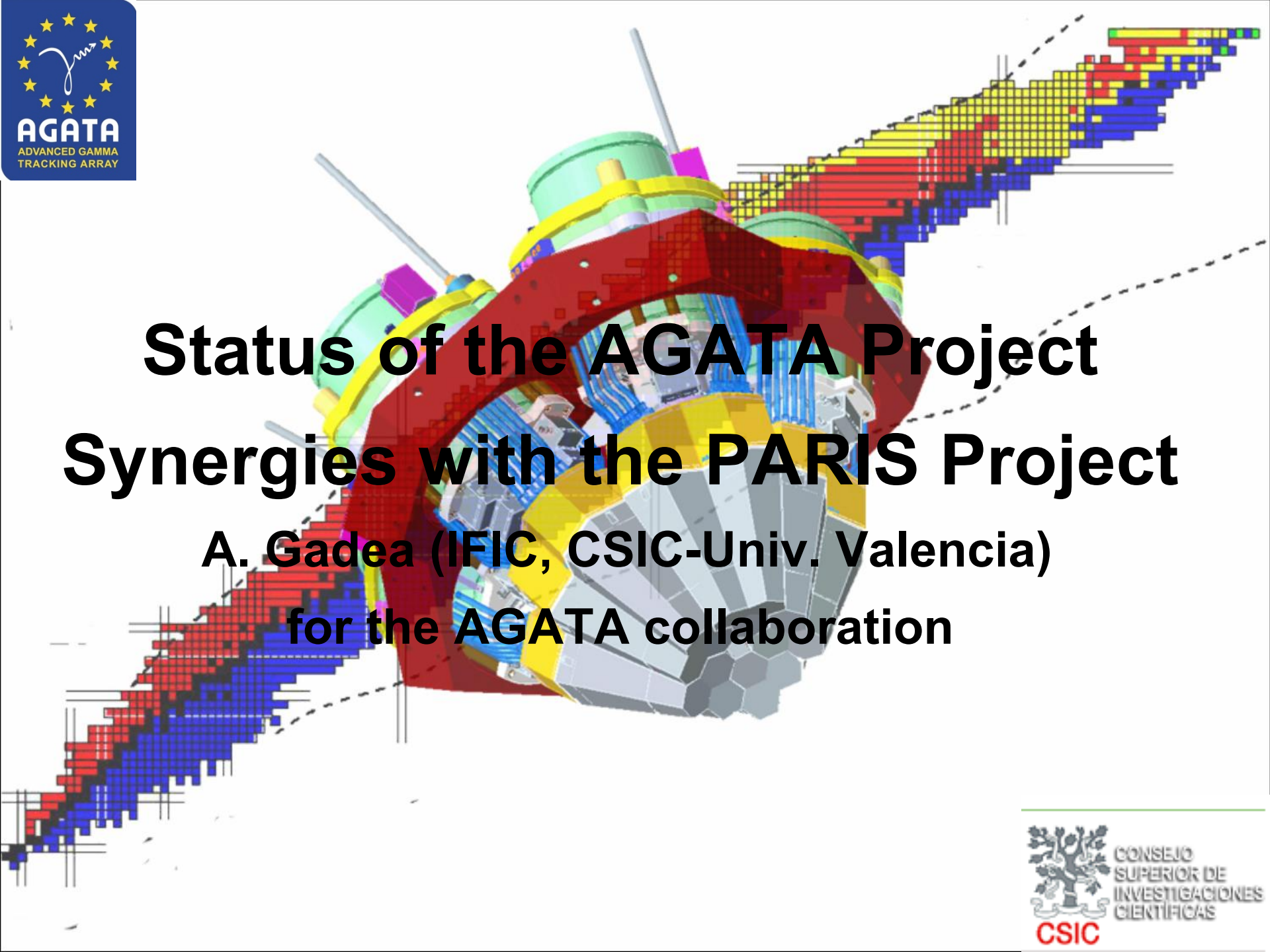


Status of the AGATA Project
Synergies with the PARIS Project

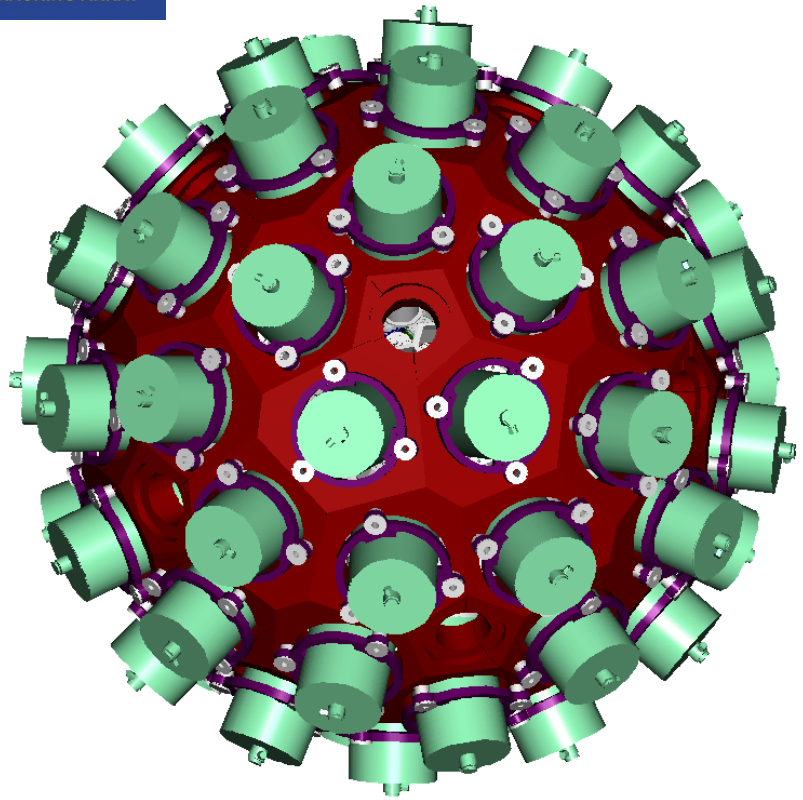
A. Gadea (IFIC, CSIC-Univ. Valencia)

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)

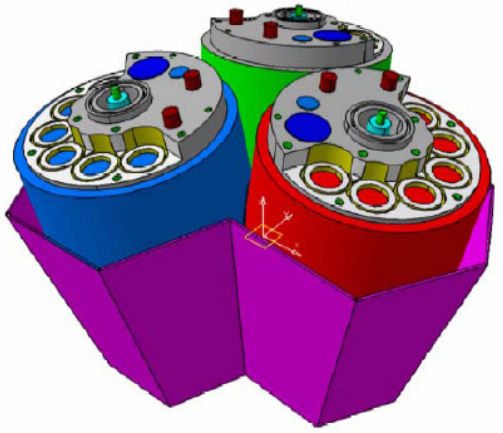
Probably the most challenging project in the NS community

6660 high-resolution digital channels, High throughput DAQ

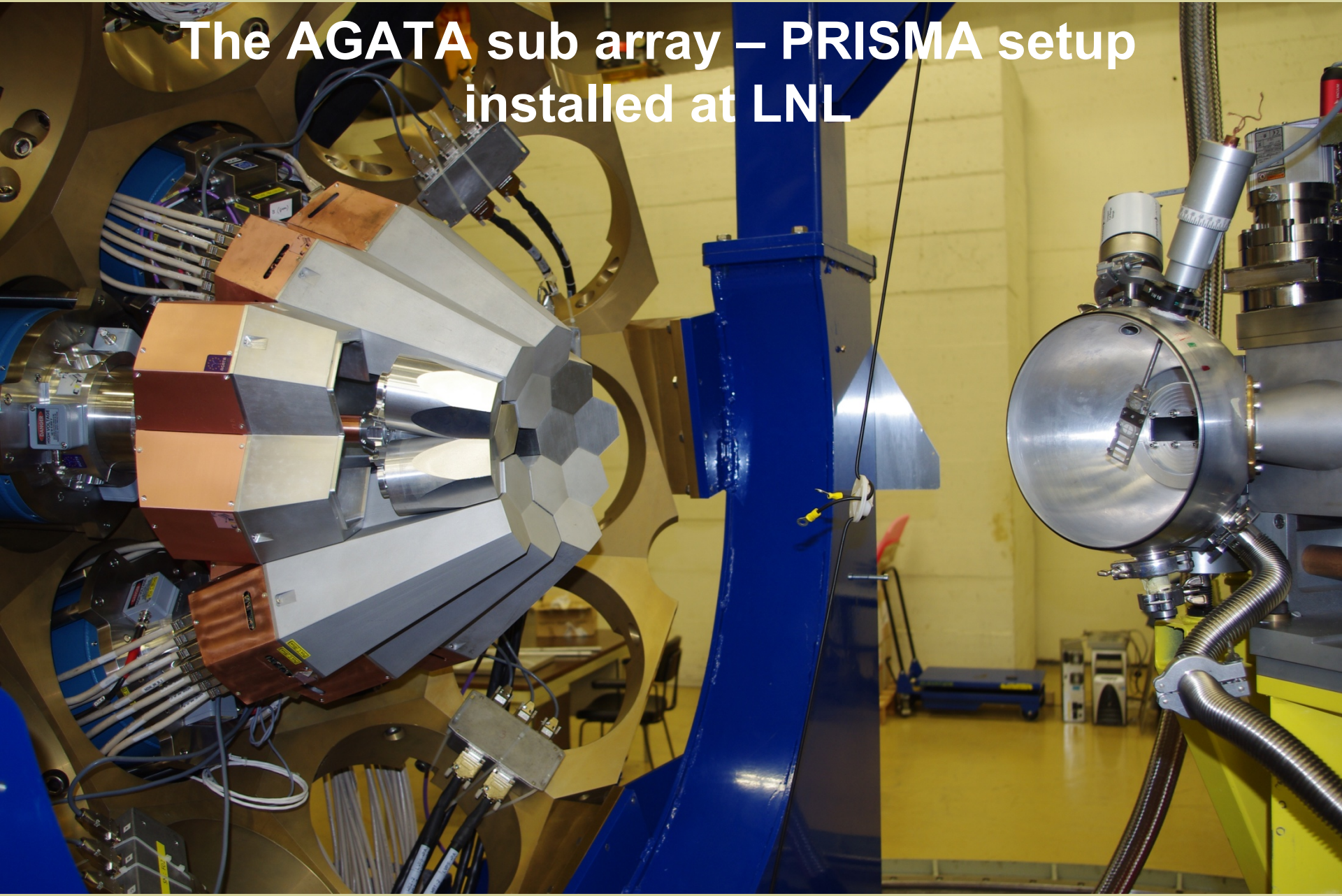
Pulse Shape Analysis → position sensitive operation mode

γ-ray tracking algorithms to achieve maximum efficiency

Specifications reached→ position resolution, rate >50kHz



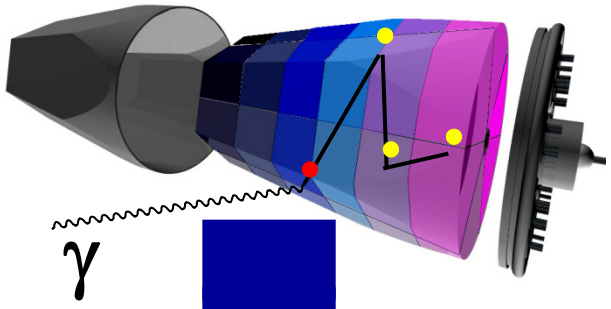
The AGATA sub array – PRISMA setup installed at LNL



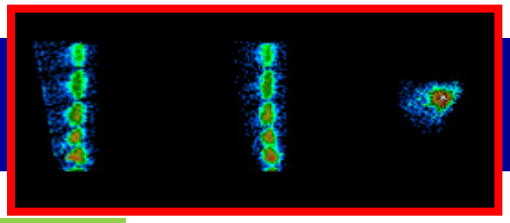
Concept of γ-Tracking

AGATA
ADVANCED GAMMA TRACKING ARRAY

Highly segmented HPGe detectors NOVEL PRE-AMPS



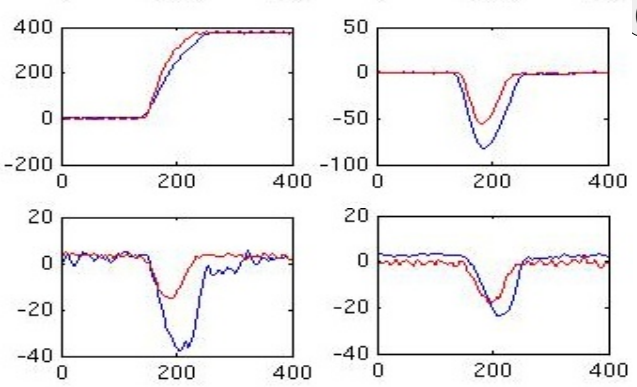
Synchronized digital electronics record and process the segment signals DIGITIZERS + PRE-PROCESSING



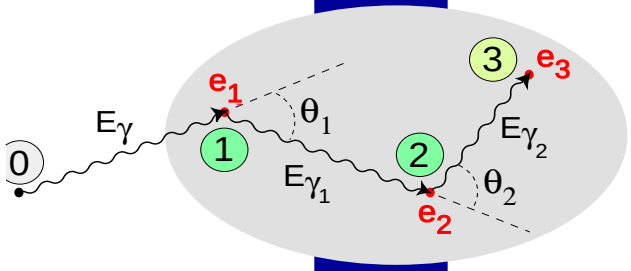
Identified interaction points

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

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



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



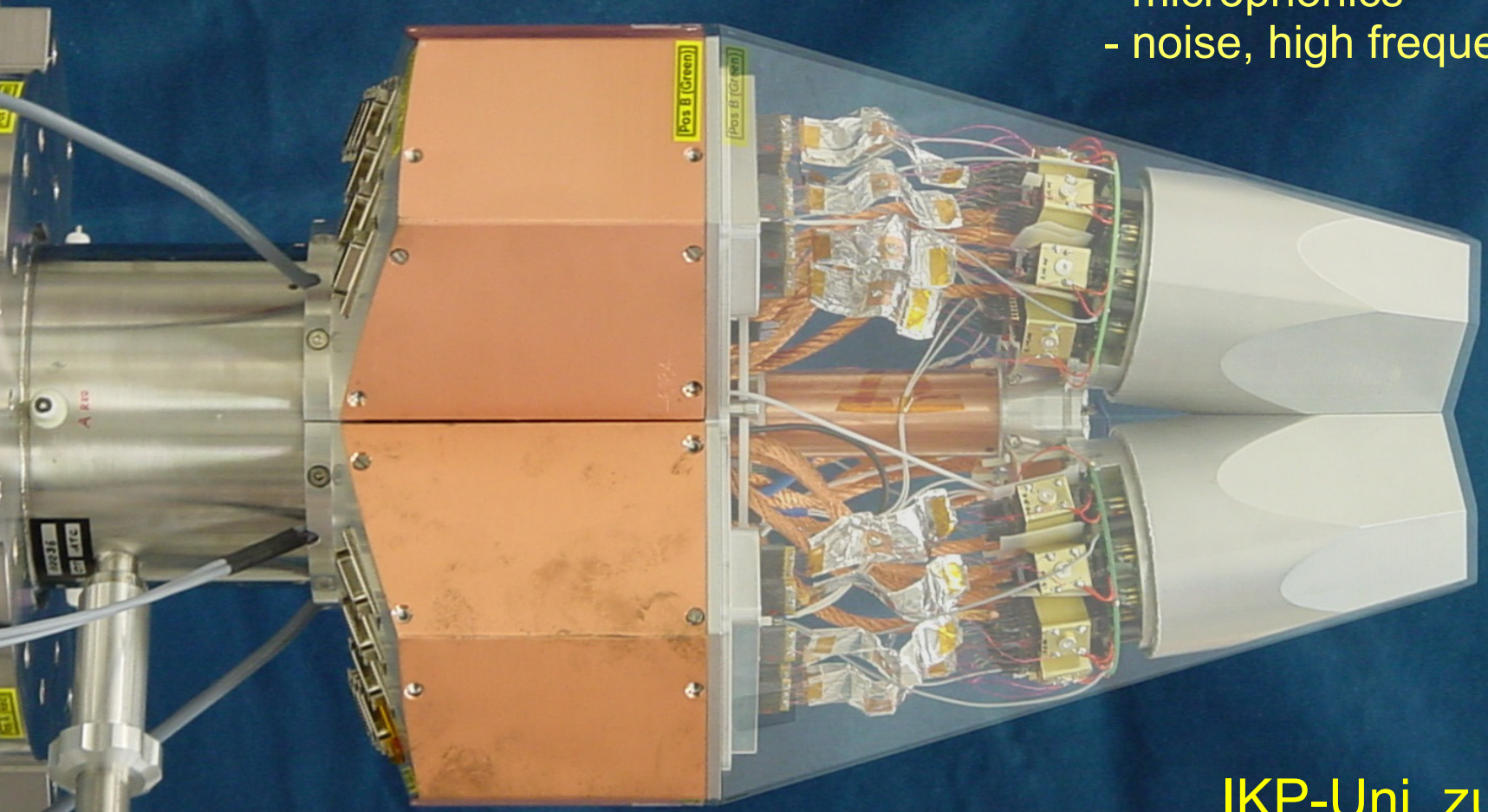
On-line reconstruction of γ-rays

Asymmetric AGATA Triple Cryostat

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

Challenges:

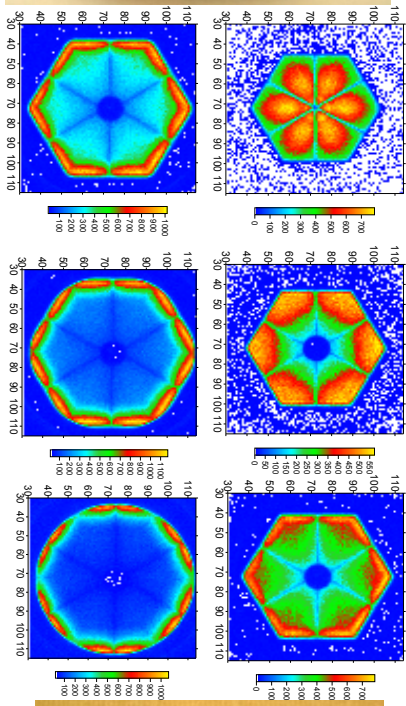
- mechanical precision
- heat development
- LN2 consumption
- microphonics
- noise, high frequencies



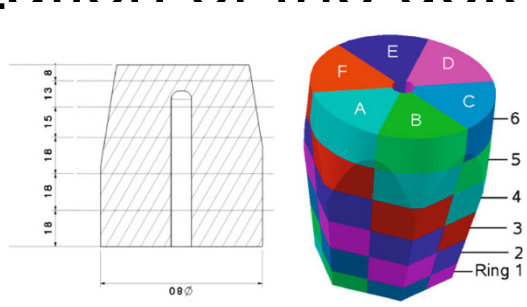
IKP-Uni. zu Köln

Detectors

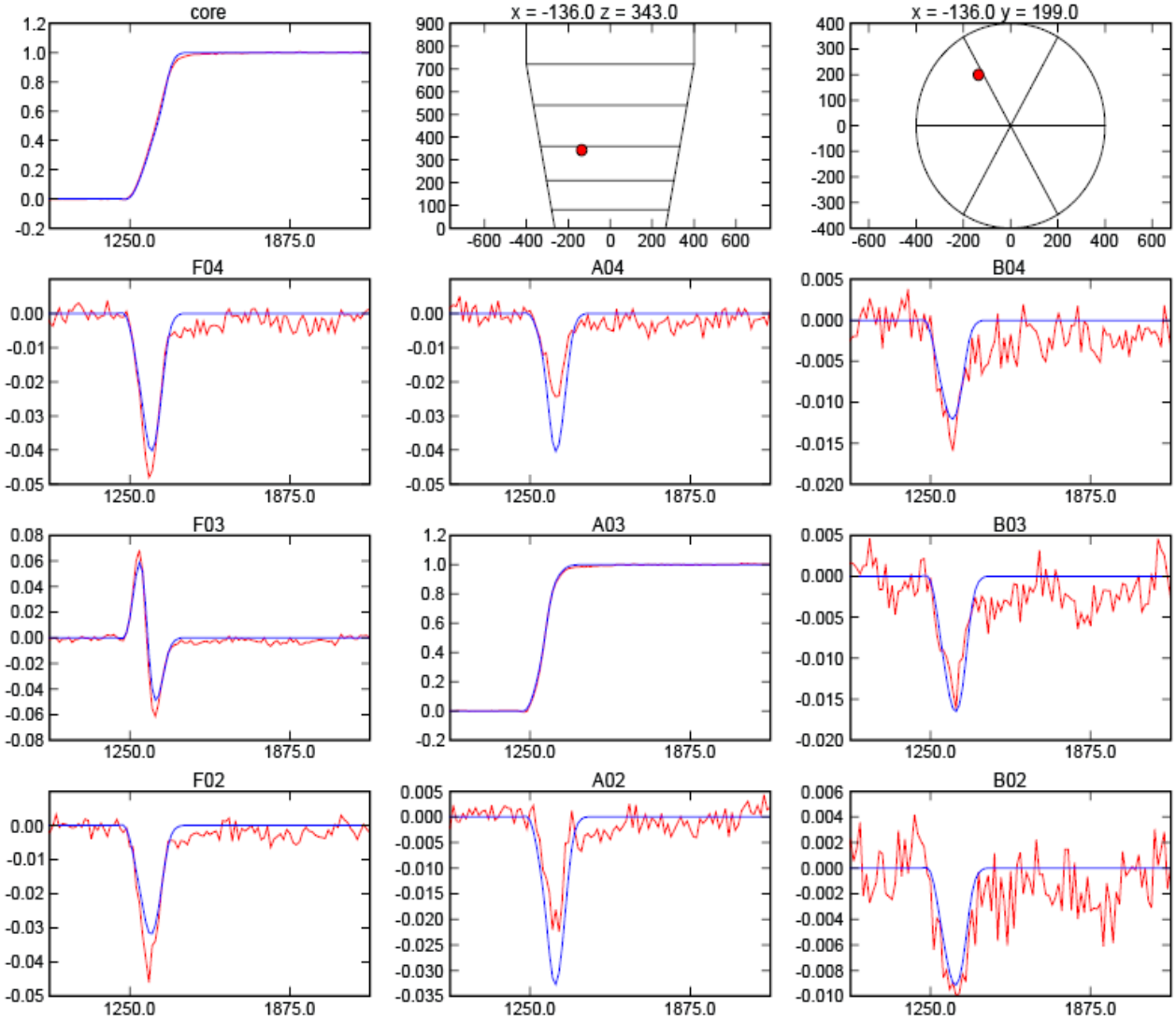
- 3 symmetric early detector R&D phase
- 15 asymmetric capsules R&D phase
- 17 asymmetric capsules ordered phase 1
- 14 operational now
- Delivery 17 capsules (total 32) due 2011
- 9 triple cryostats ordered 4(5) operational
- 5 test cryostats available
- Double cryostats for radioactive beams
- Detailed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

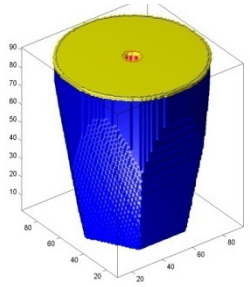


IKP Cologne University
Liverpool University
CEA-Daphne Saclay
INFN-Milano, INFN-Padova

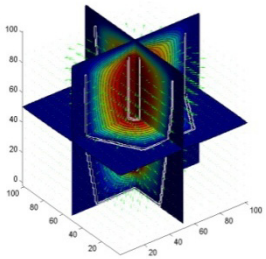


Scan data vs. detector simulation

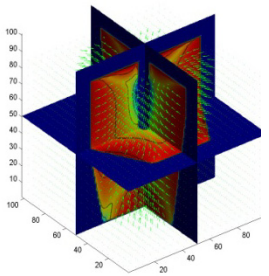




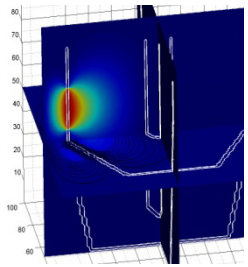
Geometry



Electric field



Drift velocities

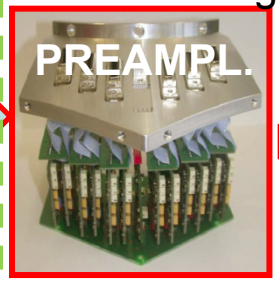


Weighting potential

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

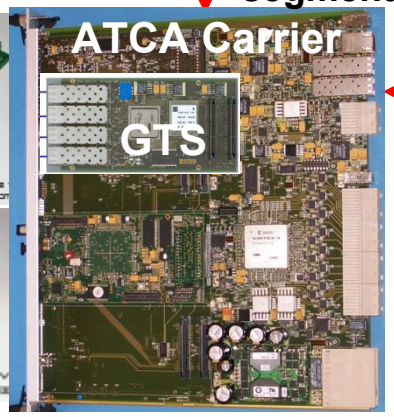
GTS
INFN-Pd

Detector
Level

PSA
FARM

Core +
36 seg.

100MB/s/
detector



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

EVENT
BUILDER

TRACKING

Control,
Storage…

Other
detectors

Global Level
DAQ-NARVAL
RUN- & SLOW-Control
IPNO/CSNSM/
LNL/GANIL/IFJ-PAN

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

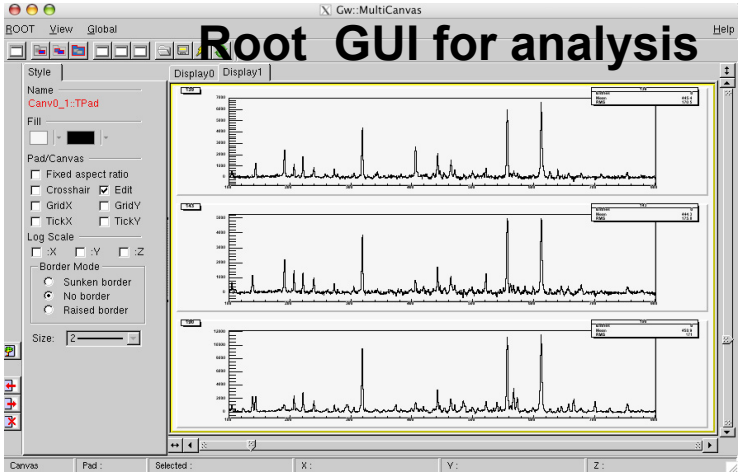
NARVAL Producer
Complementary detectors

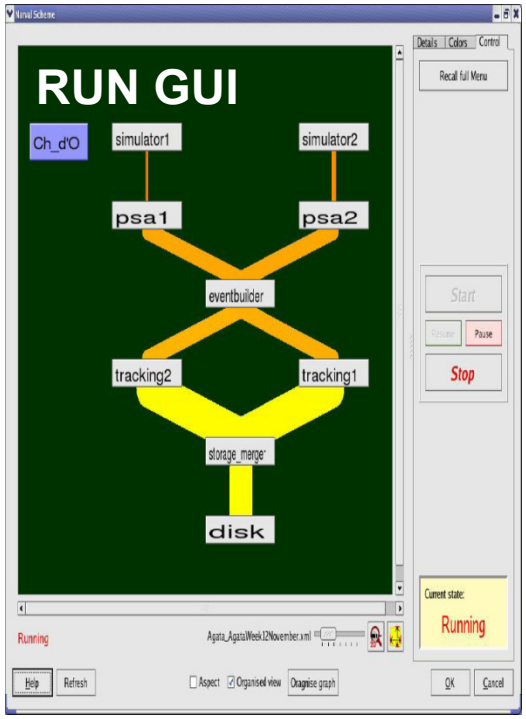
Tracking

Consumer

Advanced Data Flow system developed in ADA

Root GUI for analysis





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

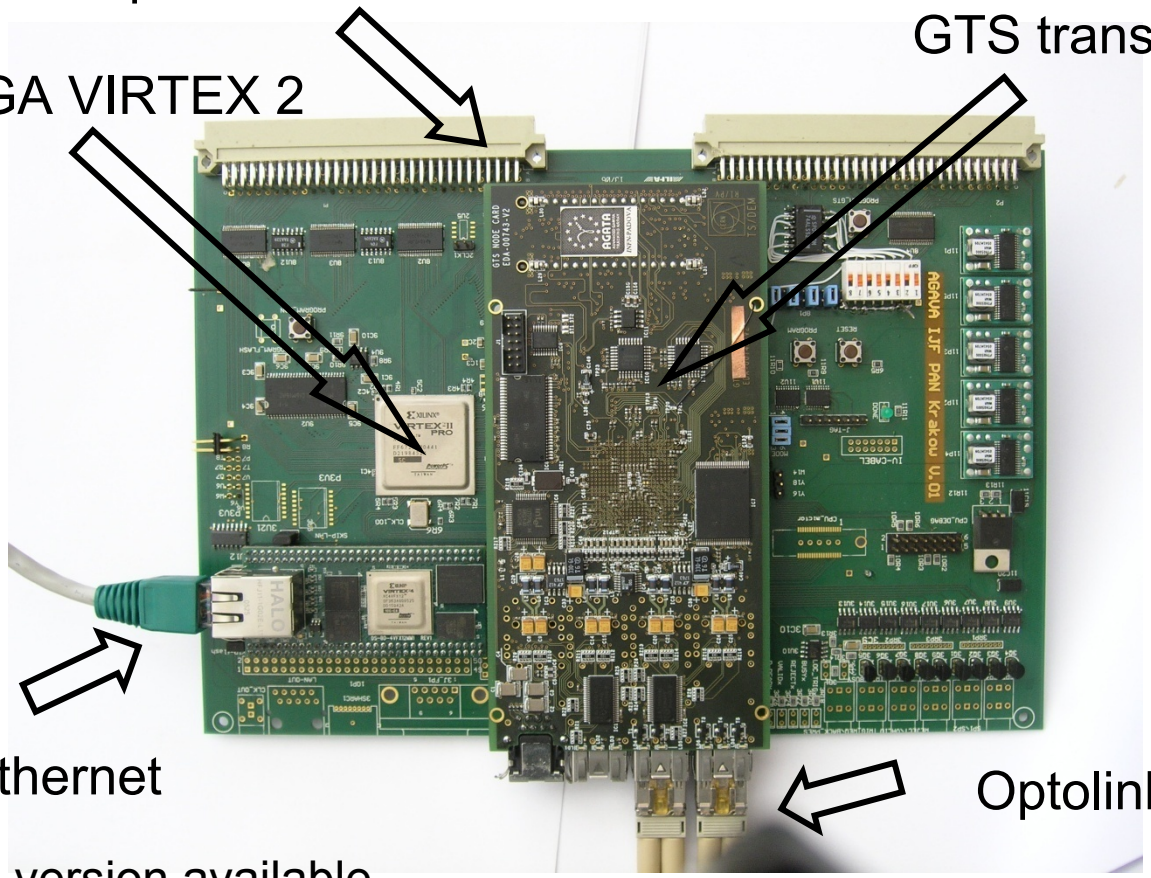
Front-End Electronics and Data Acquistion

- 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

AGAVA VME card

IFJ-PAN, Kraków & INFN-Milano



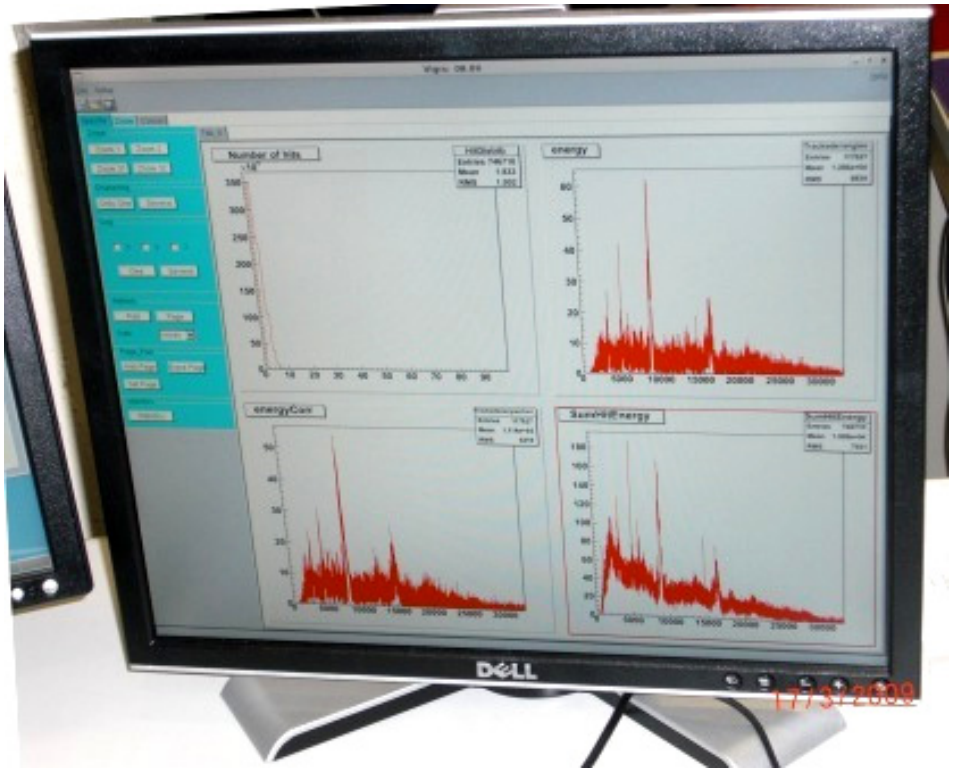
Improved firmware version available

On-line and Off-line data Analysis

Root based analysis software, PRISMA included 06/2010

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

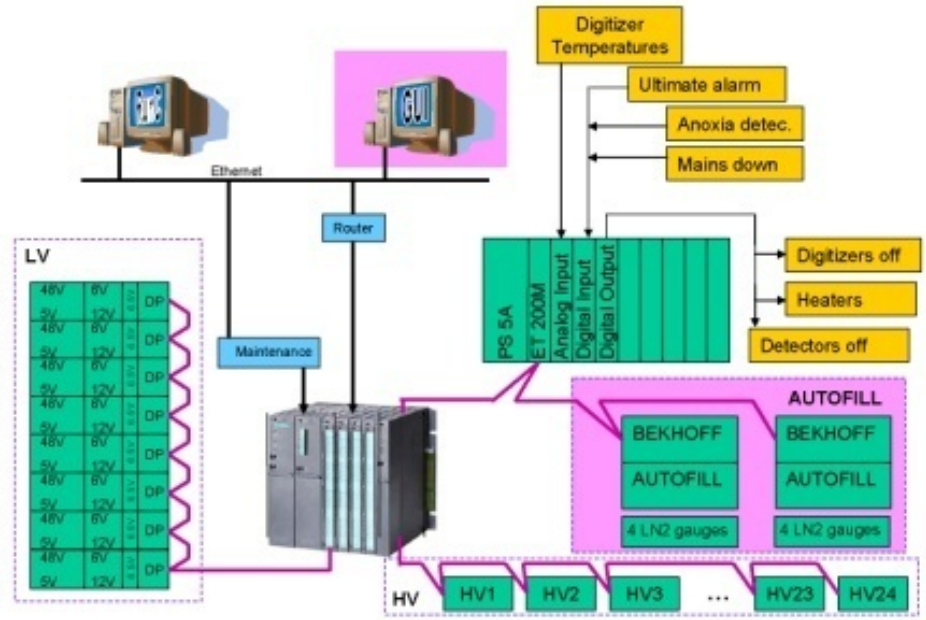
11:42
17/03/2009



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

IPN-Lyon
CSNSM Orsay
INFN-Padova

Infrastructure and Detector Support System

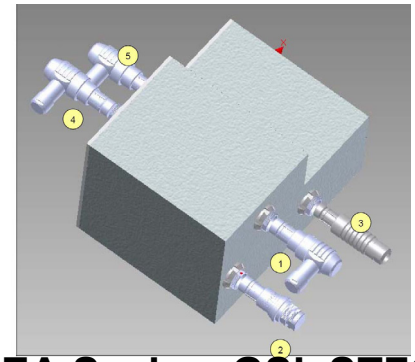


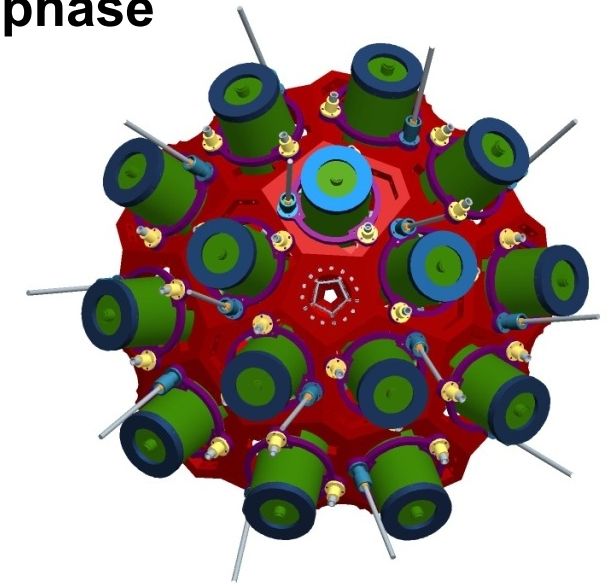
Low Voltage: Upgrade 48V modules readout, 14 modules soon ready

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

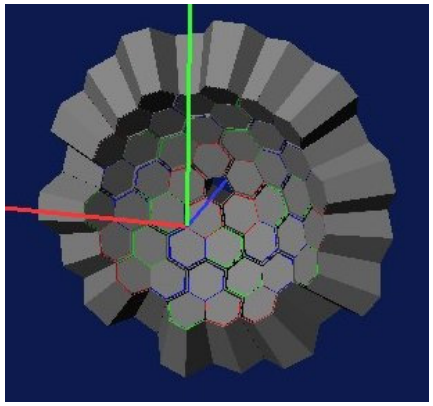
Mechanical design proceeding for the GSI phase

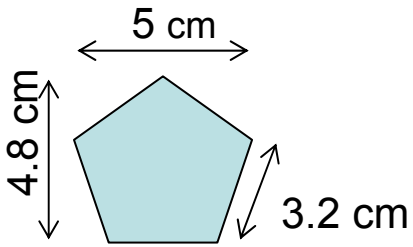




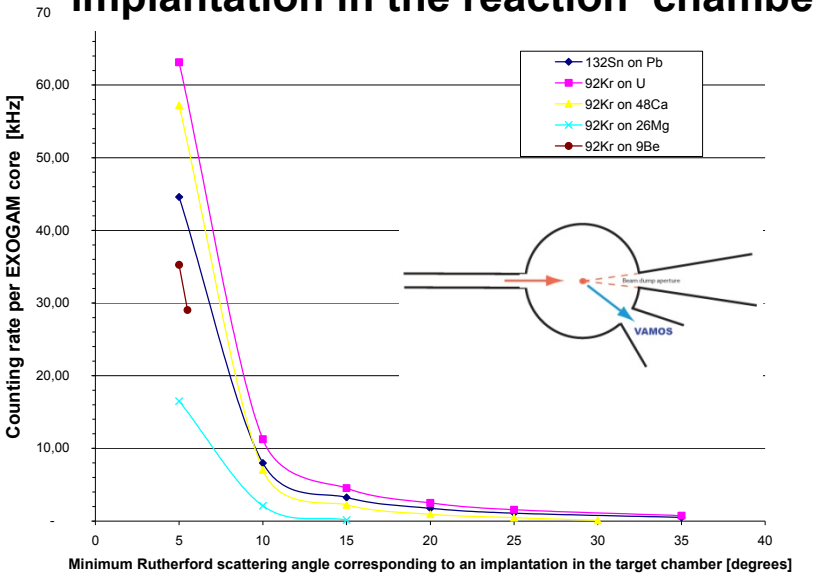
CEA Saclay, GSI, STFC-Daresbury, JYFL-Jyvaskyla, IPHC-Strasbourg, GANIL

AGATA Double Cluster for Intense and In-Flight production RIBs

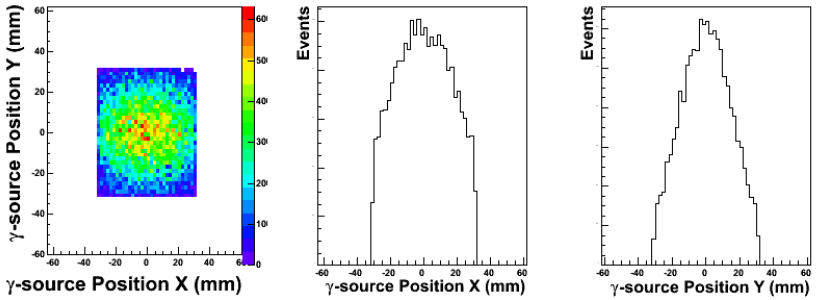




Rates at the EXOGAM Ge array due to implantation in the reaction chamber



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

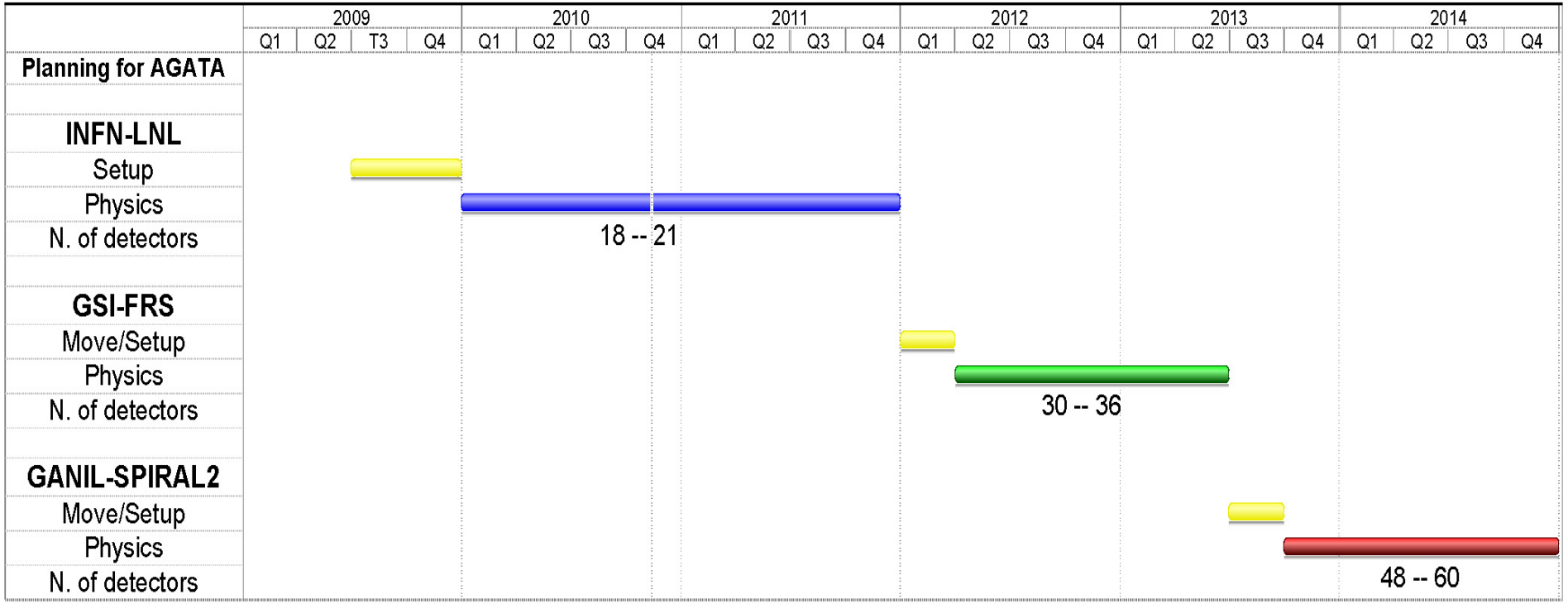
SPIRAL2

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

FRS / SFRS

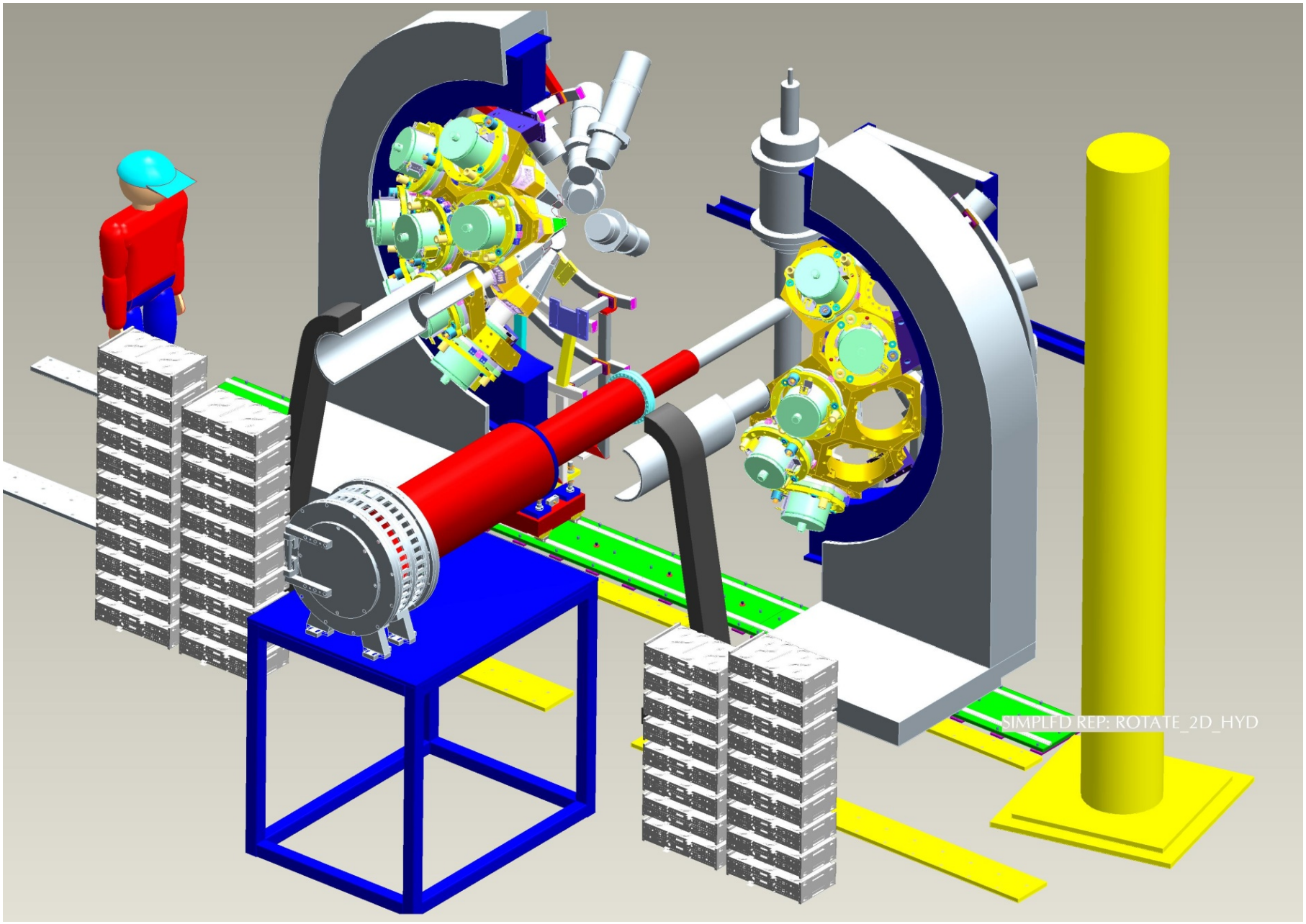
- 10cm to 12cm beam-line required after secondary target

Current planning

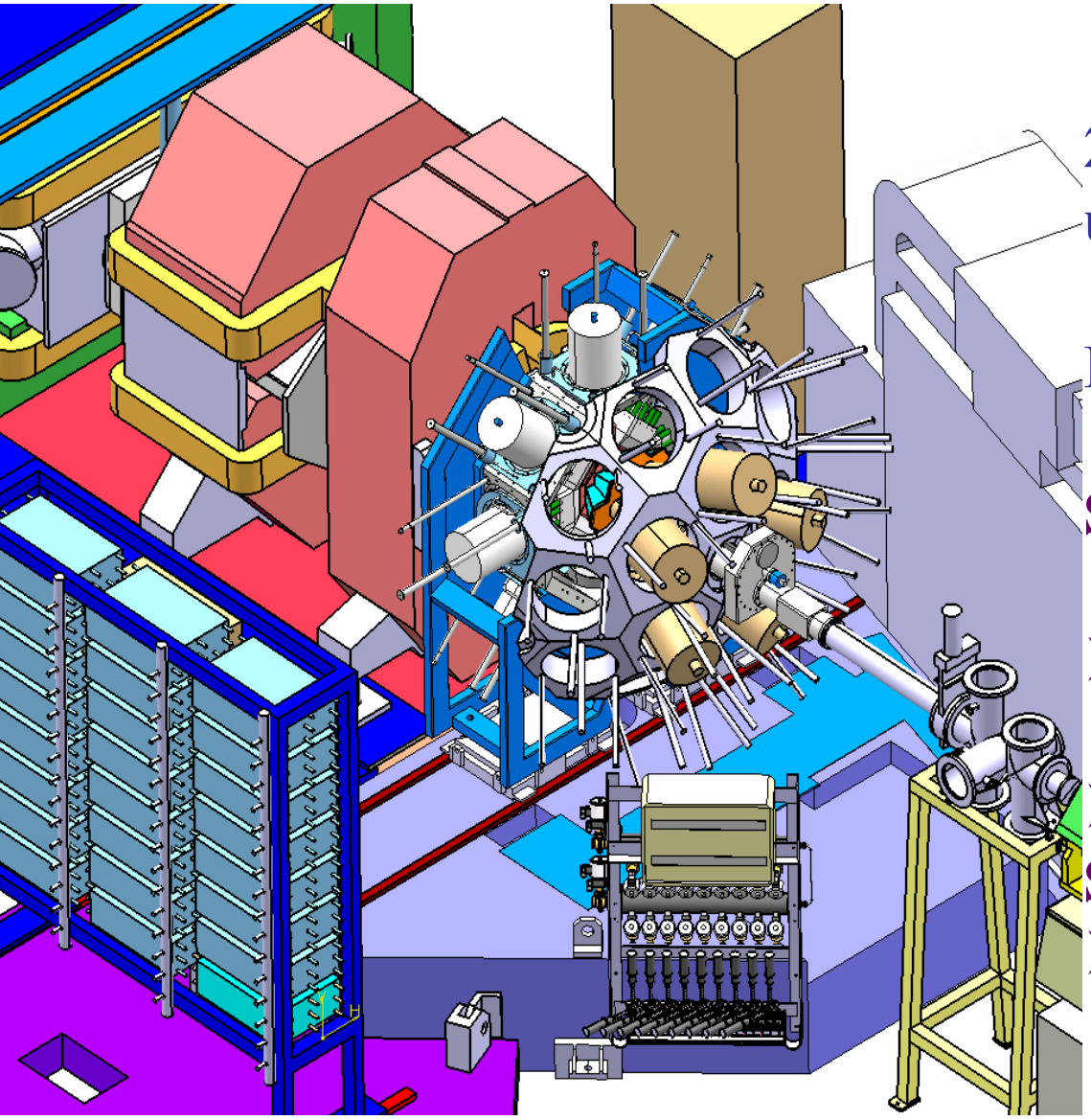


Proposed deployment of AGATA for the experimental campaigns at the three AGATA host Laboratories

AGATA at PRESPEC GSI-FRS



AGATA at GANIL



2013/14 :

up to 15 triple clusters at VAMOS

Possible Campaign with PARIS to be discussed

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

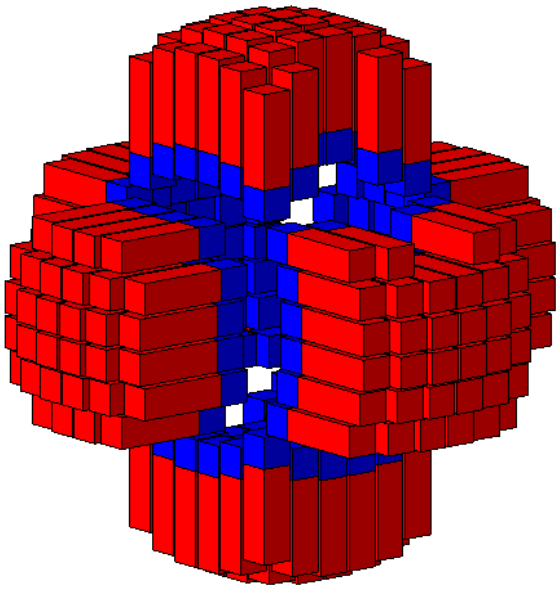
- **Deep-inelastic & fission products**
- **fusion-evaporation**

SPIRAL2 RIBs: 3-20A.MeV

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

Synergies Between PARIS and AGATA

- Synergies in the physics programme
- Synergies on instrumentation



Collective modes in the continuum / Hot nuclei

Shape phase transitions

Jacobi transition
(Oblate→ triaxial → prolate)

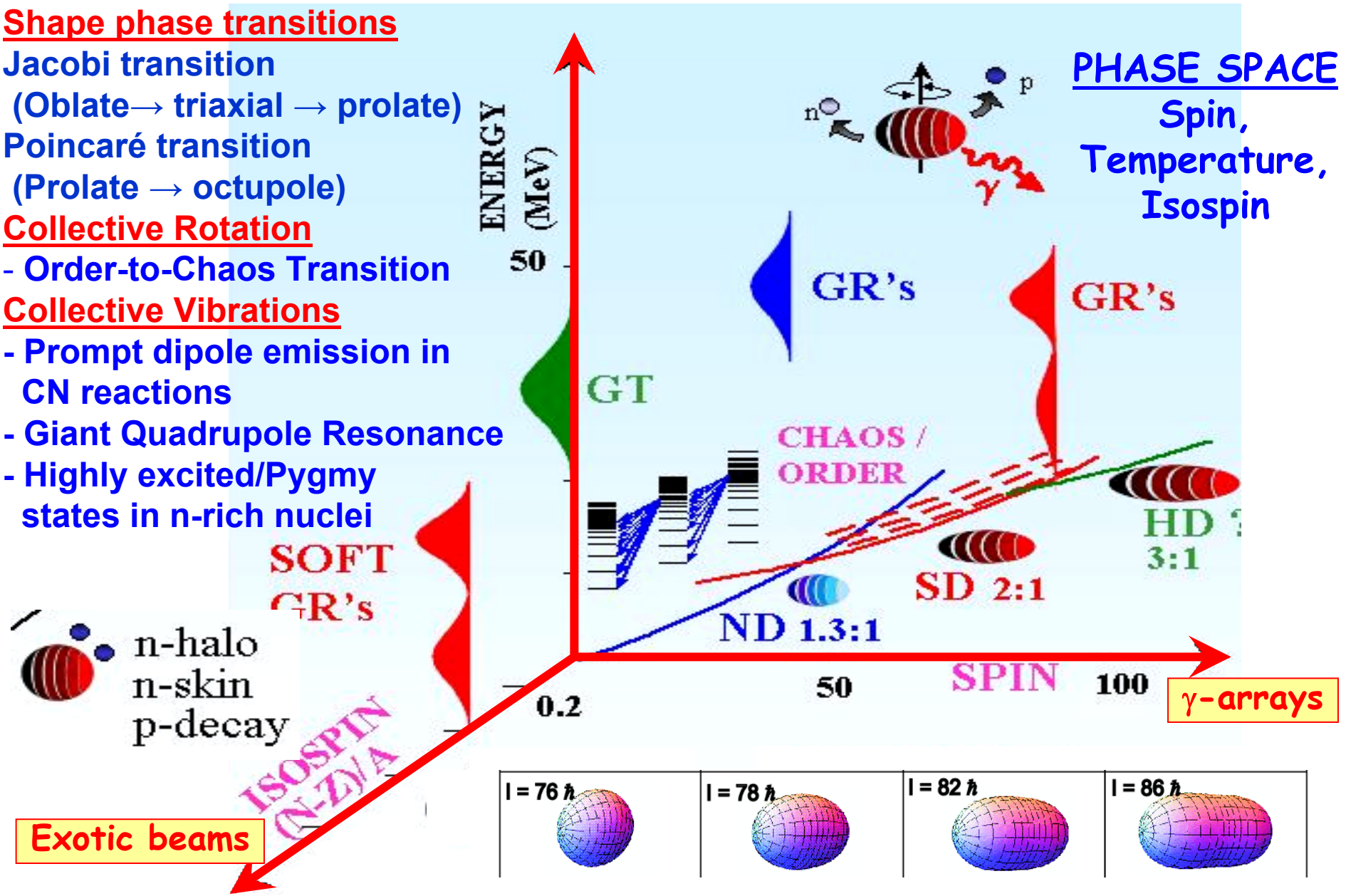
Poincaré transition
(Prolate → octupole)

Collective Rotation

- Order-to-Chaos Transition

Collective Vibrations

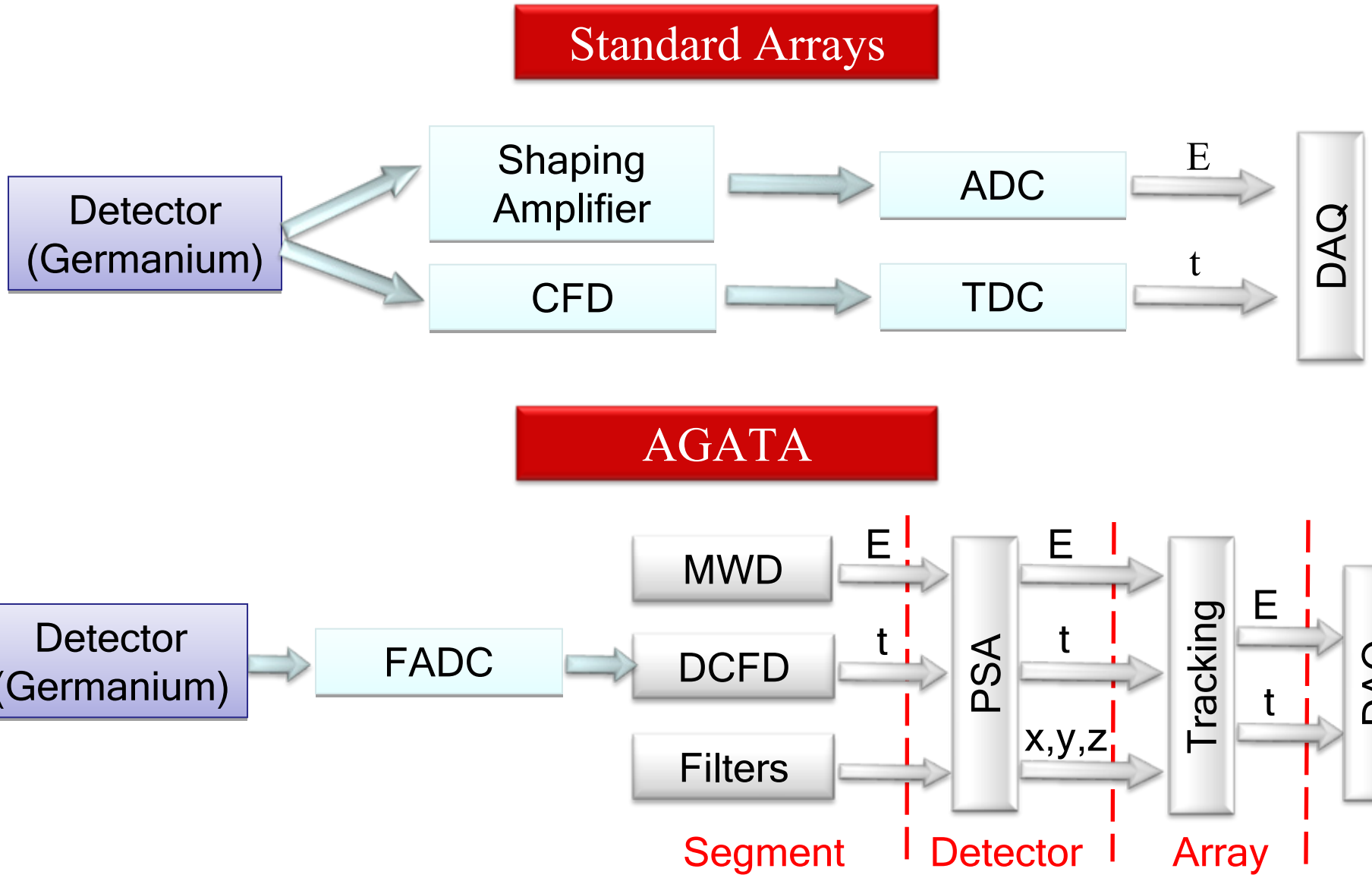
- Prompt dipole emission in CN reactions
- Giant Quadrupole Resonance
- Highly excited/Pygmy states in n-rich nuclei



PHASE SPACE

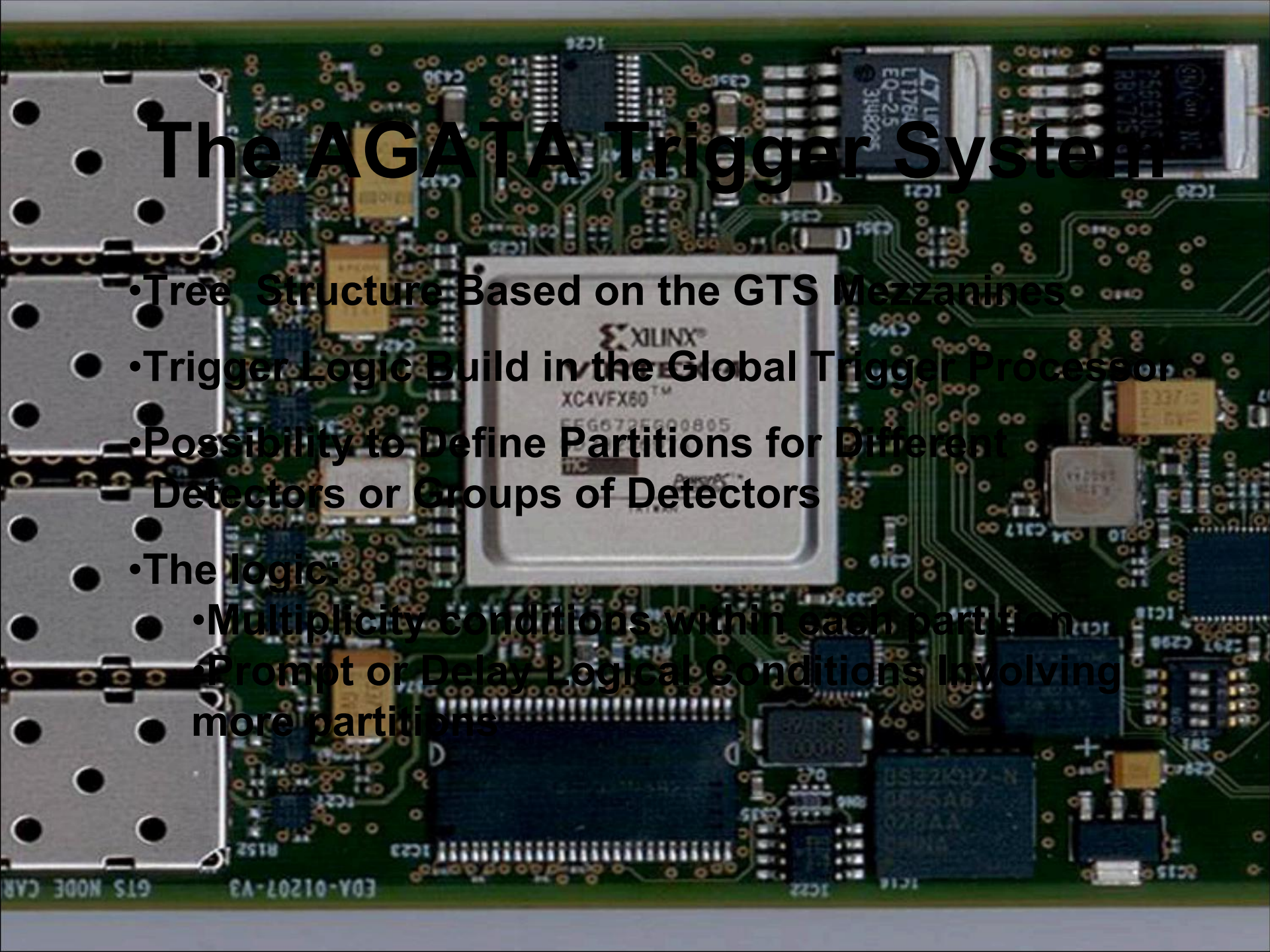
Spin,
Temperature,
Isospin

Analogue vs Digital Electronics



The AGATA Trigger System

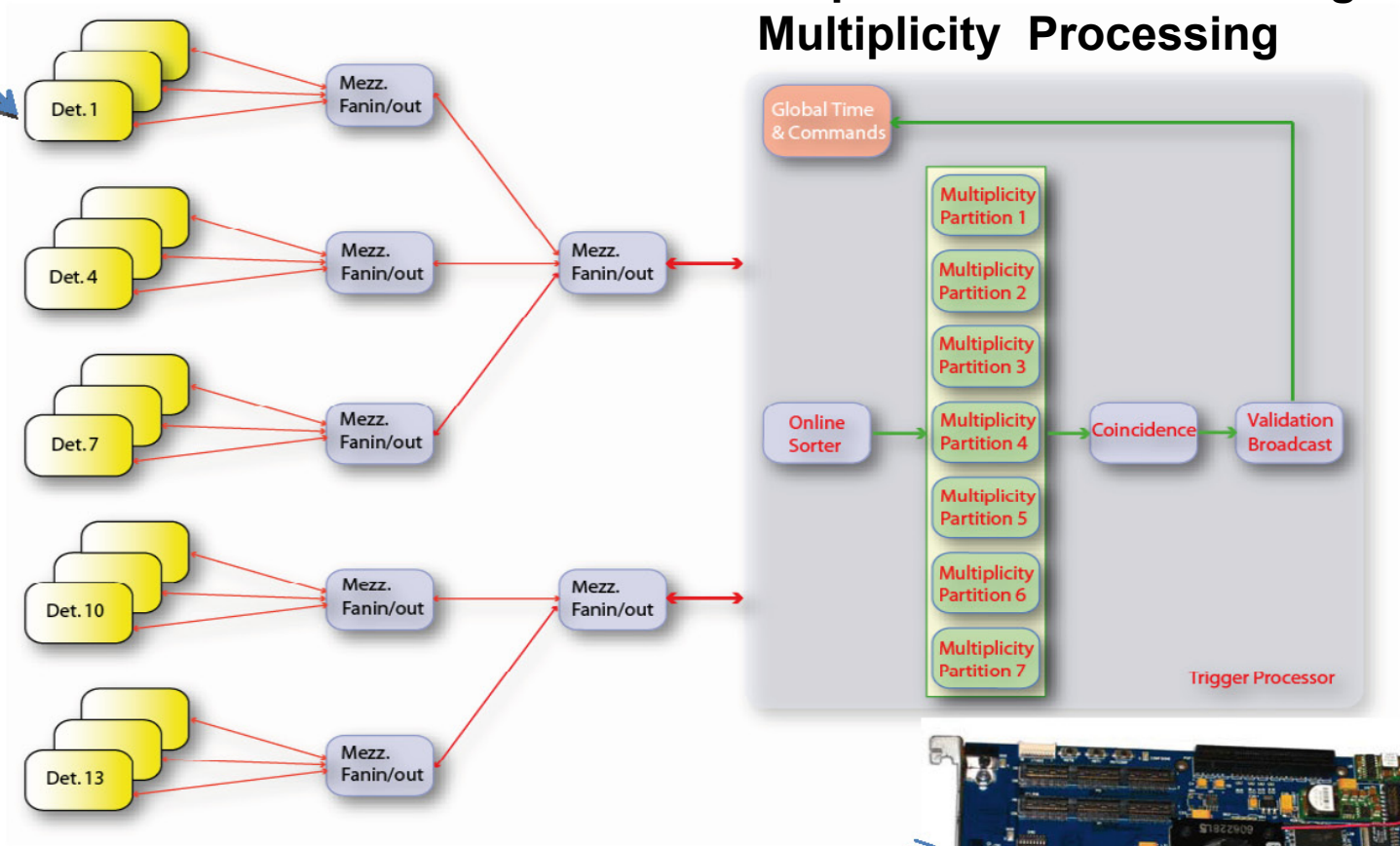
- Tree Structure Based on the GTS Mezzanines
- Trigger Logic Build in the Global Trigger Processor
- Possibility to Define Partitions for Different Detectors or Groups of Detectors
- The logic:
  - Multiplicity conditions within each partition
  - Prompt or Delay Logical Conditions Involving more partitions

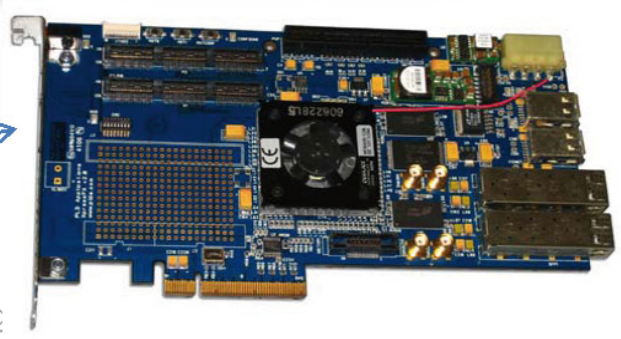


Global Trigger Processor

Max 1 MHz trigger requests/channel

Global Processor:
Sequential Batcher Sorting +
Multiplicity Processing



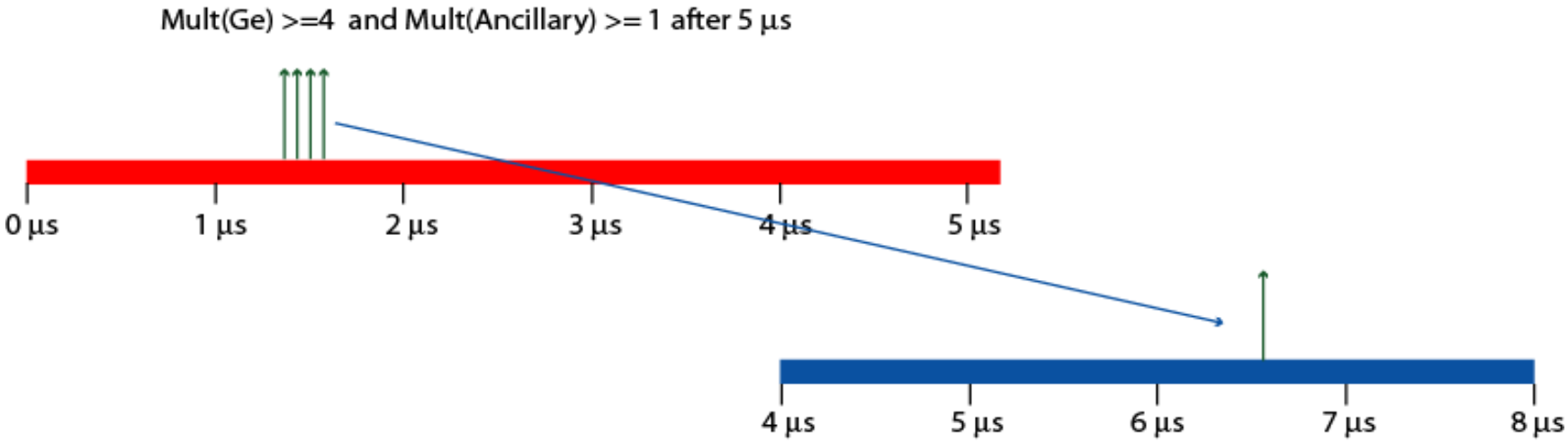


48 channels in a Xilinx Virtex-4 Fx100

M. Bellato, L. Berti, J. Chavas, INFN-Pd and LNL

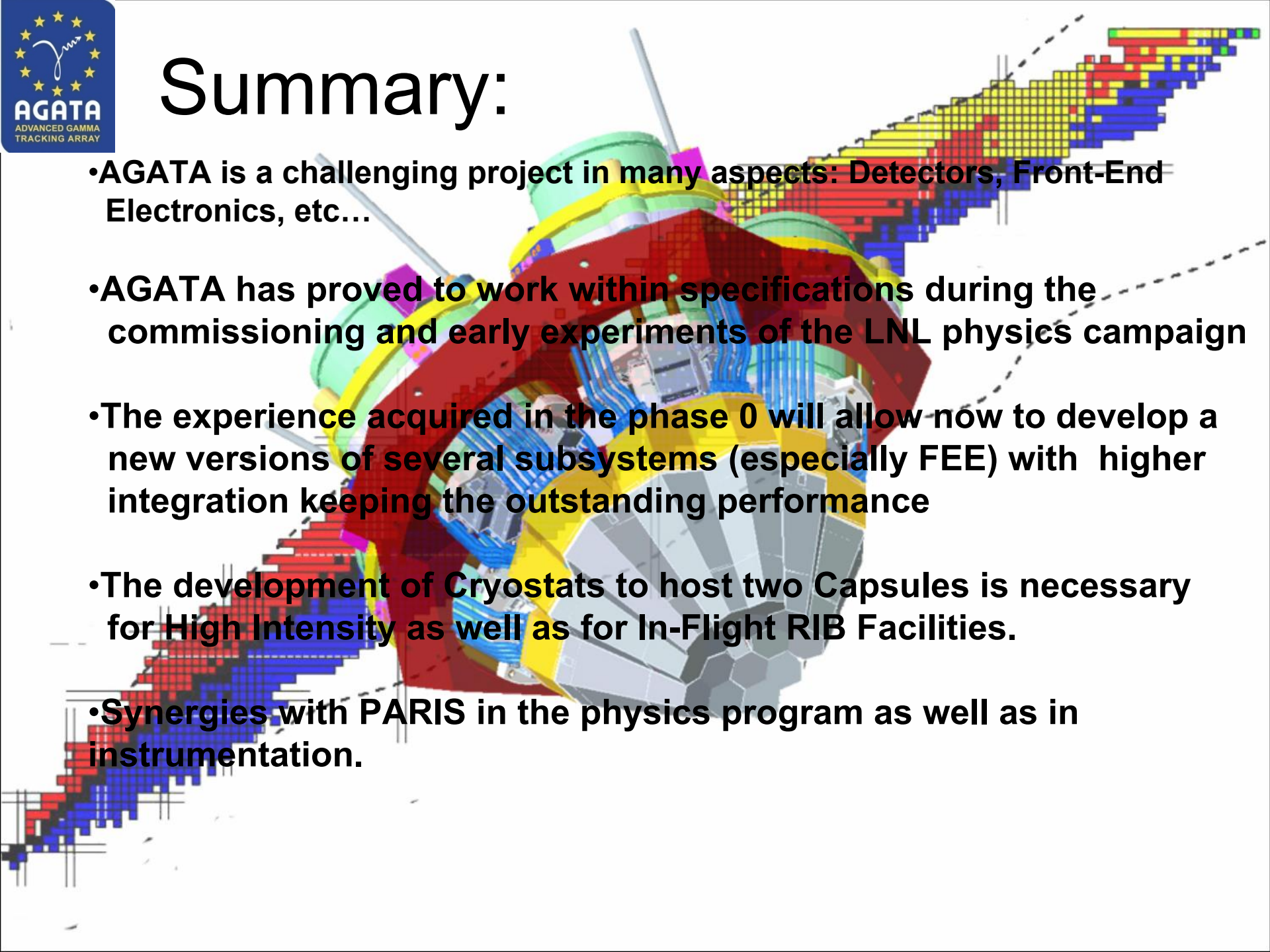
Partitions Coincidence

- Prompt and delayed
- Case study:
  - M(Ge) >= N and M(Other Detector) >= K before/after deltaT



M. Bellato, L. Berti, J. Chavas, INFN-Pd and LNL

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.
- Synergies with PARIS in the physics program as well as in instrumentation.

The AGATA Collaboration

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

>12 Countries
>40 Institutions