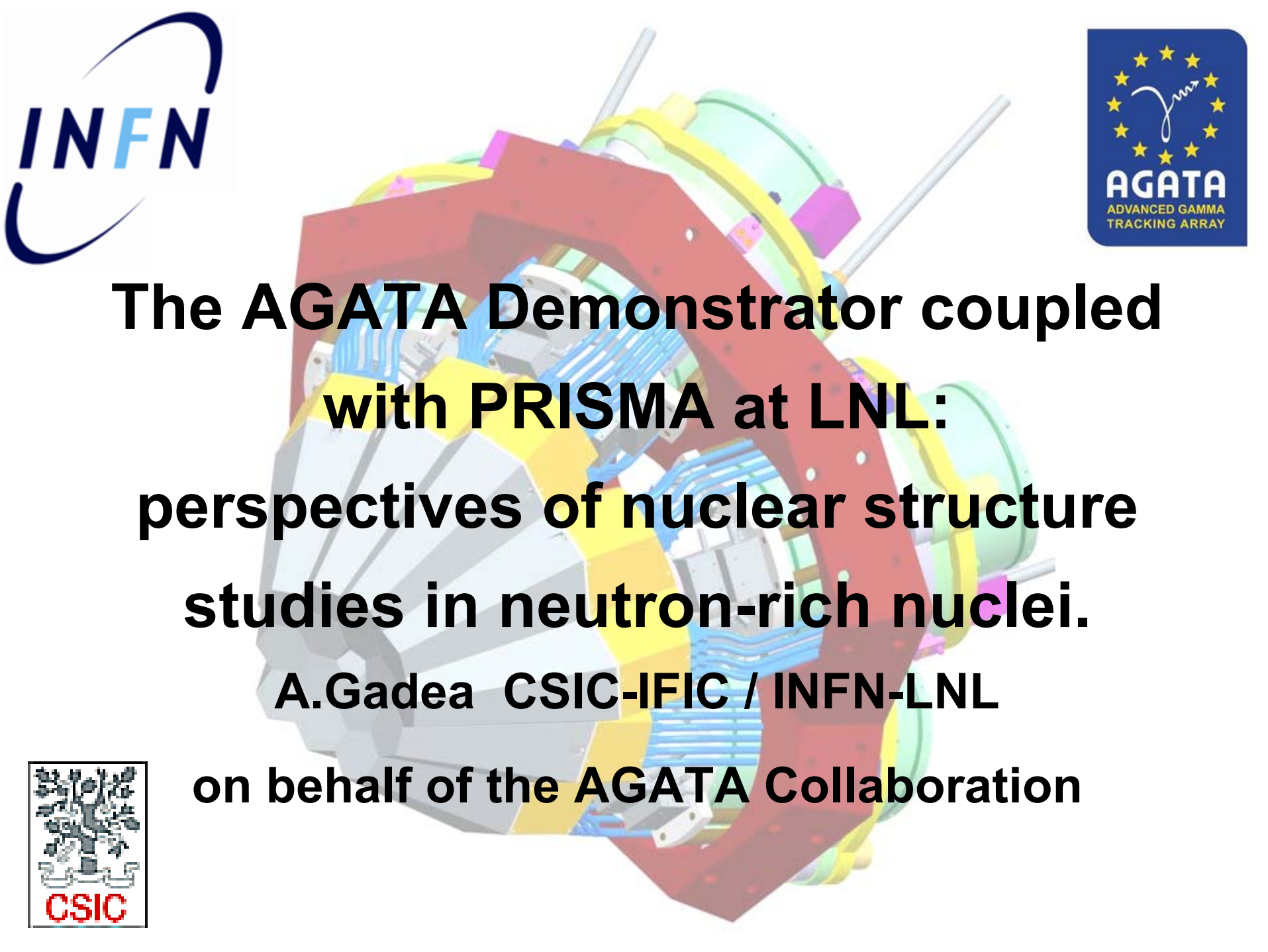
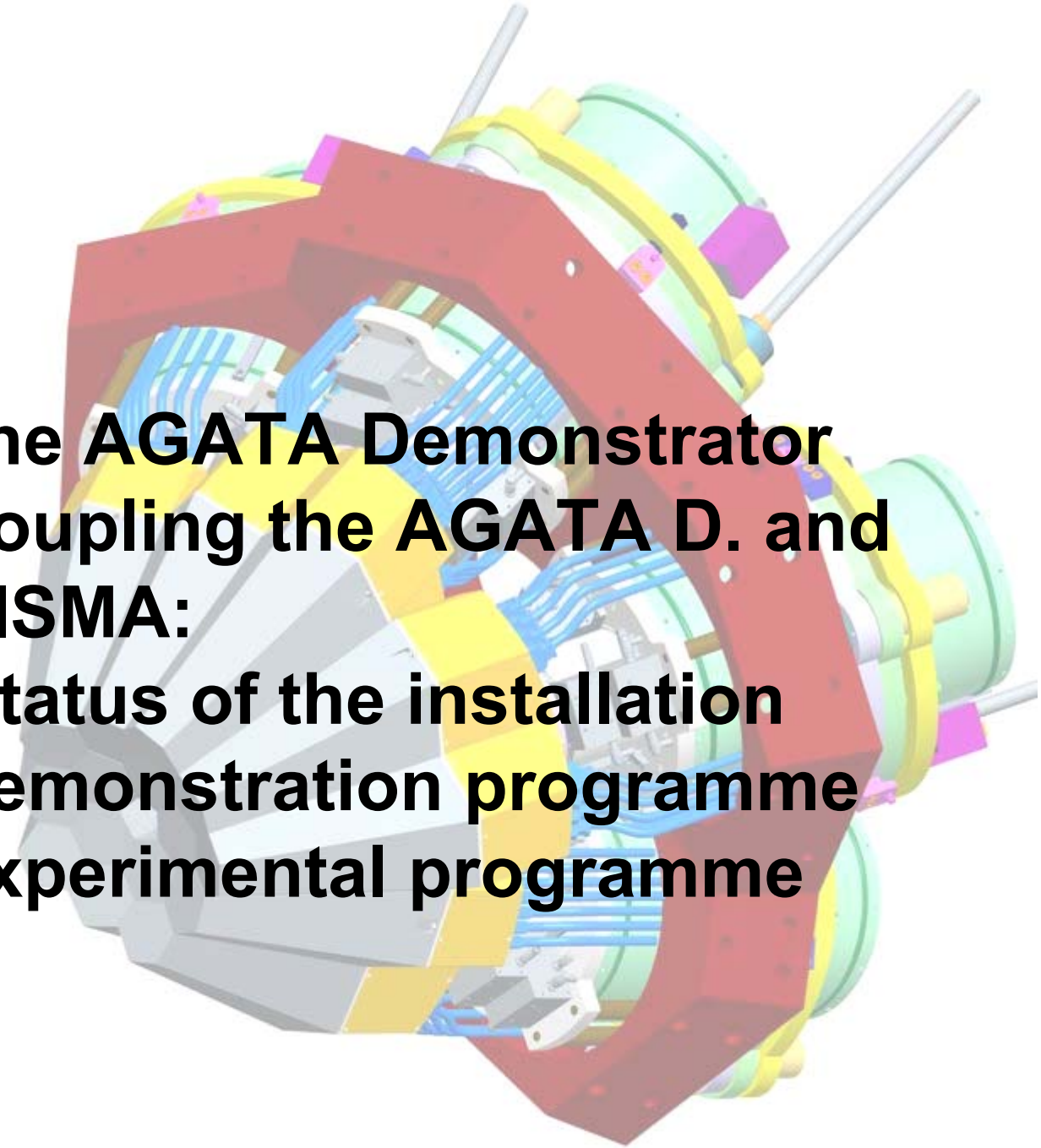


The AGATA Demonstrator coupled with PRISMA at LNL: perspectives of nuclear structure studies in neutron-rich nuclei.

A.Gadea CSIC-IFIC / INFN-LNL

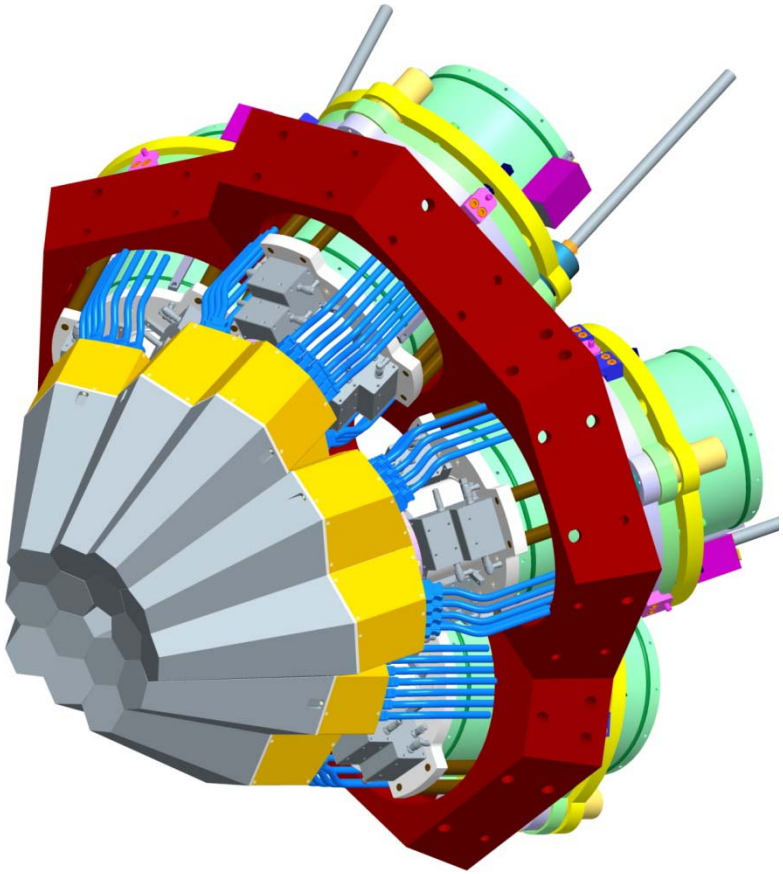
on behalf of the AGATA Collaboration



- The AGATA Demonstrator
- Coupling the AGATA D. and PRISMA:
  Status of the installation
- Demonstration programme
- Experimental programme

The AGATA Demonstrator

Objective of the final R&D phase 2003-2008



1 symmetric triple-cluster

5 asymmetric triple-clusters

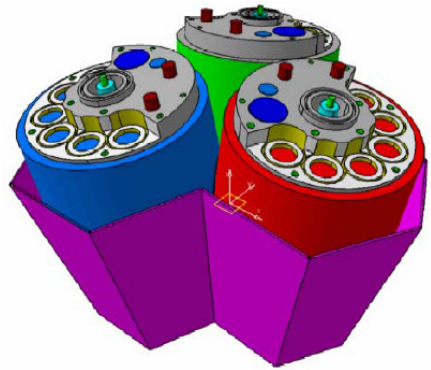
15 36-fold segmented crystals
540 segments
555 high resolution digital-channels

Eff. 3 – 8 % @ $M_\gamma = 1$
Eff. 2 – 4 % @ $M_\gamma = 30$

Operate in real time ACQ,
Pulse Shape Analysis and γ-ray Tracking

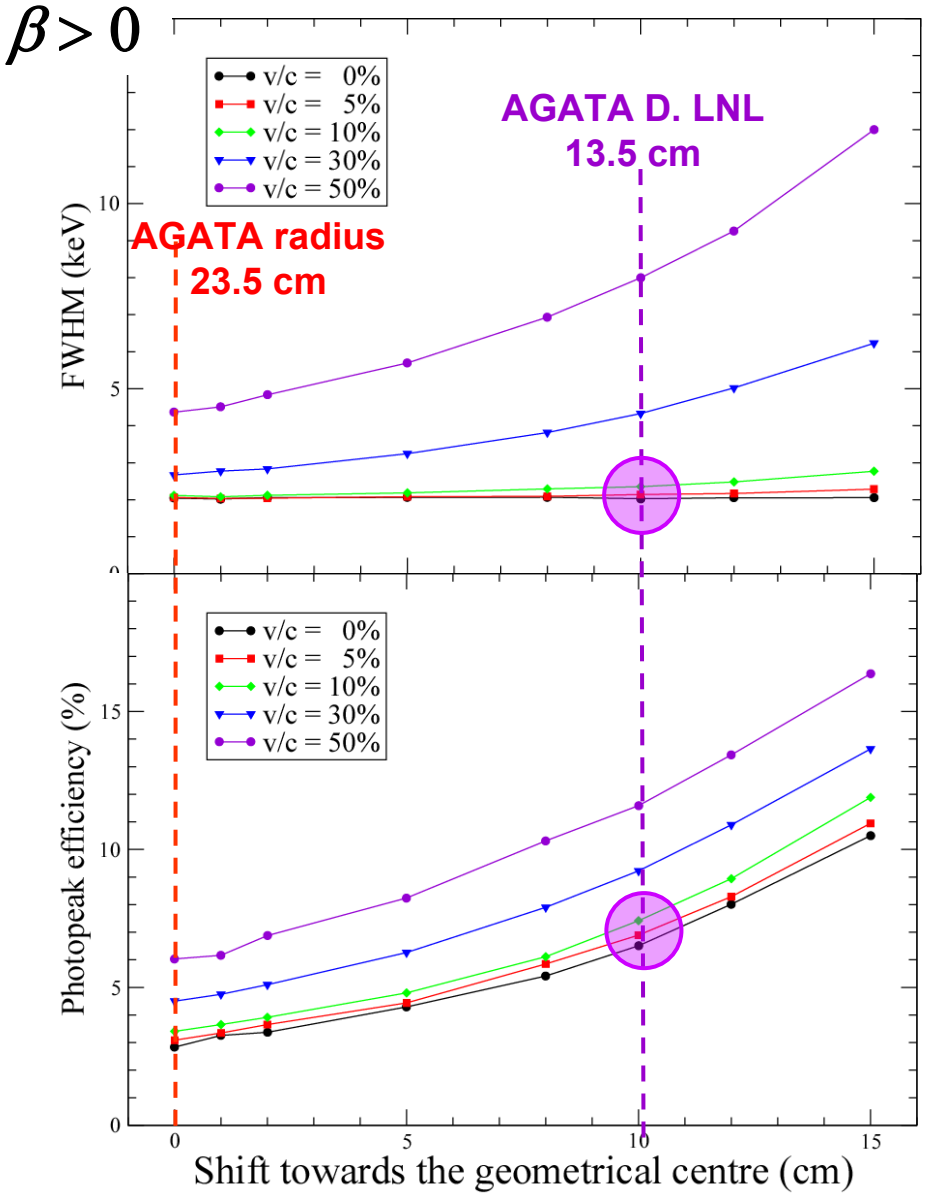
Hosting sites:

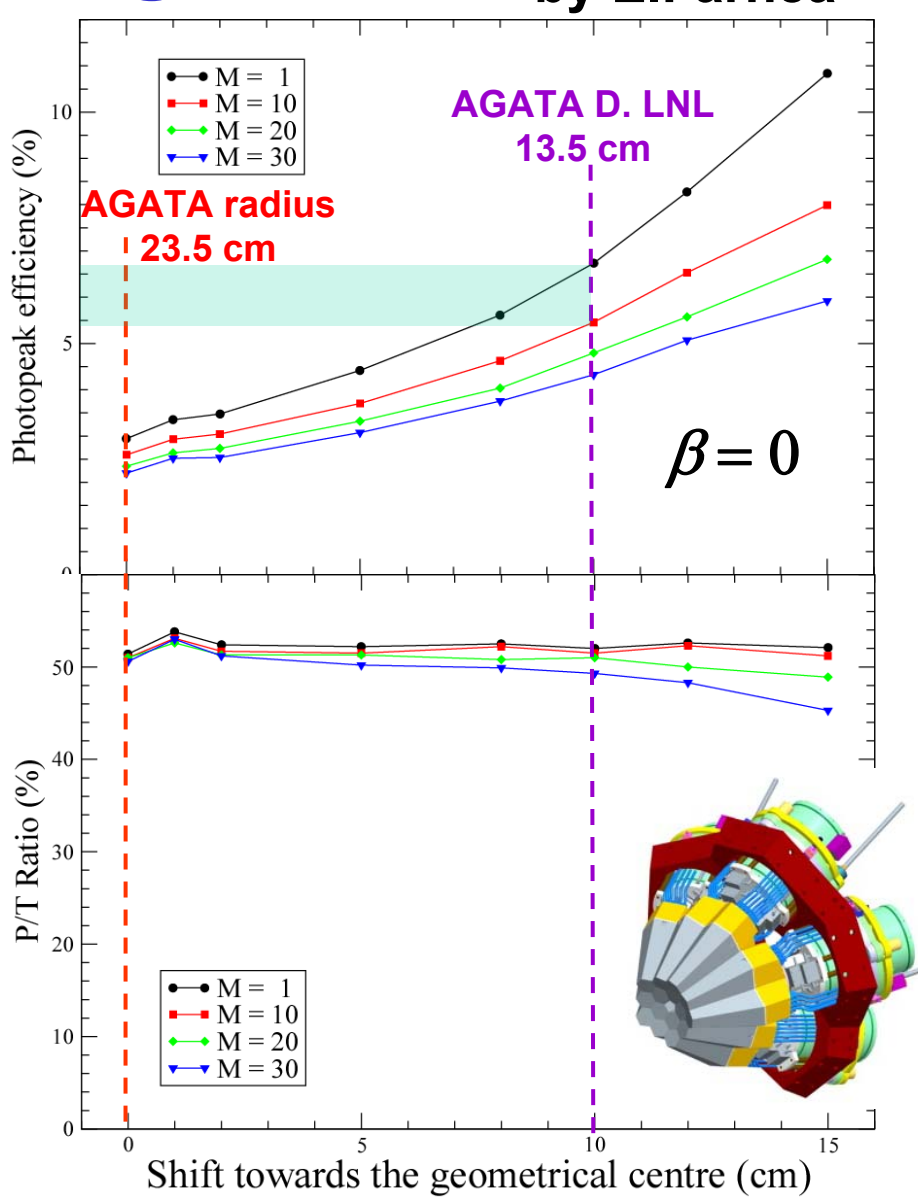
LNL → 2008
GANIL → 2010
GSI → 2012

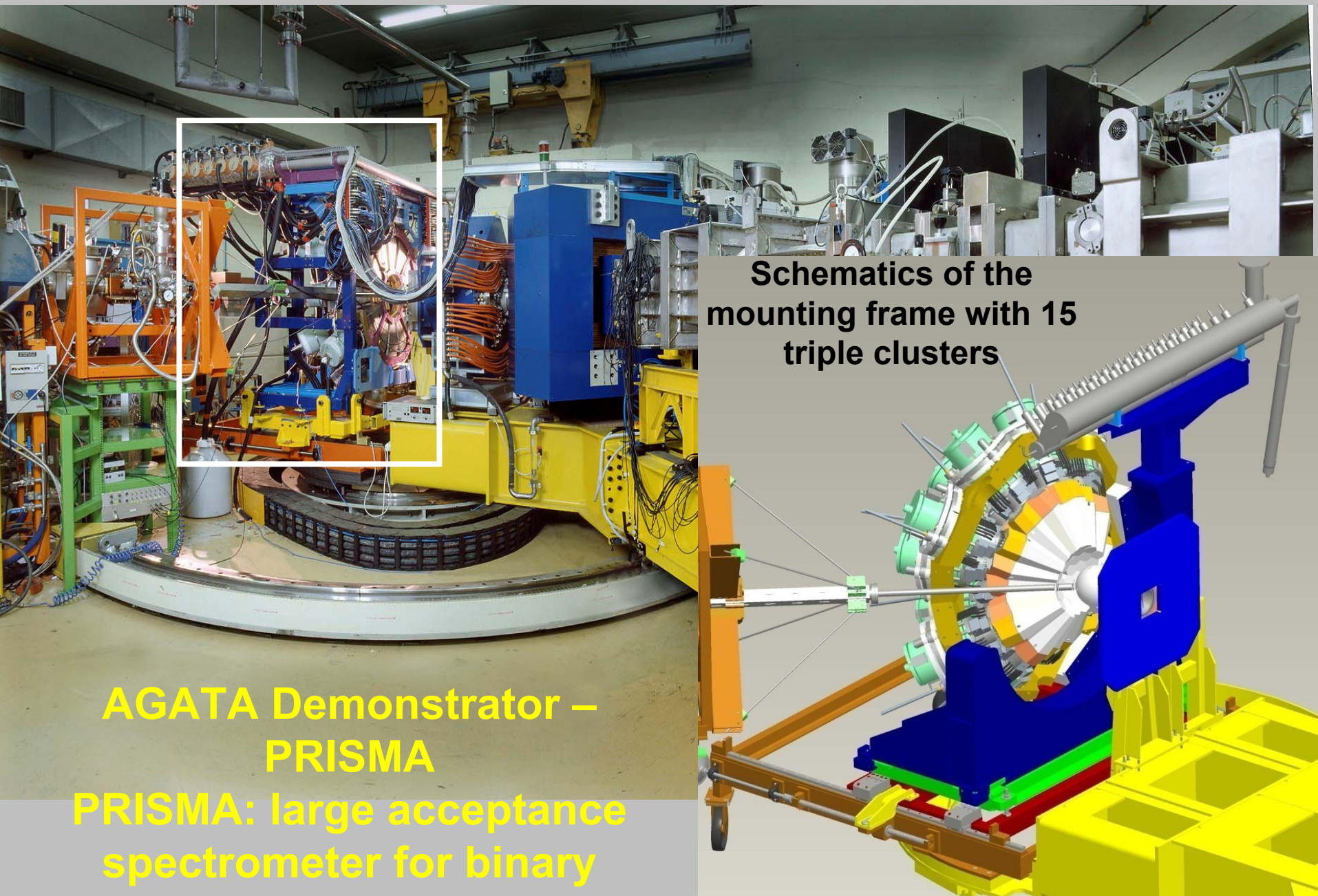


The AGATA Demonstrator performance figures

MC simulations by E.Farnea





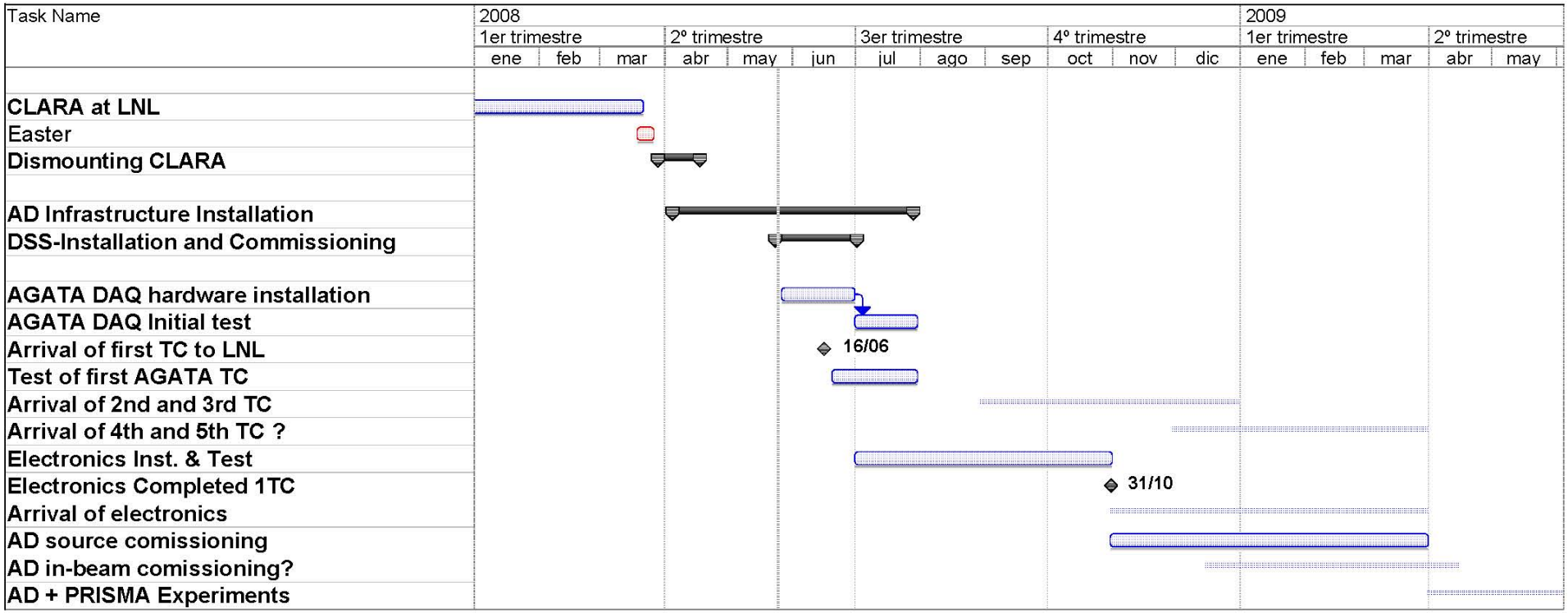


Schematics of the mounting frame with 15 triple clusters

AGATA Demonstrator – PRISMA

PRISMA: large acceptance spectrometer for binary

Installation of the AGATA Demonstrator at LNL



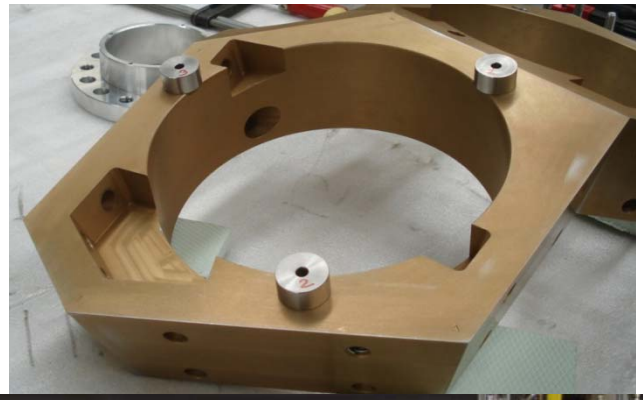
Currently: Installation of basic infrastructures at LNL

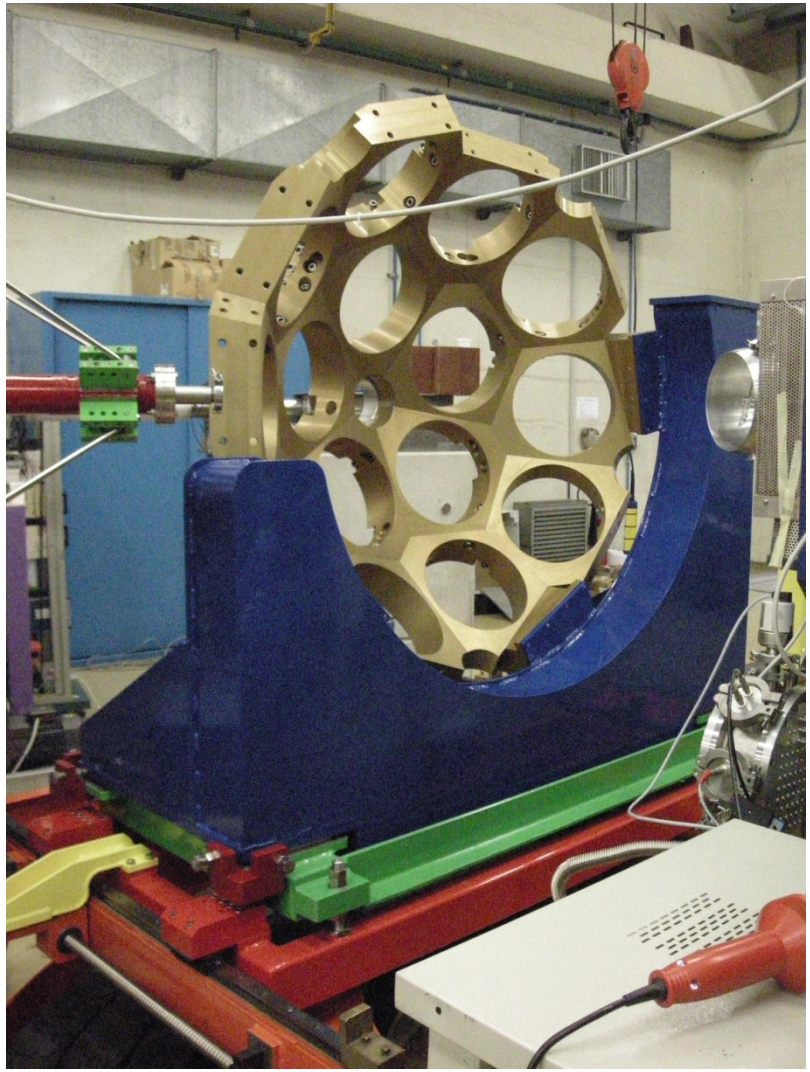
Mid-End June: Installation & Commissioning DSS

End June-July: first test with 1 AGATA TC

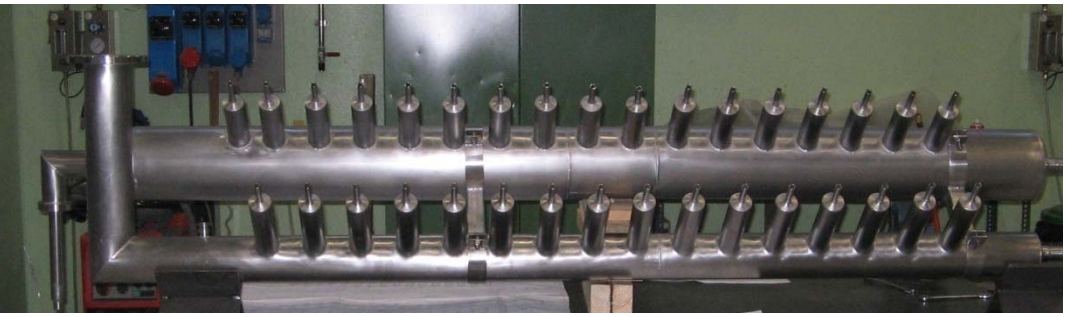
AGATA Demonstrator mechanics: from the single building block to the full structure.

(Design: STFC Daresbury, Construction: INFN-Padova, Milano, LNL)

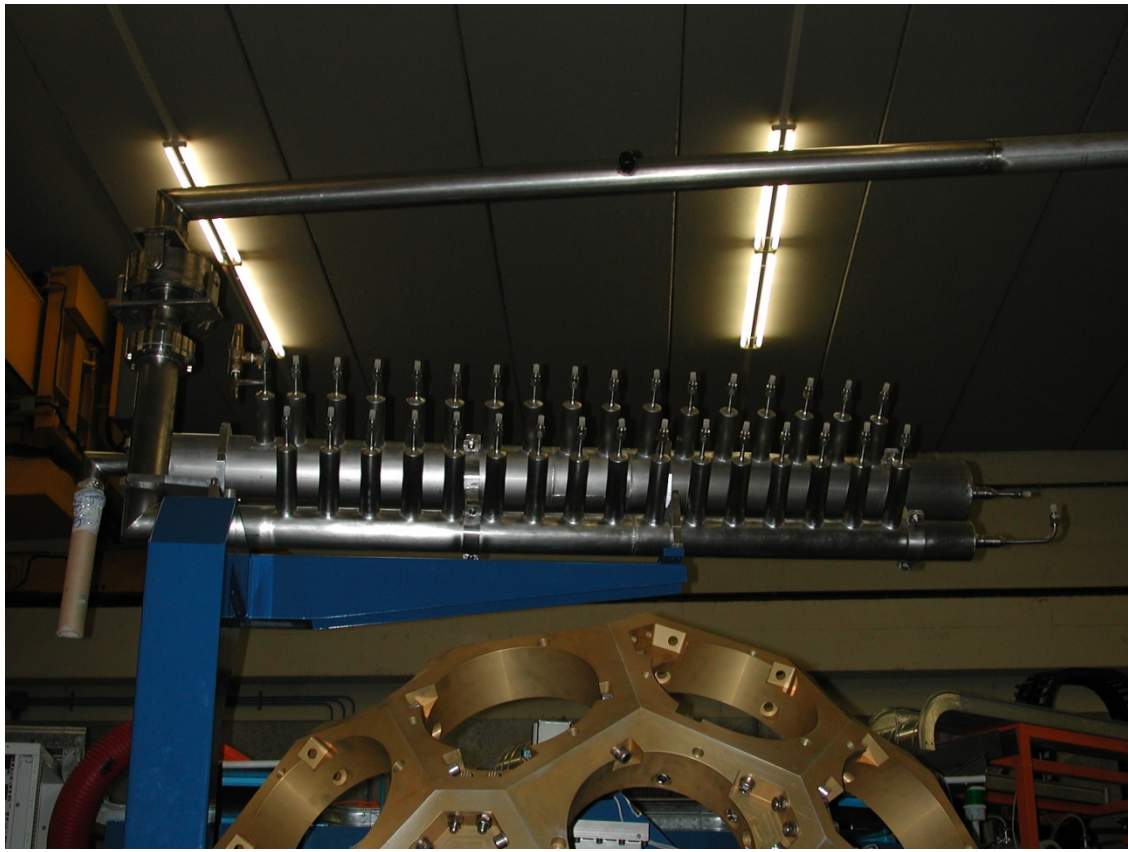




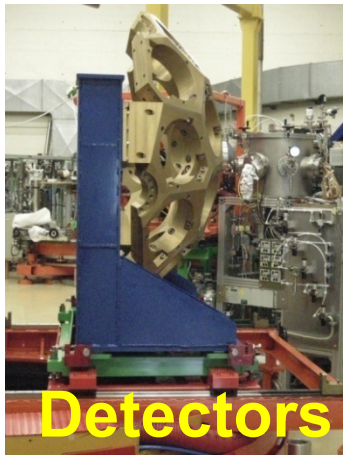
AGATA Demonstrator cryogenic infrastructures (INFN-LNL)

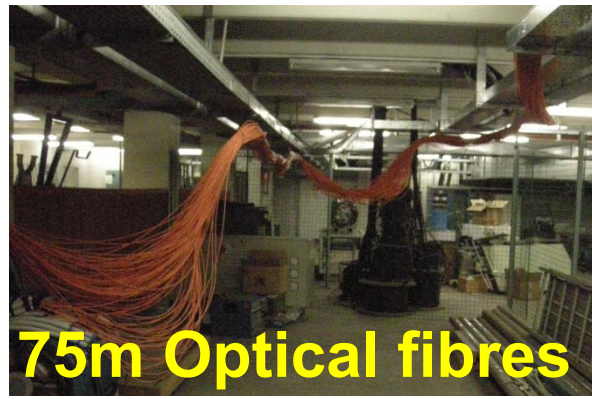


Distribution line, collector and evaporator for the LN2 excess: all parts mounted.

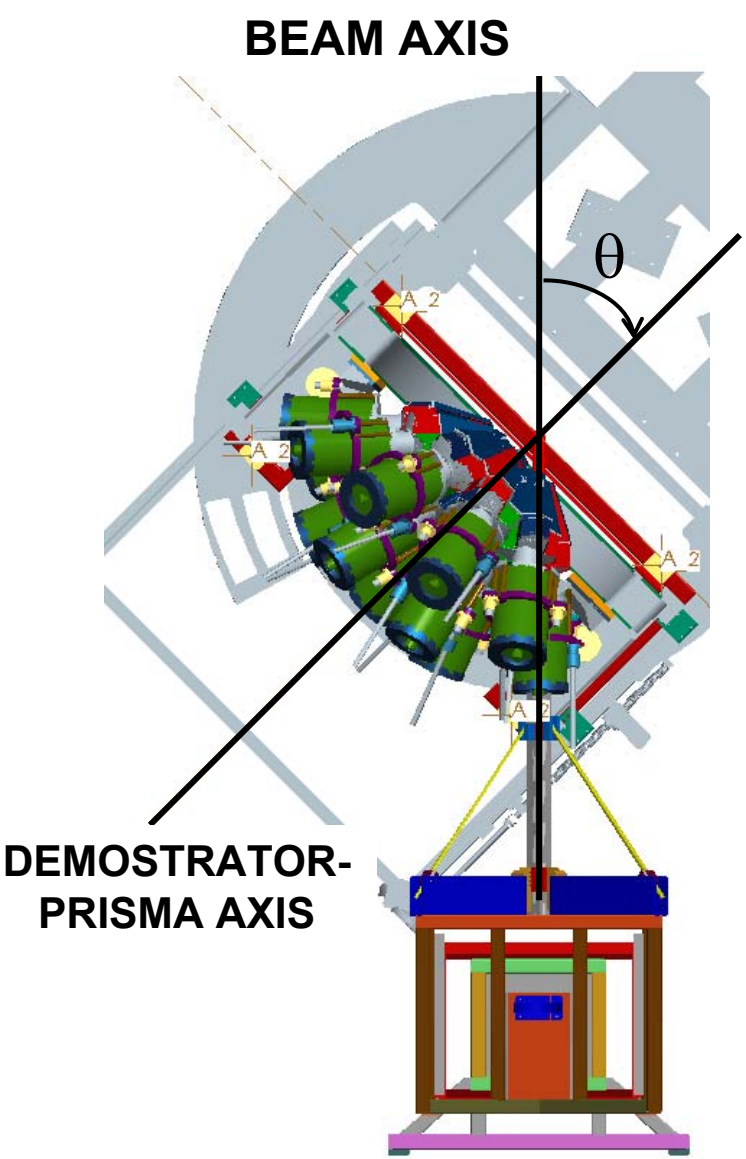


AGATA Demonstrator electronic infrastructures (INFN-LNL)





Installation of PSA and DAQ infrastructures ongoing



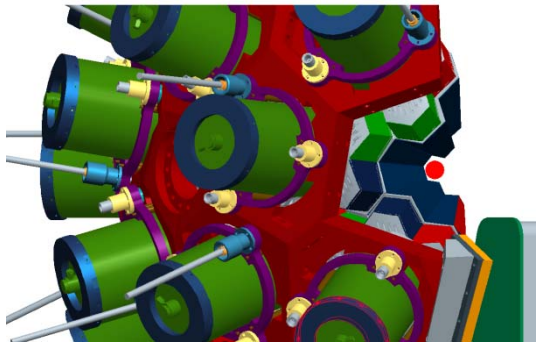
Angular Range For The AGATA DEMONSTRATOR- PRISMA Setup

Distance target-AGATA ~14cm
(efficiency ~6%)

58° to 130°
fix 37° and 0°

Distance target-AGATA ~23cm
(efficiency ~3%)

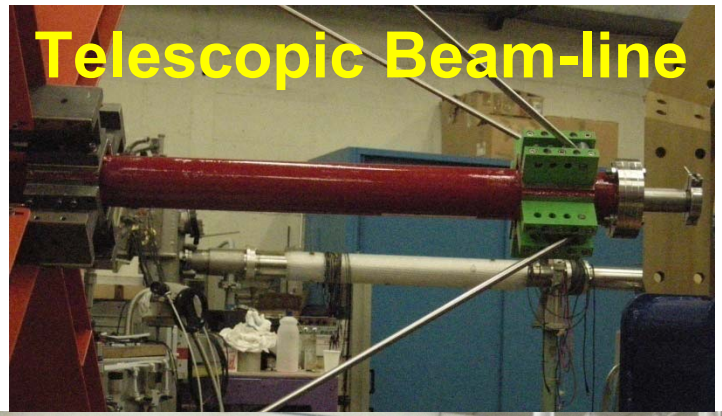
38° to 130°
fix 21° and 0°

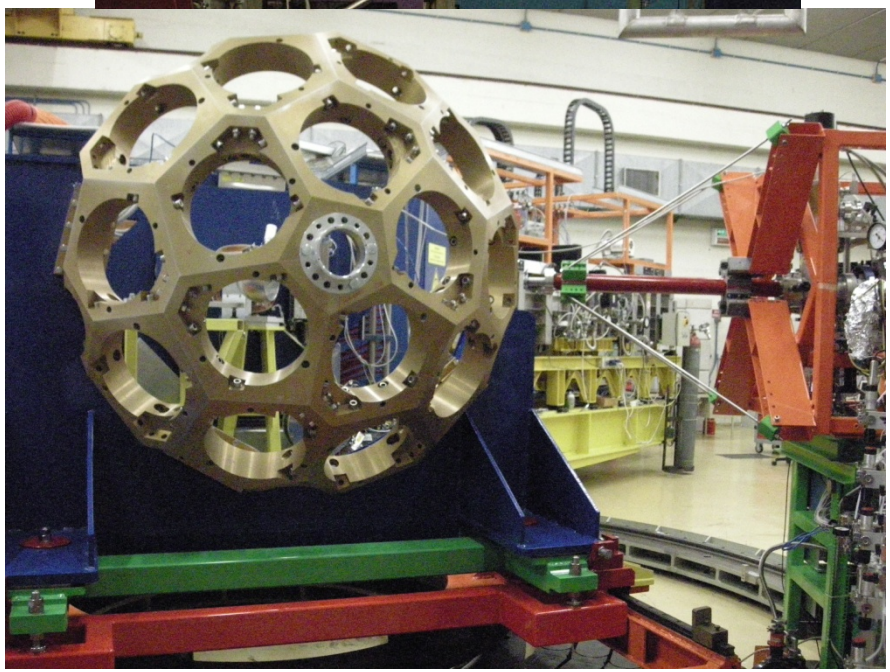


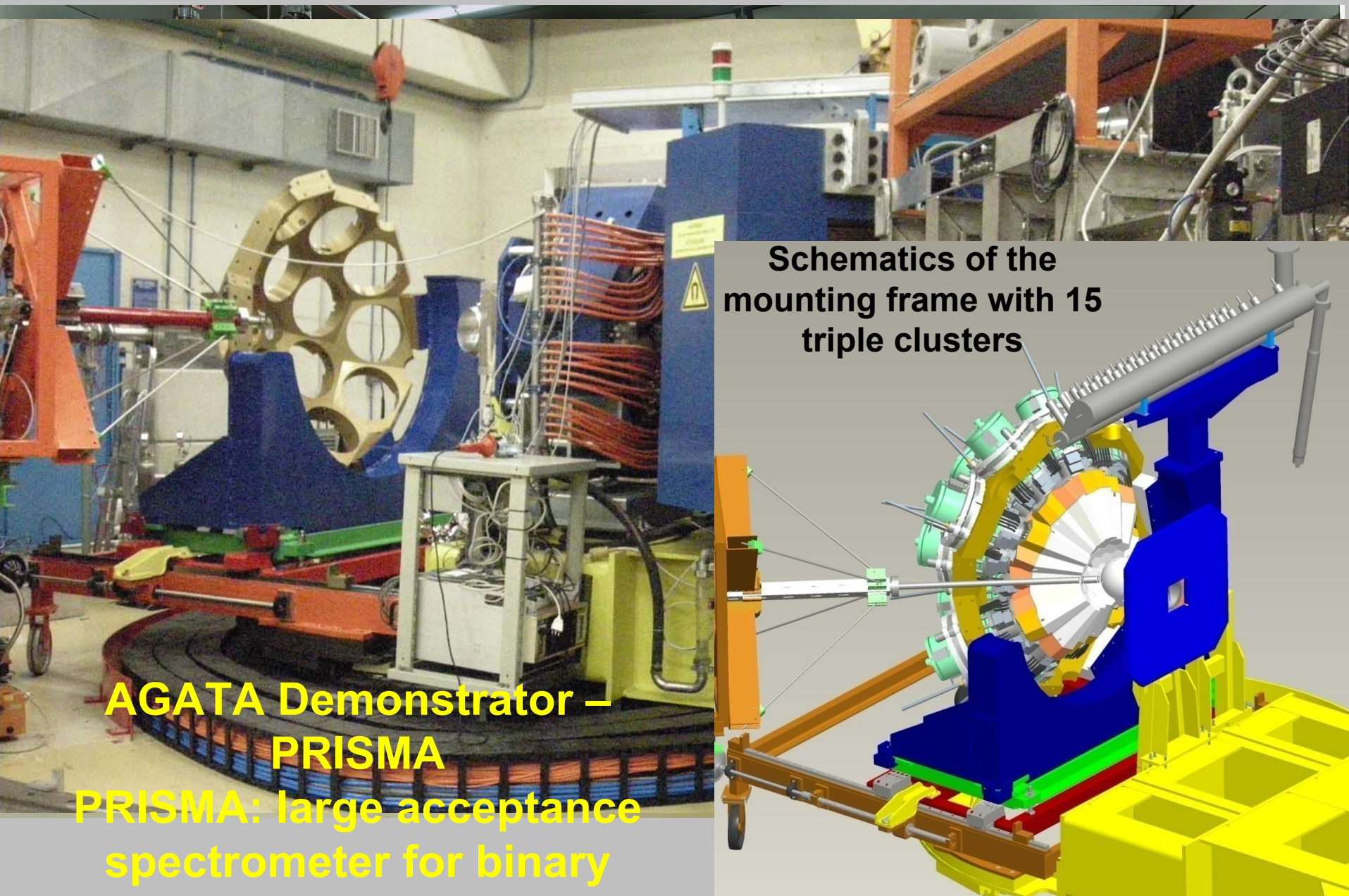
Design Engineer: Rob Griffiths
Project Engineer: John Strachan
STFC Daresbury Laboratory

AGATA Demonstrator – PRISMA reaction chamber and beam-line.

(Construction: INFN-Milano, LNL)





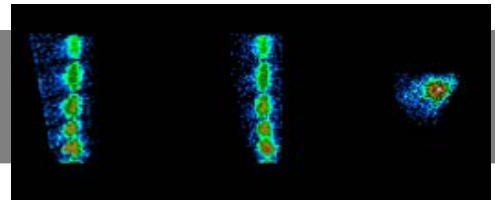


Schematics of the mounting frame with 15 triple clusters

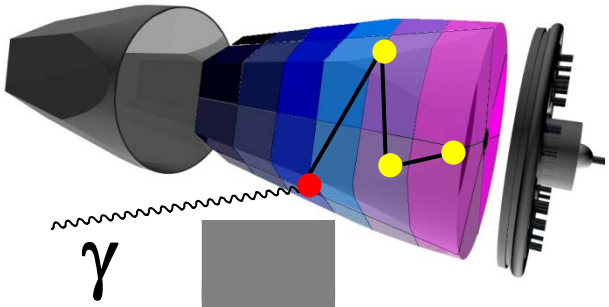
AGATA Demonstrator – PRISMA

PRISMA: large acceptance spectrometer for binary

Demonstration: concept of γ-Tracking



Highly segmented HPGe detectors

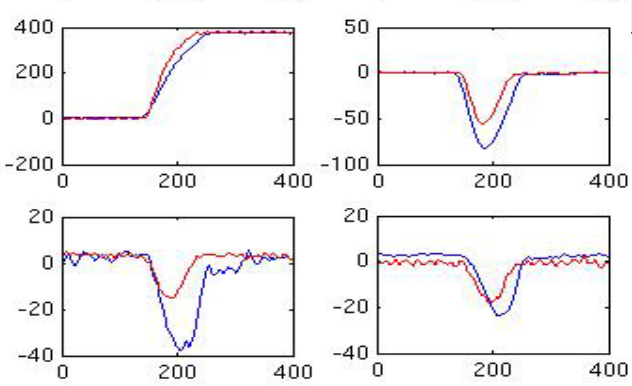


Digital electronics to record and process the segment signals DIGITIZERS + PRE-PROCESSING

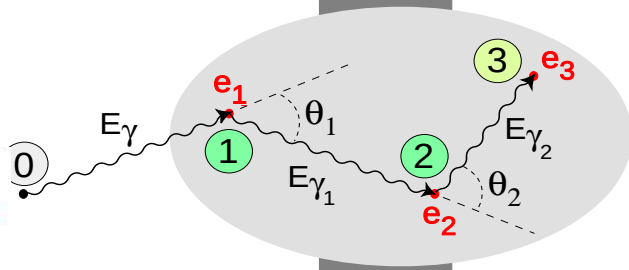
Identified interaction points

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

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

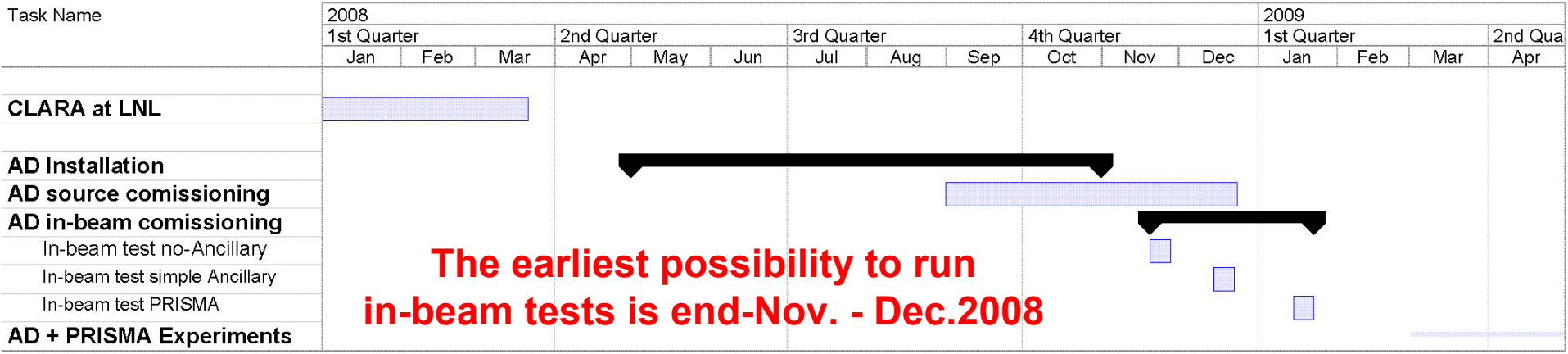


Reconstruction of tracks e.g. by evaluation of permutations of interaction points TRACKING



On-line reconstruction of γ-rays

Commissioning Preliminary Plan



- **Phase 0:** commissioning with radioactive sources starting when detectors and electronics are available (even partially).
- **Phase 1:** easy test with tandem beams with no ancillary detectors. Radiative capture or fusion-evaporation reactions with light targets in inverse kinematics.
- **Phase 2:** test with a “simple” ancillary detector with limited number of parameters (DANTE). Coulomb excitation reactions with medium mass beams (A<100) in inverse kinematics.
- **Phase 3:** test with PRISMA with multi-nucleon transfer reactions and at high multiplicity with appropriate ancillaries.

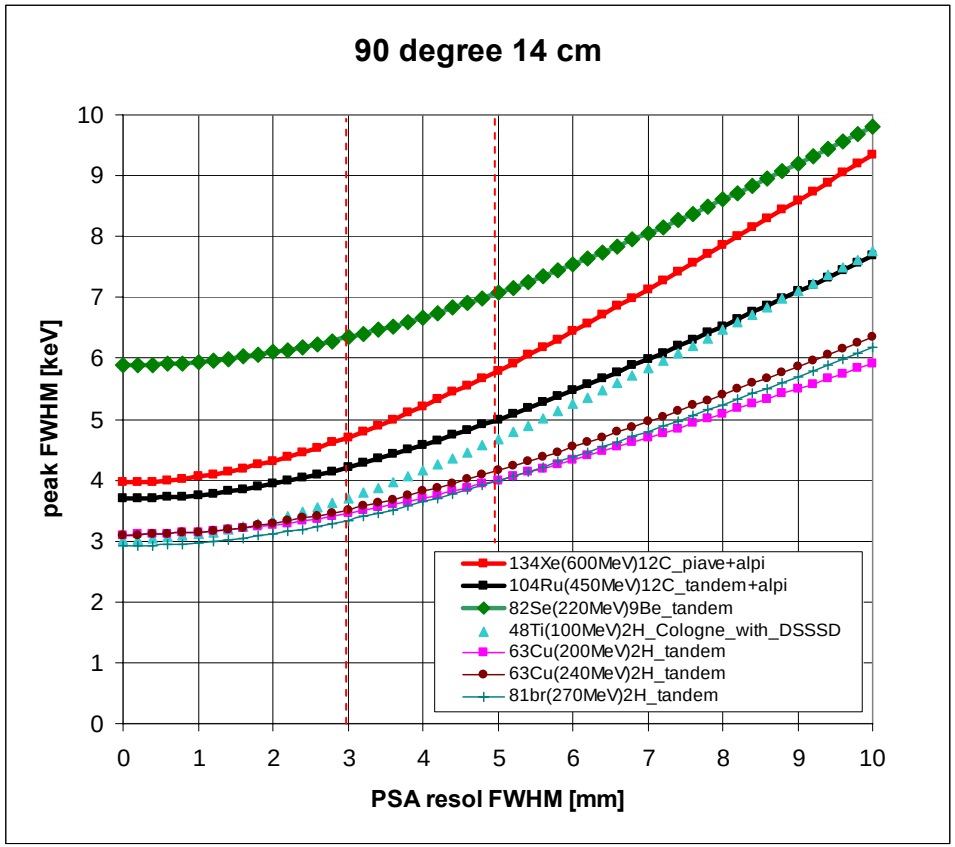
- In-beam test with no ancillary. Initial test of the PSA and tracking algorithms. Required reactions products with narrow angular distributions, inverse kinematics.

fussion evaporation with light targets (θ_{FWHM} << 1º)

^{37}Cl 75MeV + deuterated Pd target → ^{38}Ar (E_γ=~1MeV)

^{63}Cu 240MeV + deuterated Pd target → ^{64}Zn (E_γ=~1MeV)

^{81}Br 270MeV + deuterated Pd target → ^{82}Kr (E_γ=~0.8-1.5MeV)

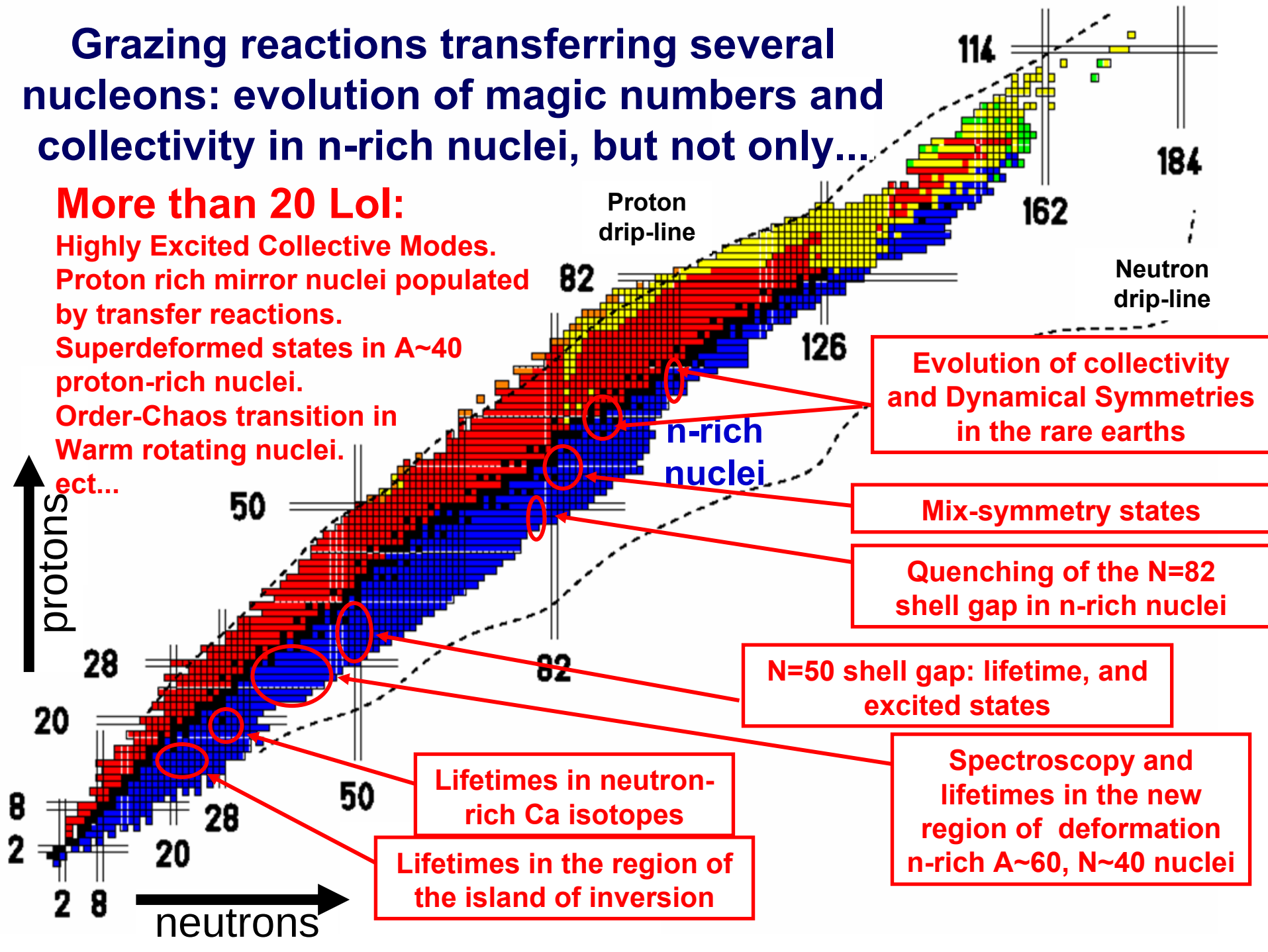


Peak resolution (FWHM) as function of the PSA resolution (FWHM) for an AGATA detector placed at 14 cm from the target at 90º

Grazing reactions transferring several nucleons: evolution of magic numbers and collectivity in n-rich nuclei, but not only...

More than 20 LoI:

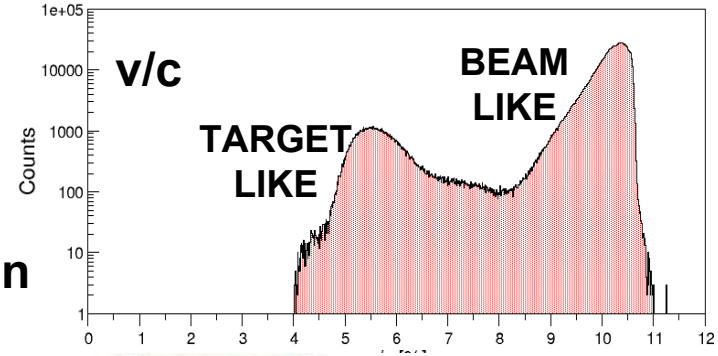
Highly Excited Collective Modes.
Proton rich mirror nuclei populated by transfer reactions.
Superdeformed states in A~40 proton-rich nuclei.
Order-Chaos transition in Warm rotating nuclei.
ect...

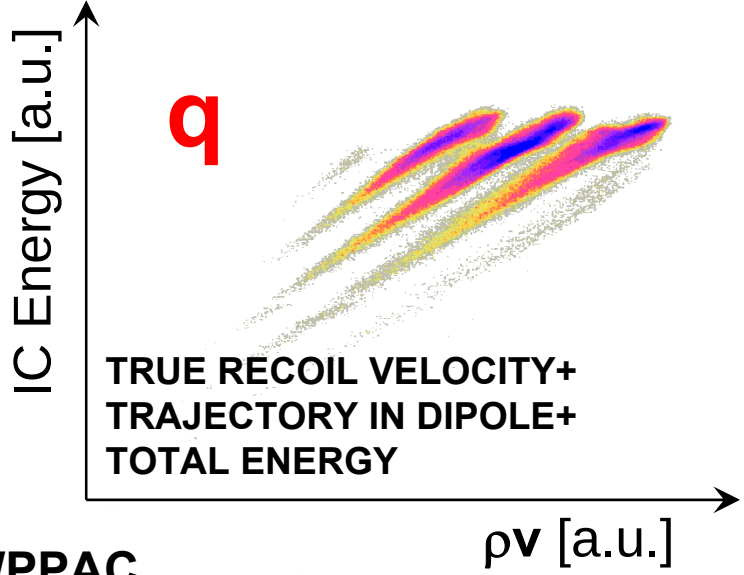


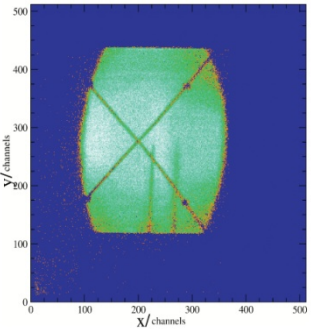
Tracking on PRISMA

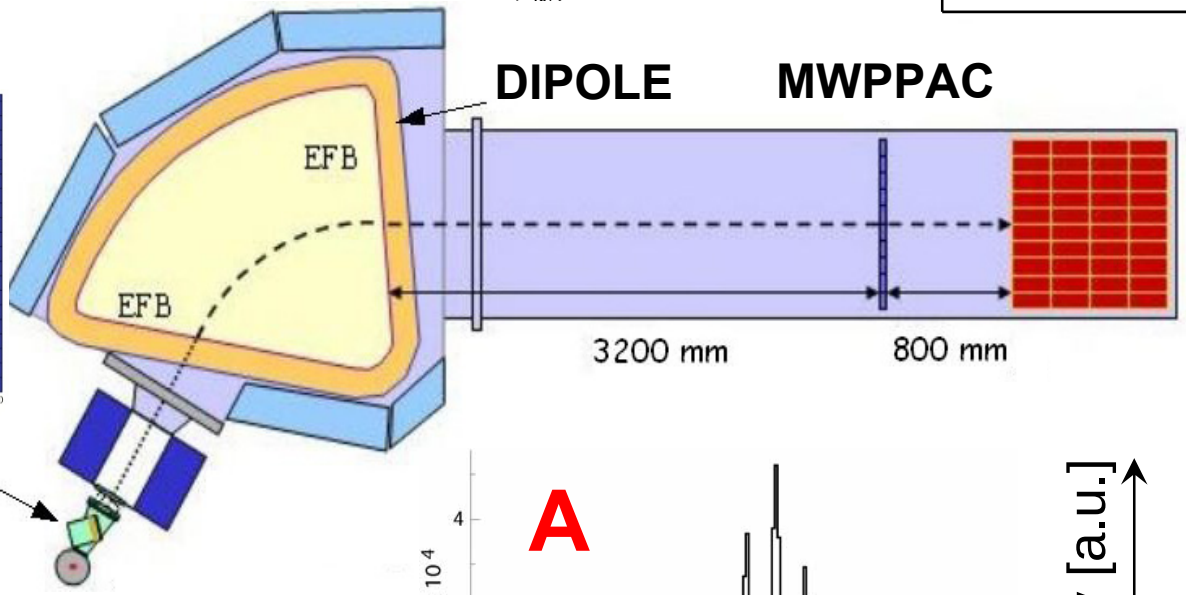
A/q

- true recoil velocity
- trajectory in dipole





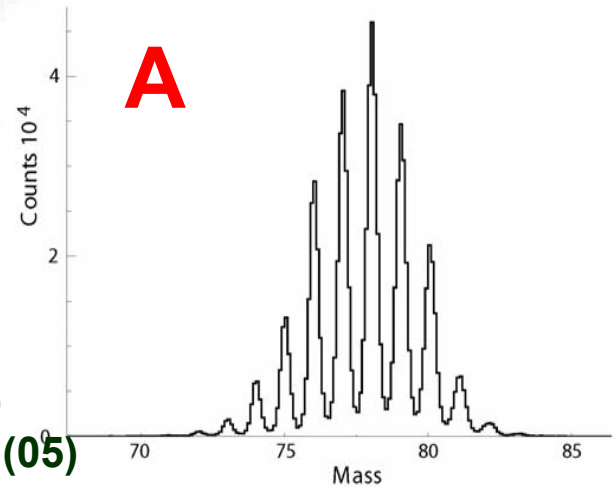


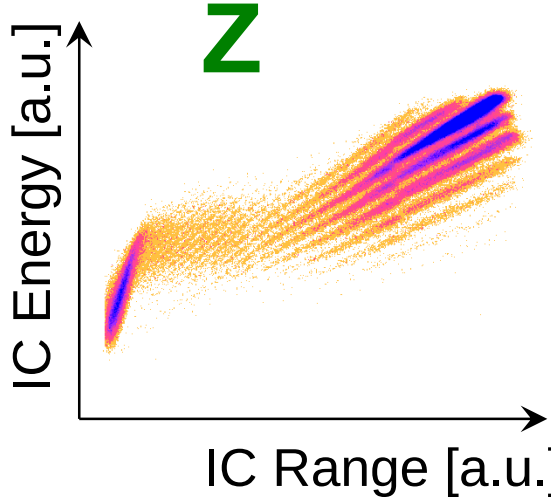


IONIZATION CHAMBER 5‰ Energy resolution

MCP Start Detector

MCP-MWPPAC ΔTOF=0.5 ns

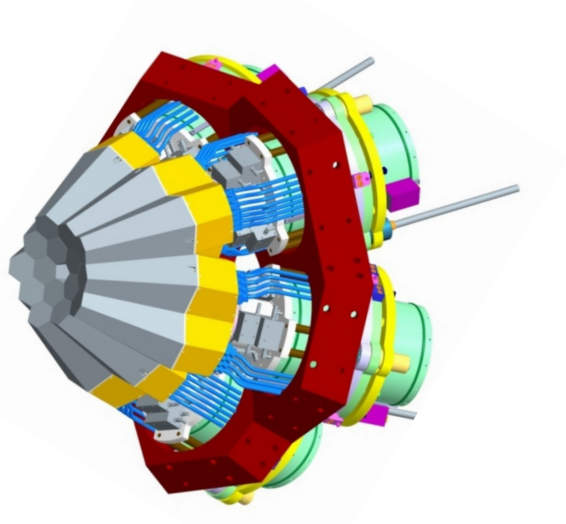




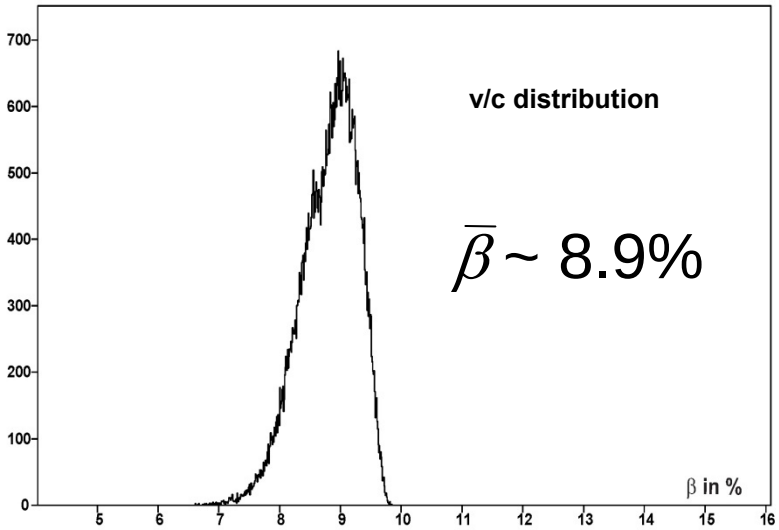
S.Beghini et al. NIM A551, 364 (05)
G.Montagnoli et al. NIM A547, 455 (05)

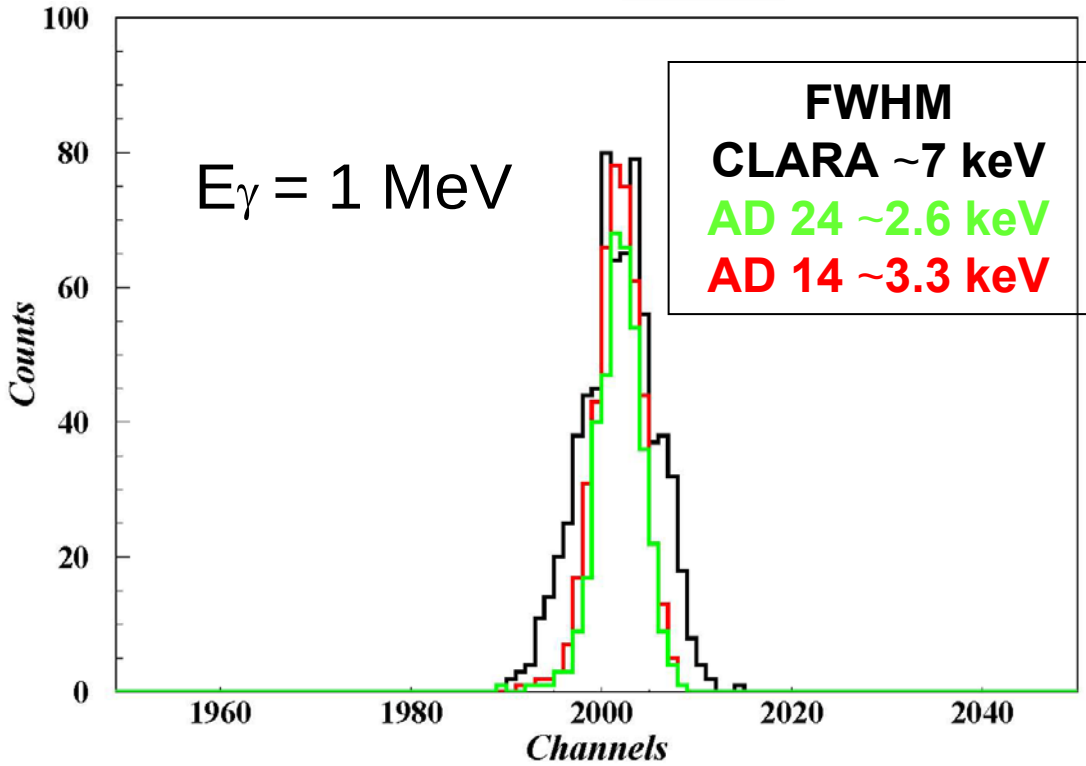
AGATA Demonstrator at PRISMA

Efficiency at 1MeV: ~6% at 14cm
Peak/Total: ~50%
Angles covered: from ~135º to 180º
FWHM, β~10%, 1MeV: <4 keV



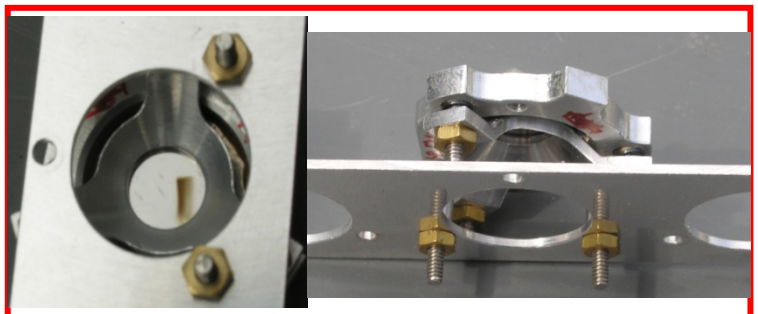
Simulation with full PRISMA reconstruction by E.Farnea



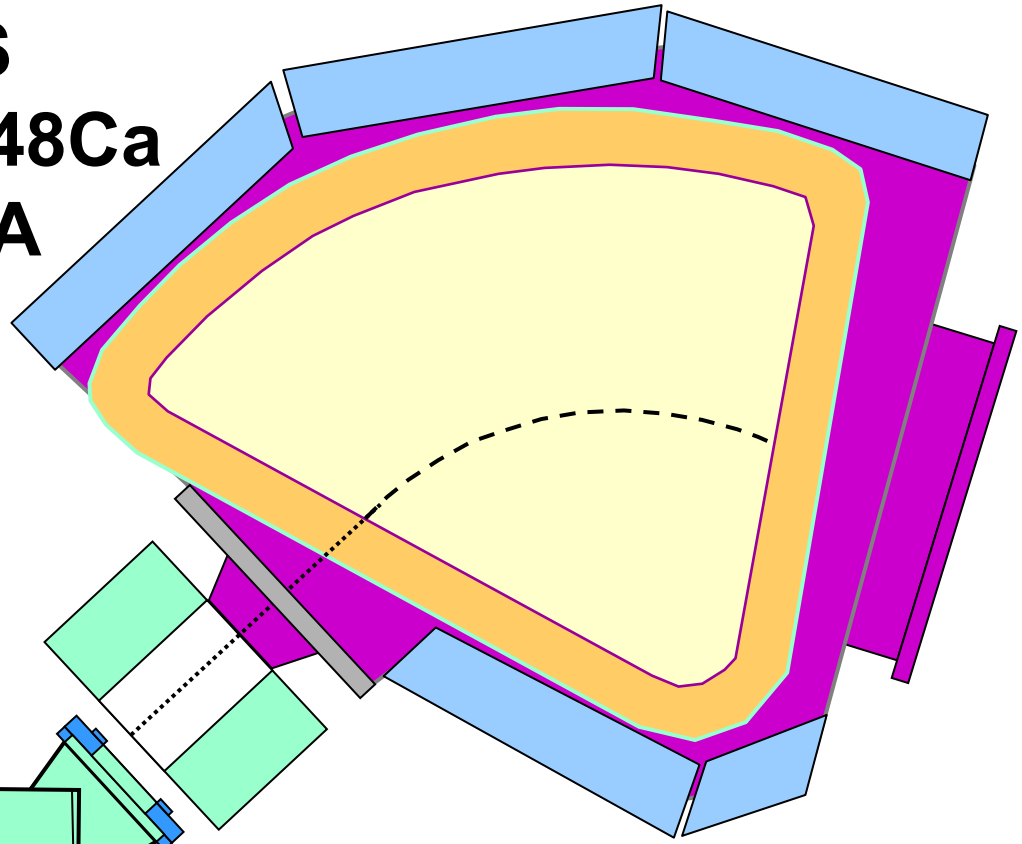


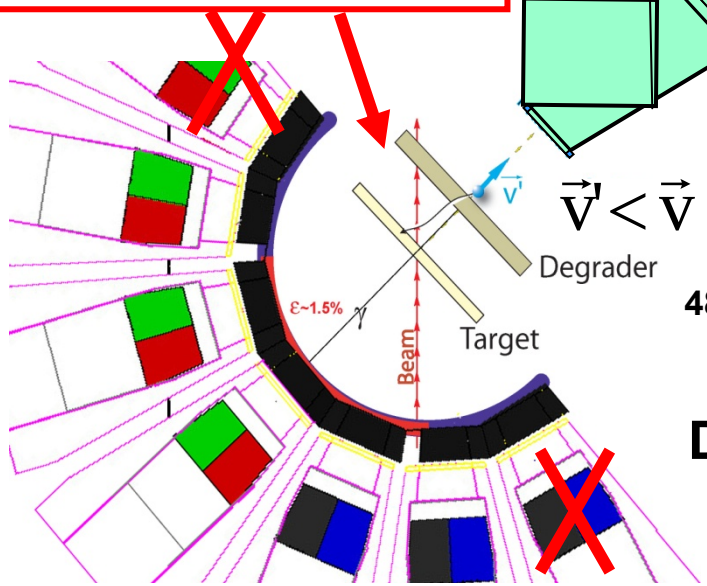
Differential RDDS Measurement in the 48Ca region with CLARA

D.Mengoni, J.Valiente, A.Gadea, A.Dewald



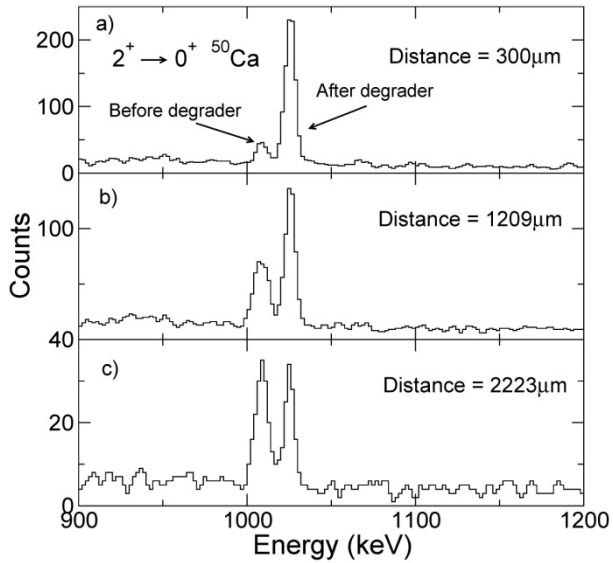
Differential Plunger for angles ≠ 0º



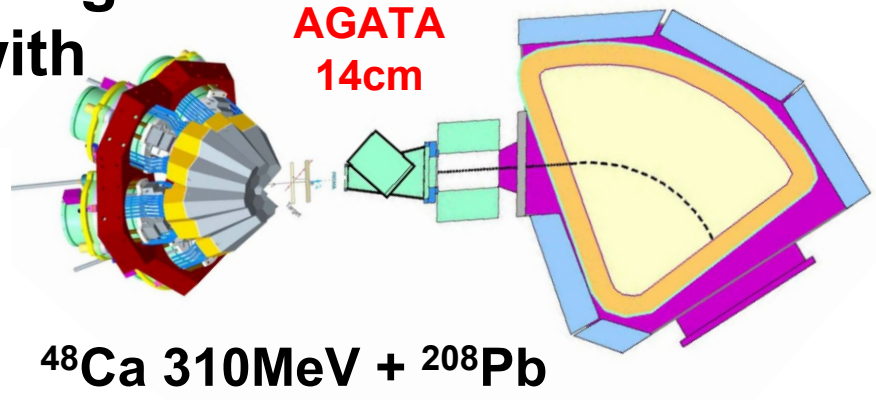


$\vec{v}' < \vec{v}$

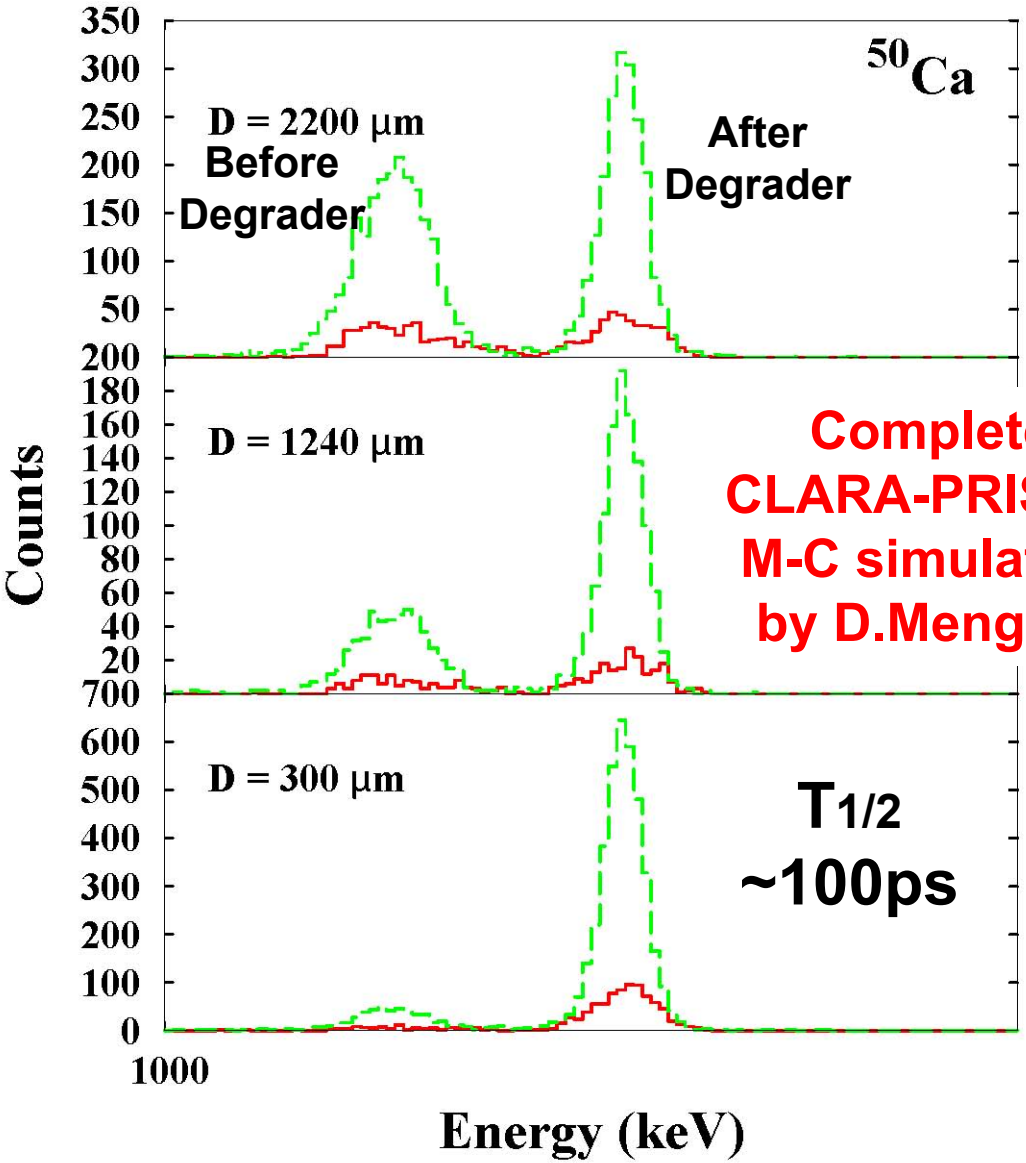
^{48}Ca 310MeV + ^{208}Pb (1mg) Degrader 4mg Mg



Comparison between the Diff.plunger lifetime experiment performed with CLARA and with the AGATA D.

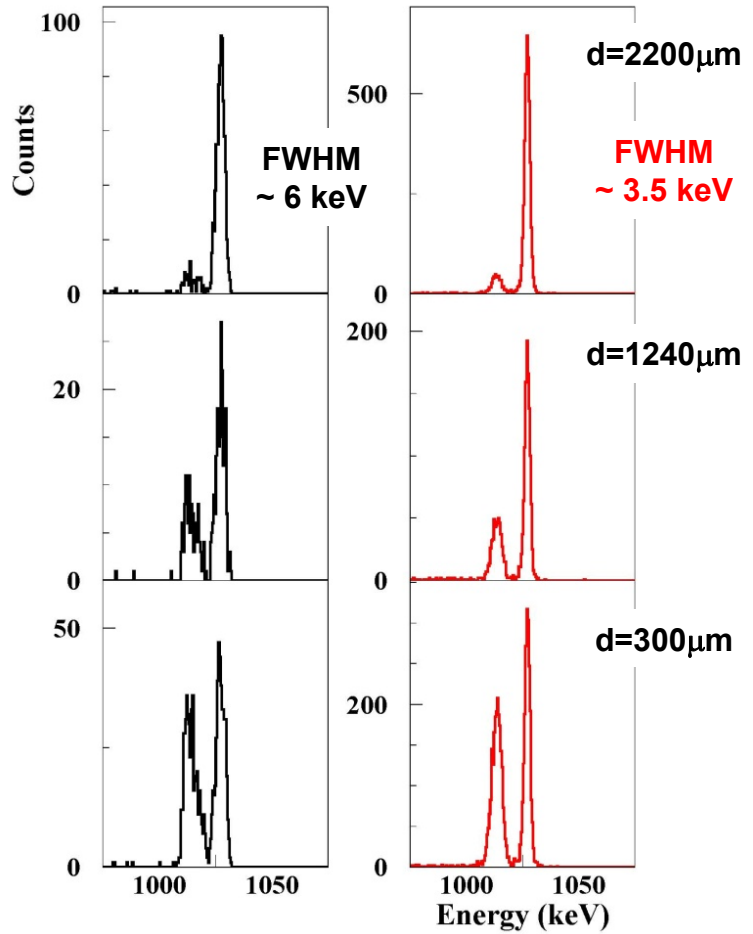


^{48}Ca 310MeV + ^{208}Pb



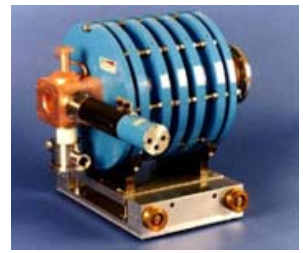
Complete CLARA-PRISMA M-C simulation by D.Mengoni

$T_{1/2}$ ~100ps



Outlook:

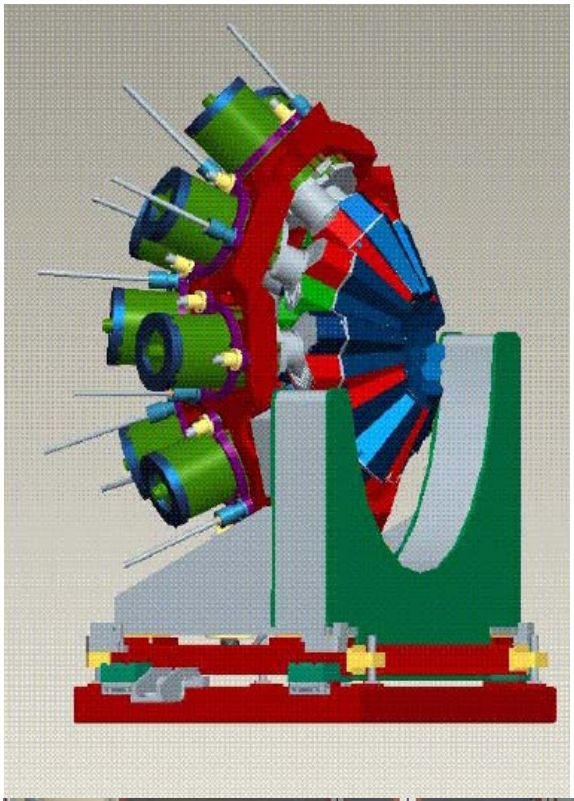
- LNL is doing a consistent effort to have the acceleration complex upgraded for the arrival of the AGATA Demonstrator (AD). A new ECR source is presently being installed .
- The basic infrastructures for AD will be completed by summer 2008 and, the first tests with an AGATA TC are expected between summer and October.
- For the physics campaign, following the Demonstration, the AD is will provide experimental capabilities beyond CLARA.
- Installation possible thanks to the AGATA and INFN-AGATA collaborations



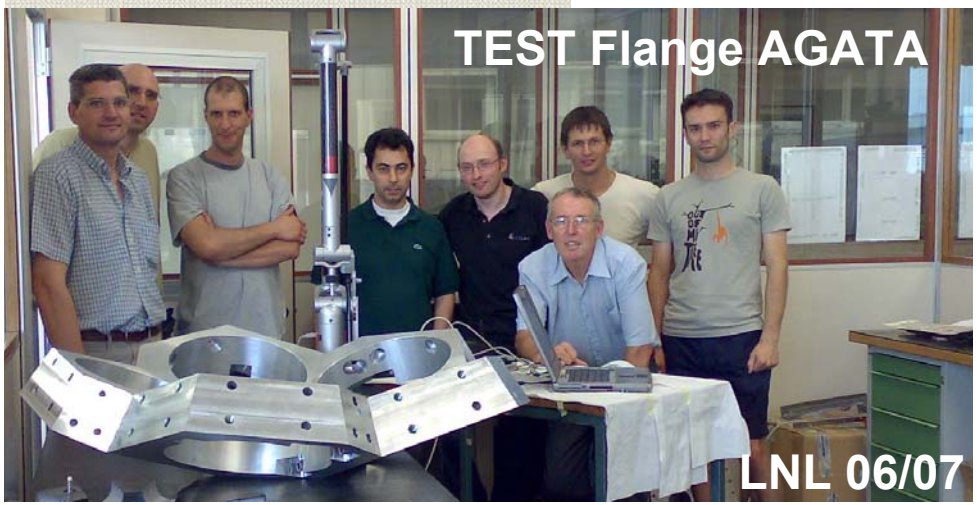
Some expected beams in 2009

Ion	*mass*	*charge*	*m/q*	E_M *(Mev/A)*	I_{targ} *(pnA)*
Ar	40	9	4,44	13,3	60
Zn	70	13	5,38	9,6	46
Kr	86	17	5,06	10,1	17
Sn	124	20	6,20	8,1	10
Xe	136	26	5,23	9,9	19
Au	197	28	7,04	6,6	21
Pb	208	30	6,93	6,7	3,3

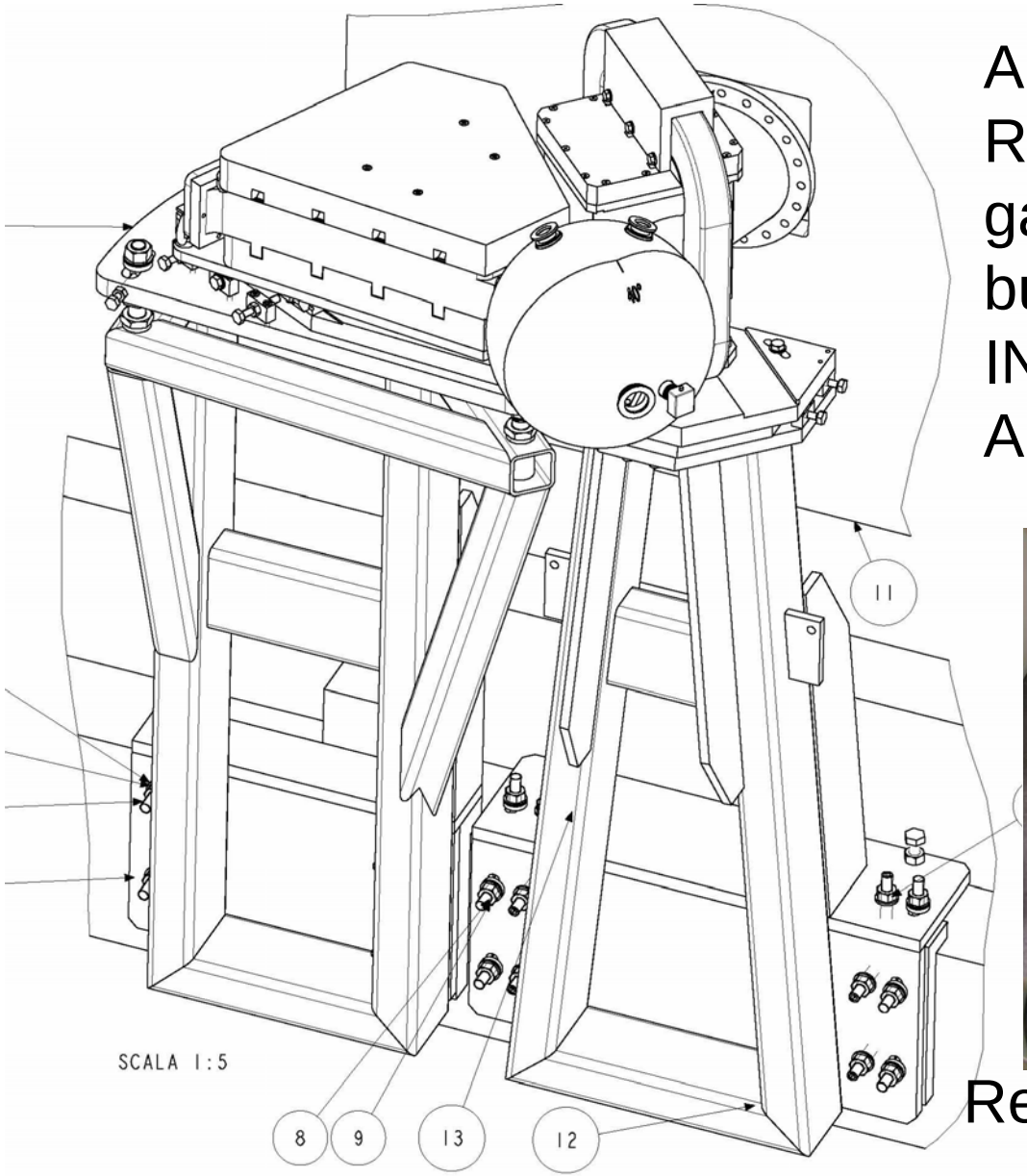
Support Structure Mechanics:



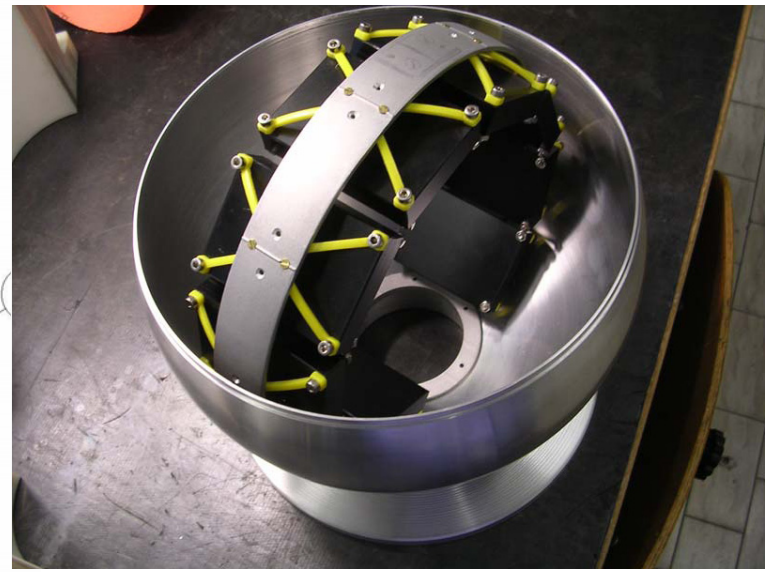
-Design completed by STFC Daresbury early summer 2007
-Machining of the flanges done by INFN – Padova, Milano and LNL
-16 Flanges ready, excluding limited machining at LNL.
-Mounting test (5 flanges) performed end of June. Required tooling for accurate mounting
-Surface treatment expected ready by December 2007
-Mounting test 15 flanges Dec. 2007 – Jan. 2008?



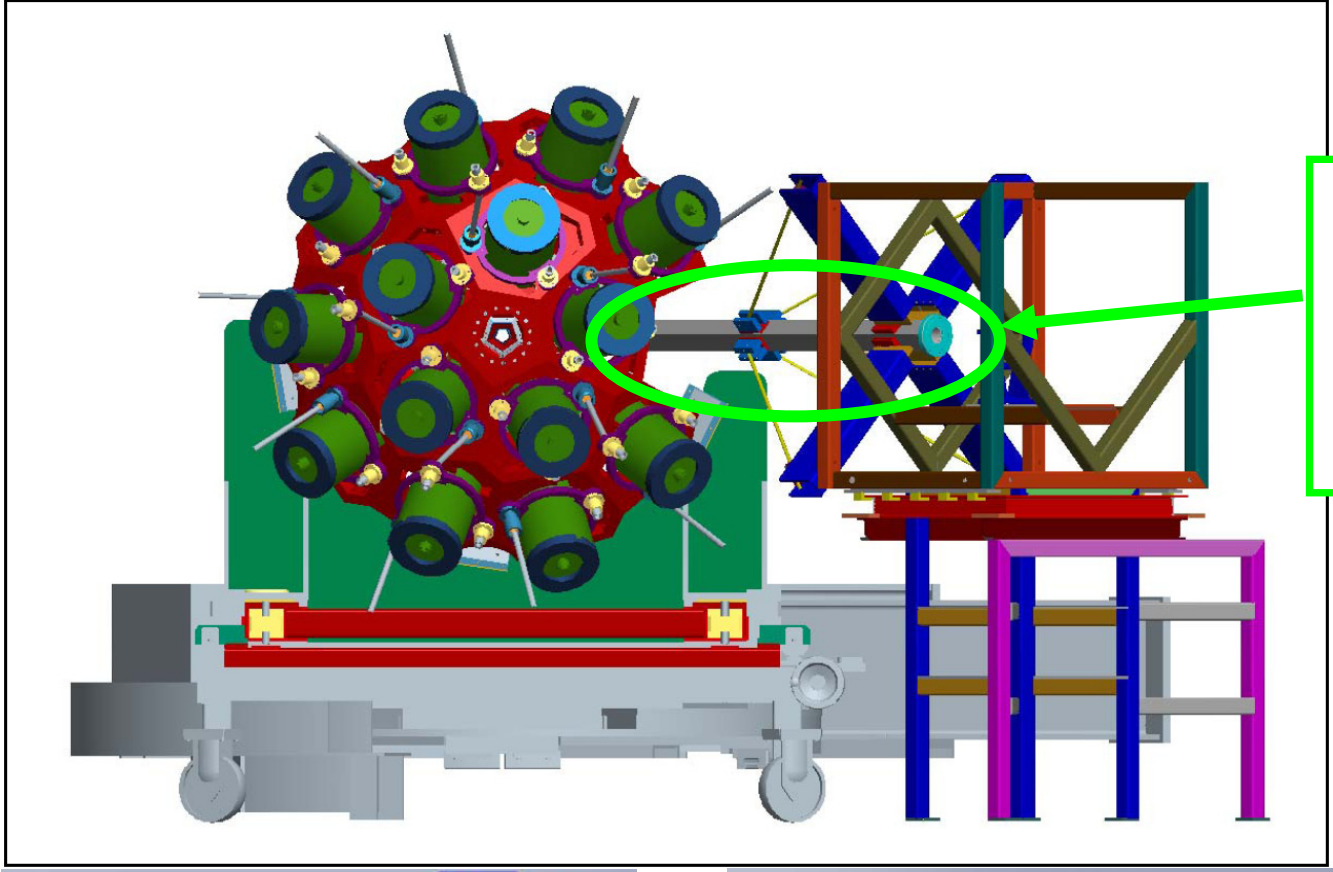
-Purchased the pre-machined parts to build the under-lying (welded) structure
-Design of the LN2 cryogenic line support by STFC ready.
-Scheduled the construction of the structures from December



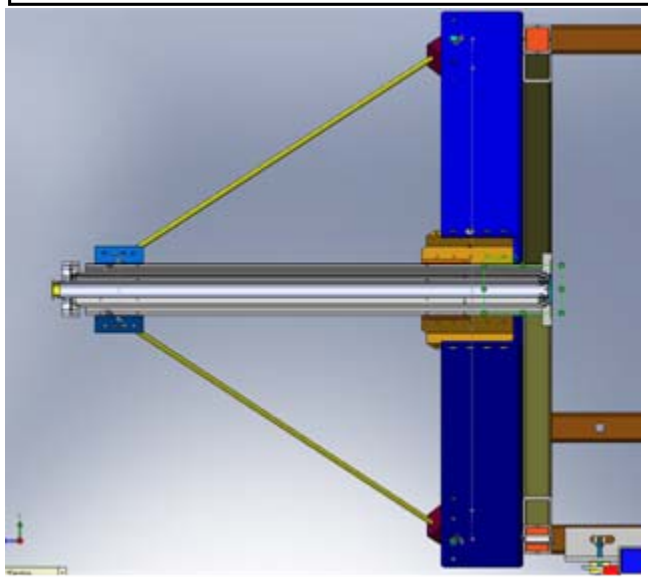
AGATA Demonstrator
Reaction chamber with low gamma-ray absorption build by INFN-Milano and INFN-LNL
Angular range ~0^{o} to ~130^{o}



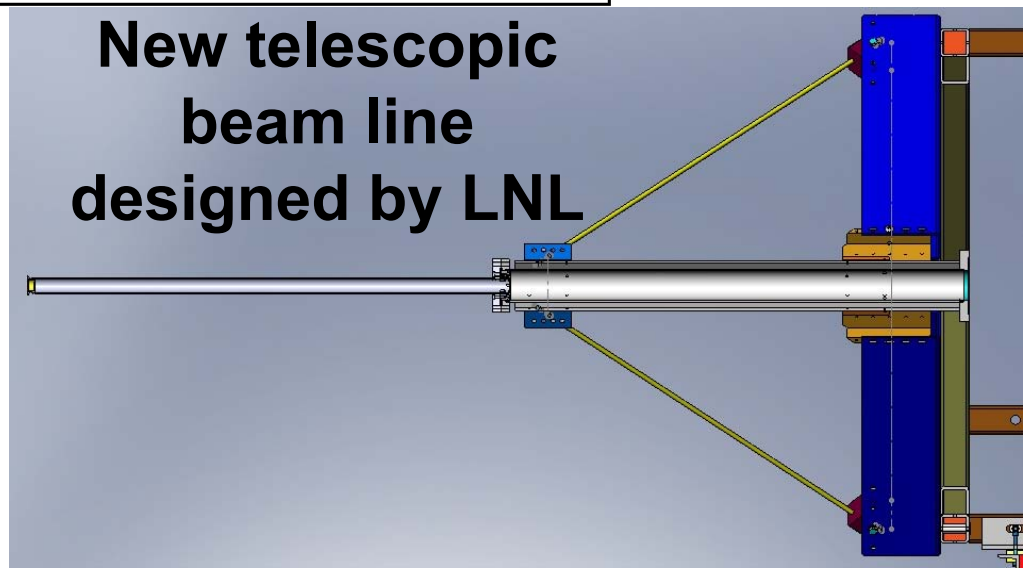
Reaction chamber main body with the 90° DANTE ring



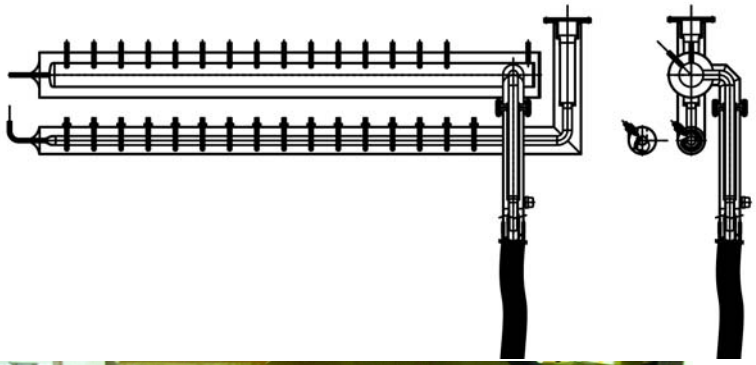
Beam-Line for the CLARA reaction Chamber

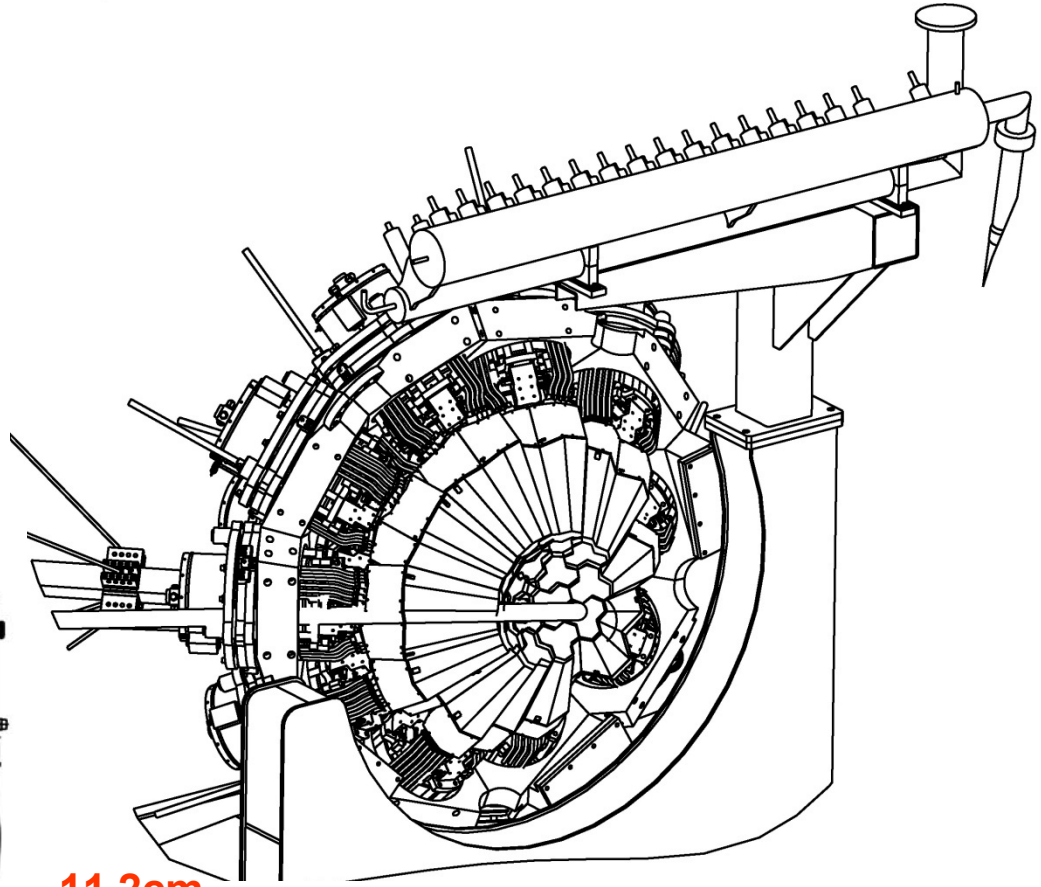


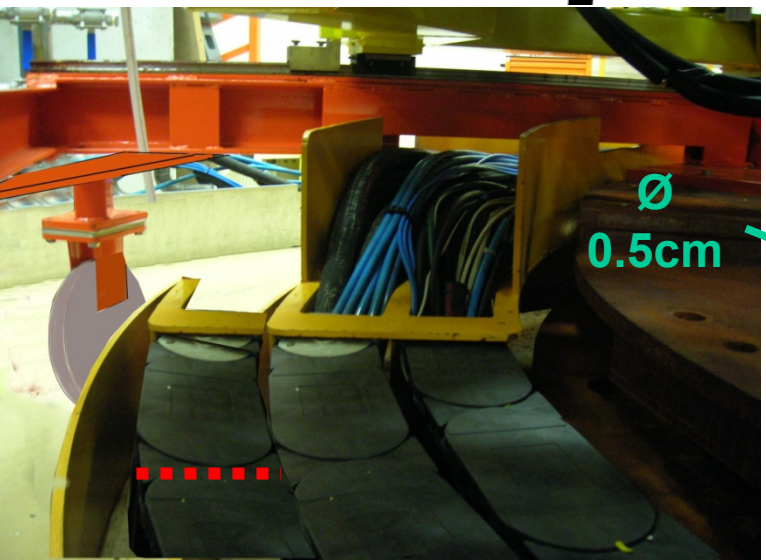
New telescopic beam line designed by LNL

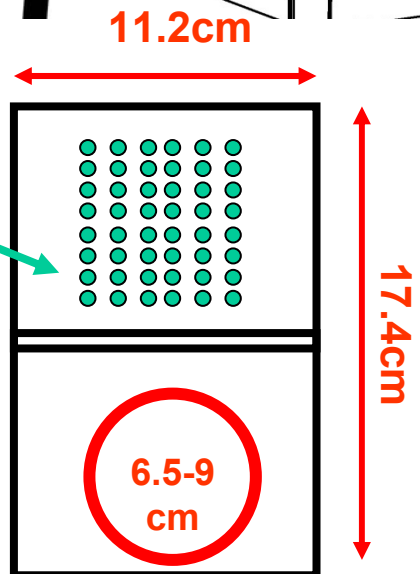


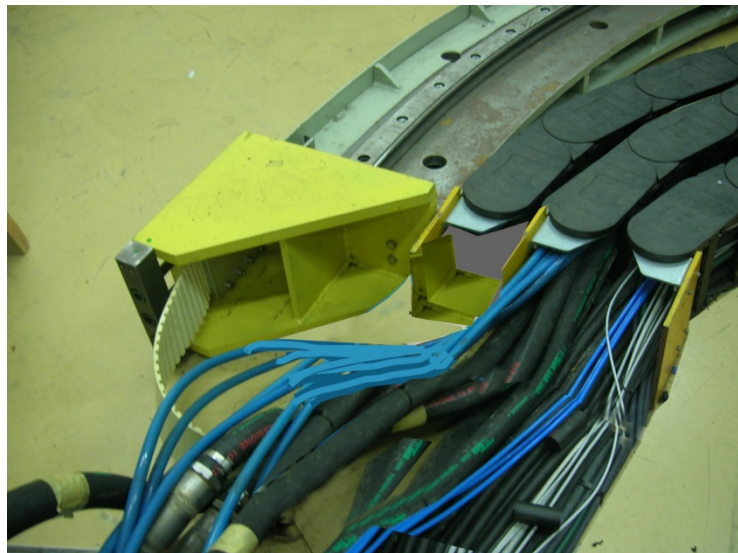
Liquid Nitrogen distribution system and collector for the residual Liquid/gas Nitrogen. The optical fibres and the vacuum hose for the residual LN2 will be inside a cabling flexible tray

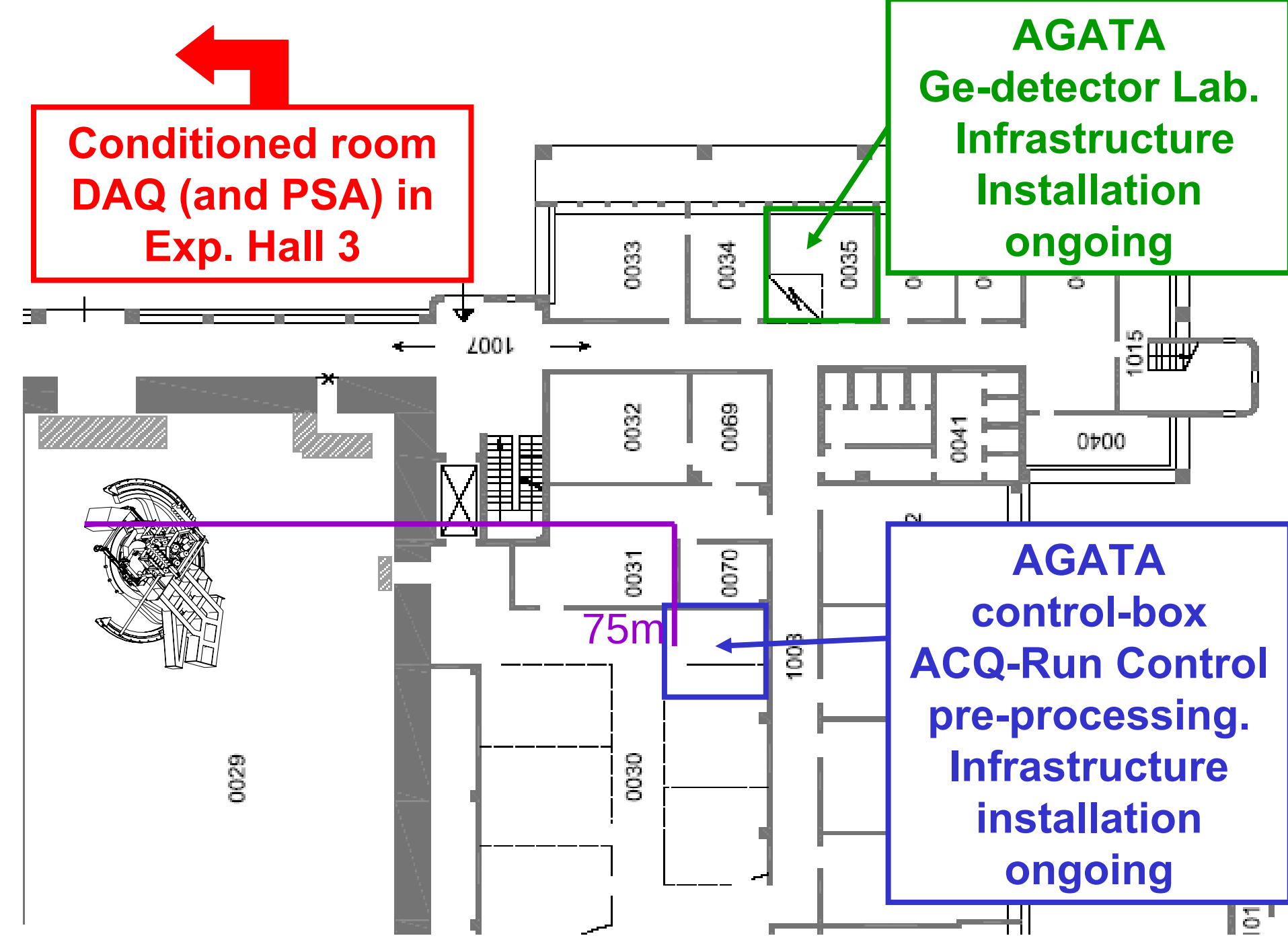


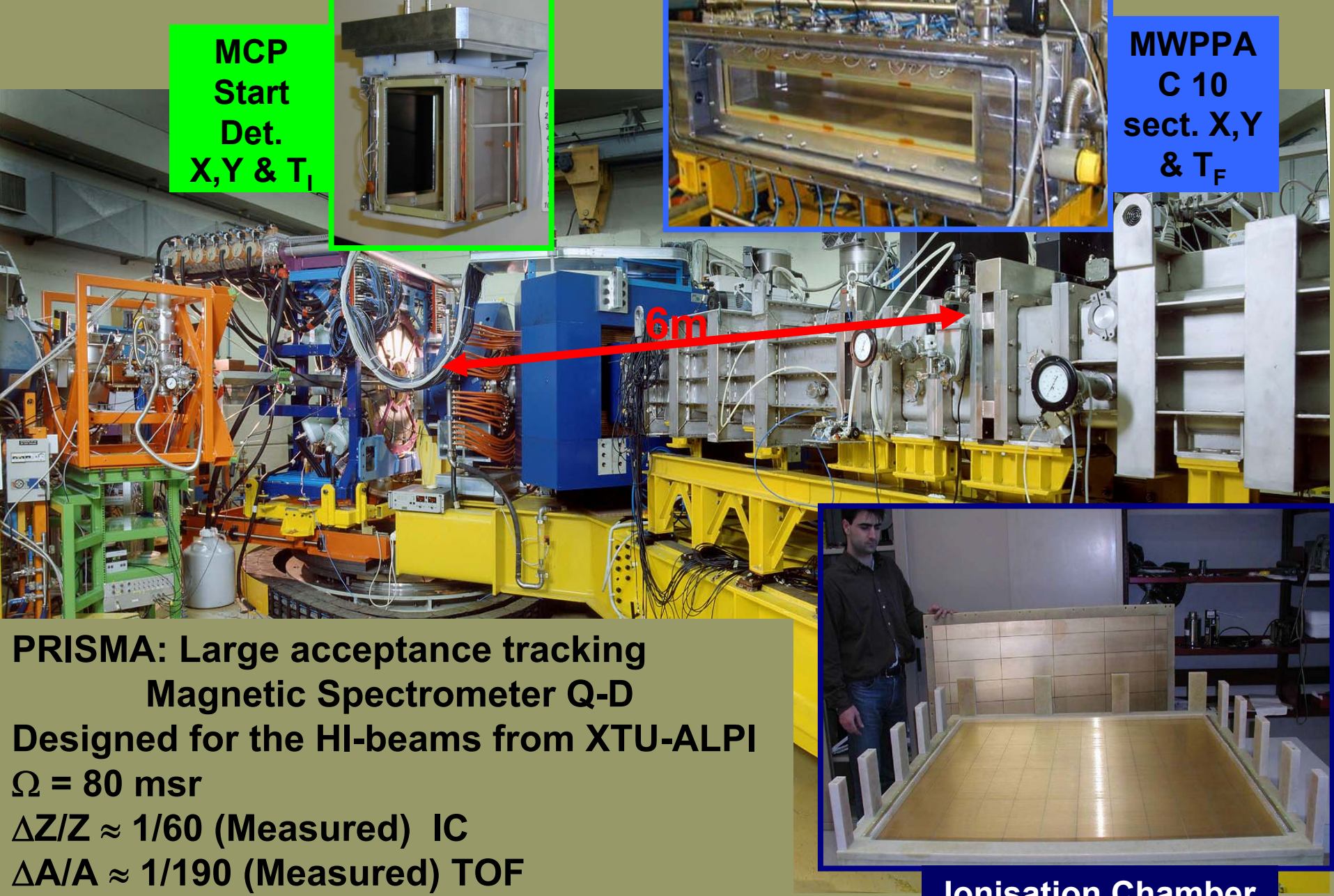






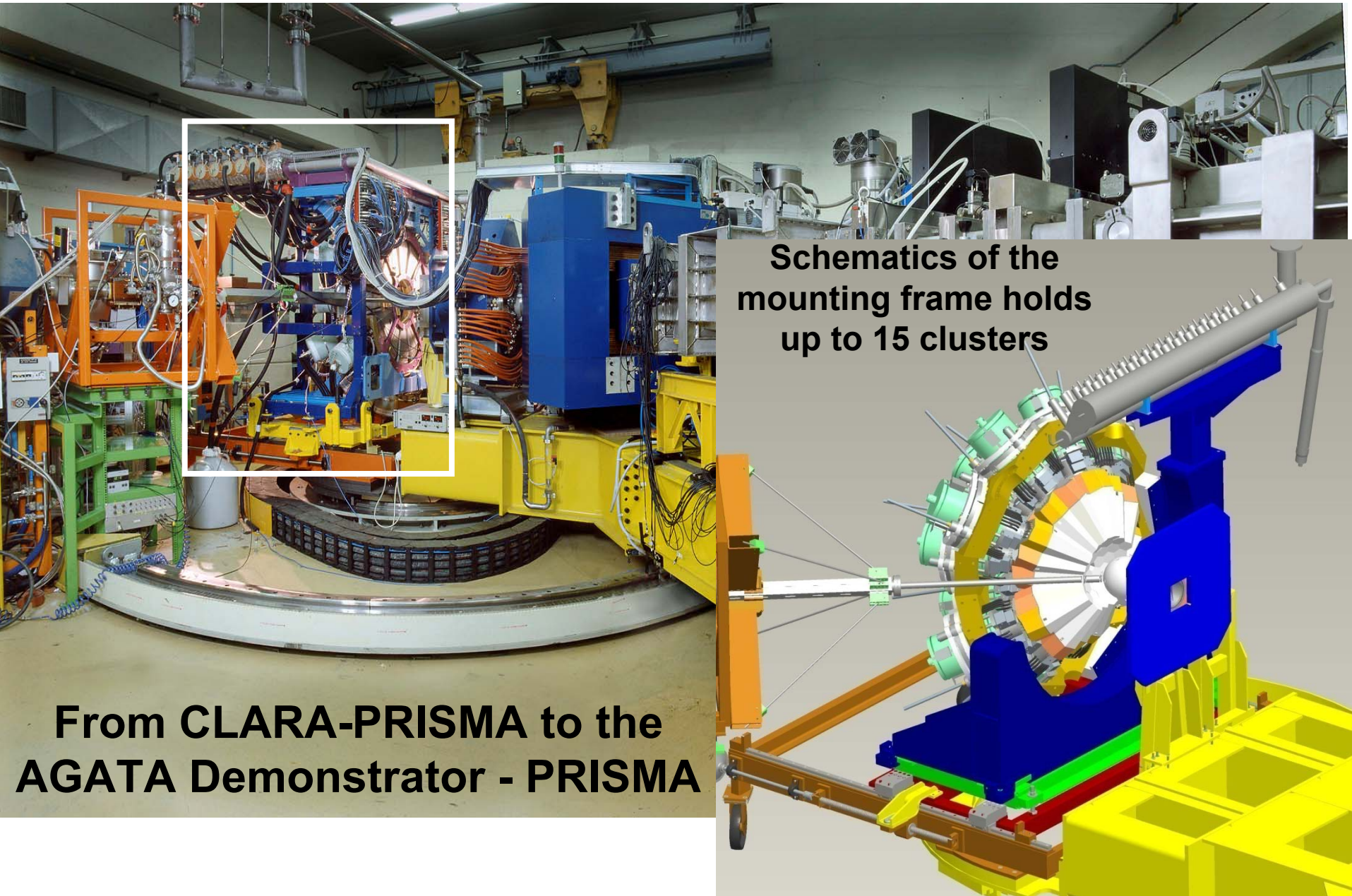



Conditioned room
DAQ (and PSA) in
Exp. Hall 3
AGATA
Ge-detector Lab.
Infrastructure
Installation
ongoing
AGATA
control-box
ACQ-Run Control
pre-processing.
Infrastructure
installation
ongoing
75m
0033
0034
0035
1007
1015
0032
0069
0041
0040
0031
0070
1008
0029
0030



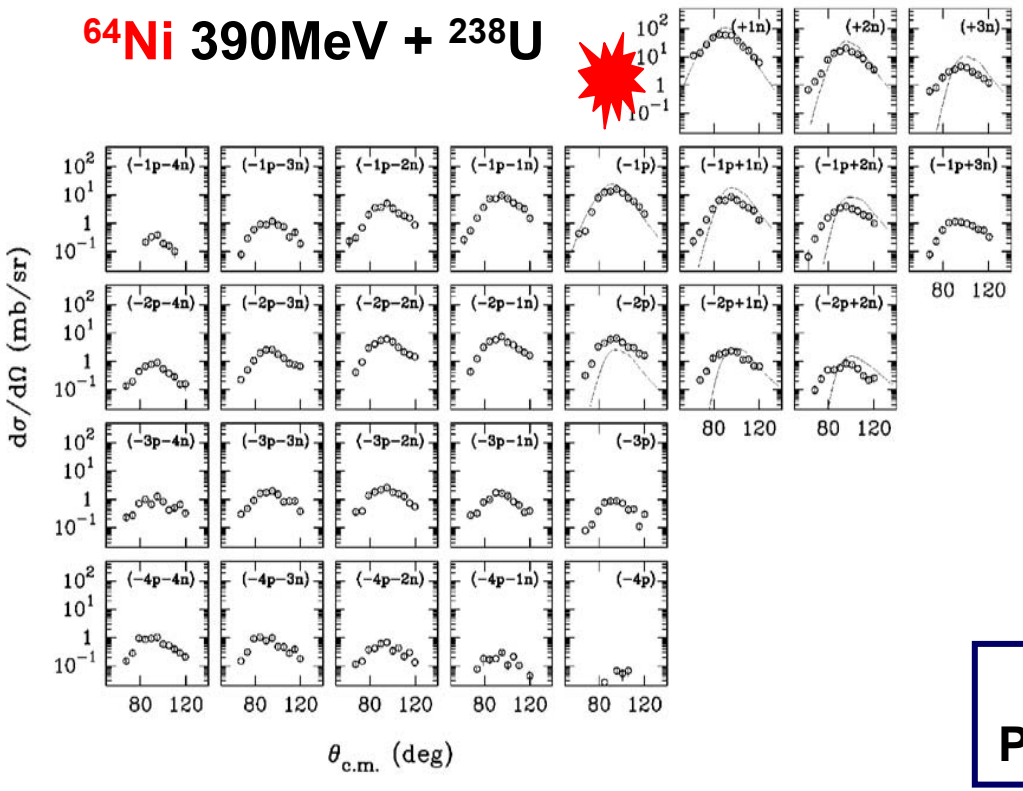
PRISMA: Large acceptance tracking
Magnetic Spectrometer Q-D
Designed for the HI-beams from XTU-ALPI
Ω = 80 msr
$\Delta Z/Z \approx 1/60$ (Measured) IC
$\Delta A/A \approx 1/190$ (Measured) TOF
Energy acceptance ±20%
Max. Bρ = 1.2 T.m.

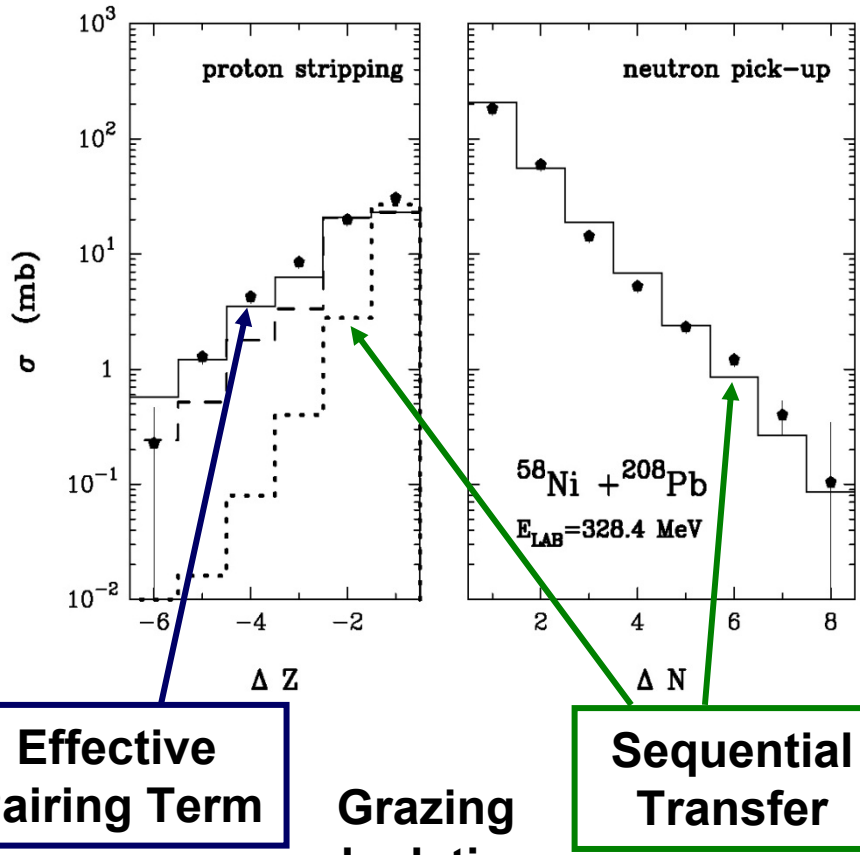
Ionisation Chamber
10x4 sect.
ΔE - E


Schematics of the
mounting frame holds
up to 15 clusters
From CLARA-PRISMA to the
AGATA Demonstrator - PRISMA

Grazing reactions transferring several nucleons as a tool to study n-rich nuclei

Deep-inelastic reactions used since thick target pioneering work of R.Broda et al. (Phys. Lett. B 251 (1990) 245)
Use of Multinucleon-transfer triggered by the work of L. Corradi et al. at LNL





L.Corradi et al., Phys.Rev.C59 (99)261, Theory: G.Pollarolo