Bucharest**
Sweden:	**Univ. Göteborg, Lund Univ., KTH Stockholm, Uppsala Univ.**
Turkey:	**Univ. Ankara, Univ. Istanbul, Technical Univ. Istanbul**
UK:	**Univ. Brighton, CLRC Daresbury, Univ. Edinburgh, Univ. Liverpool, Univ. Manchester, Univ. West of Scotland, Univ. Surrey, Univ. York**
Spain:	**IFIC Valencia, IEM-CSIC Madrid, LRI Univ. Salamanca**

Thanks to the Local Organizers from IPN-Lyon

Thanks to all you for making possible AGATA