The AGATA Demonstrator Array at LNL: status of the project

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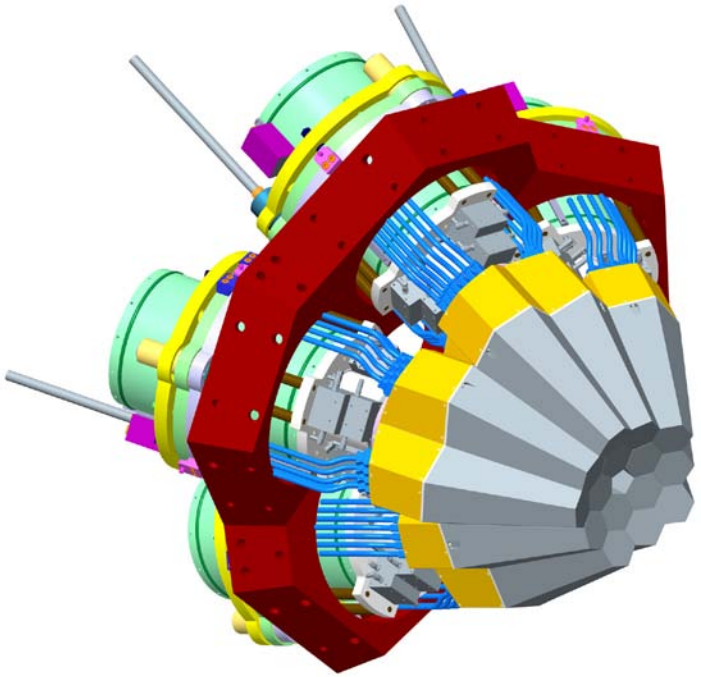
INFN Sezione di Padova

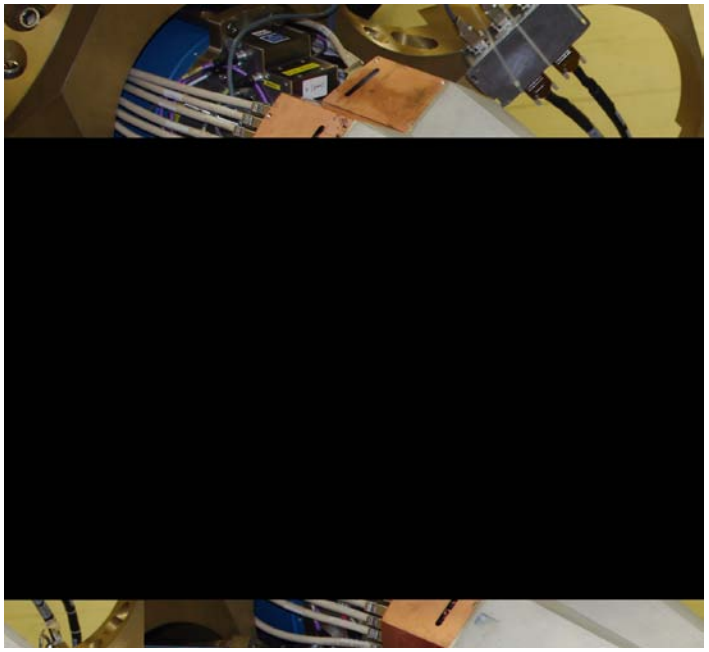
On behalf of the AGATA Collaboration

1. Status of the installation at Legnaro
2. Highlights from the performed experiments

The AGATA Demonstrator

Objective of the final R&D phase 2003-2008



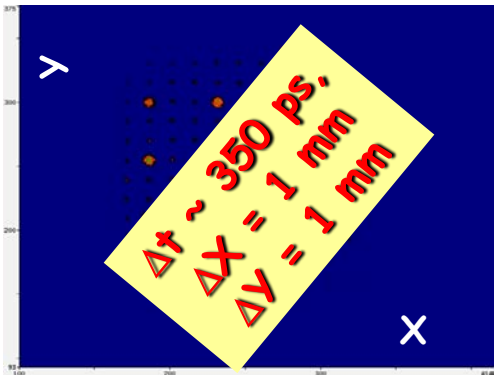


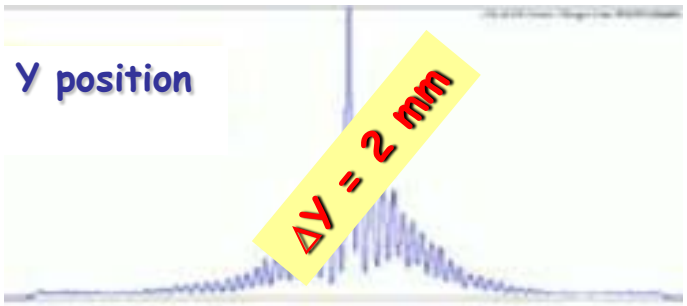
5 asymmetric triple-clusters
- 36-fold segmented crystals
- 555 digital-channels
- Eff. 3 – 8 % @ M_γ = 1
- Eff. 2 – 4 % @ M_γ = 30

Full EDAQ with on line PSA and γ-ray tracking
In beam Commissioning
First installation site: LNL

Main issue is Doppler correction capability → coupling to beam and recoil tracking devices

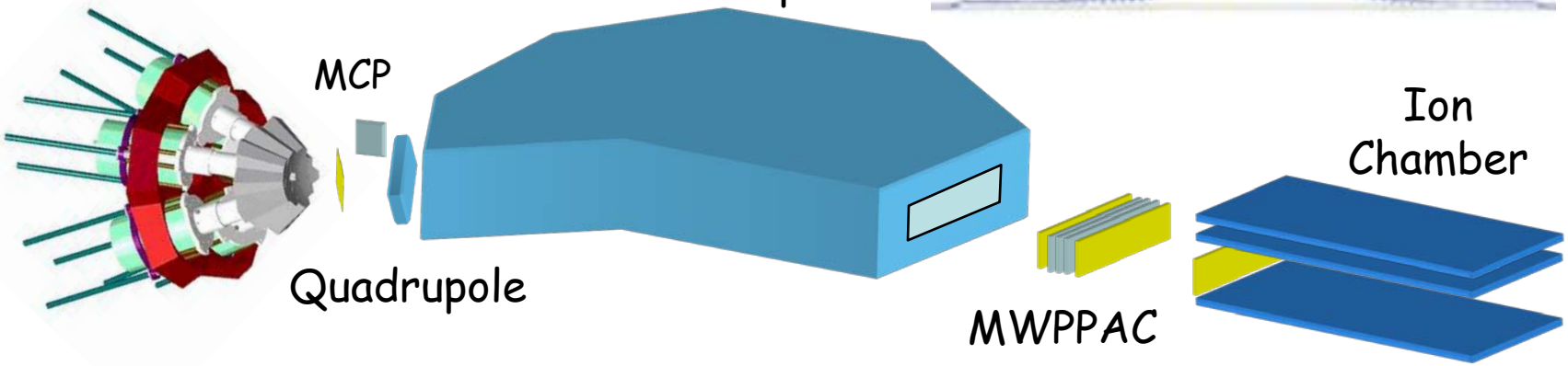
AGATA Demonstrator + PRISMA



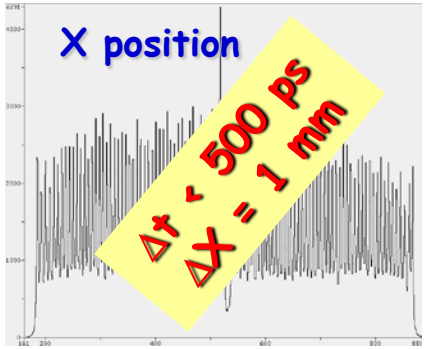


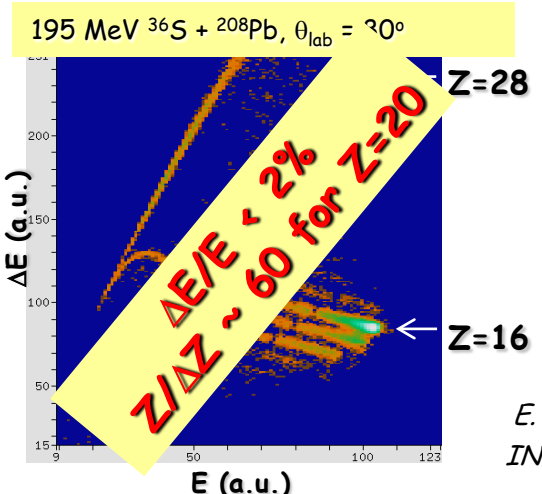
AGATA Demonstrator

Dipole



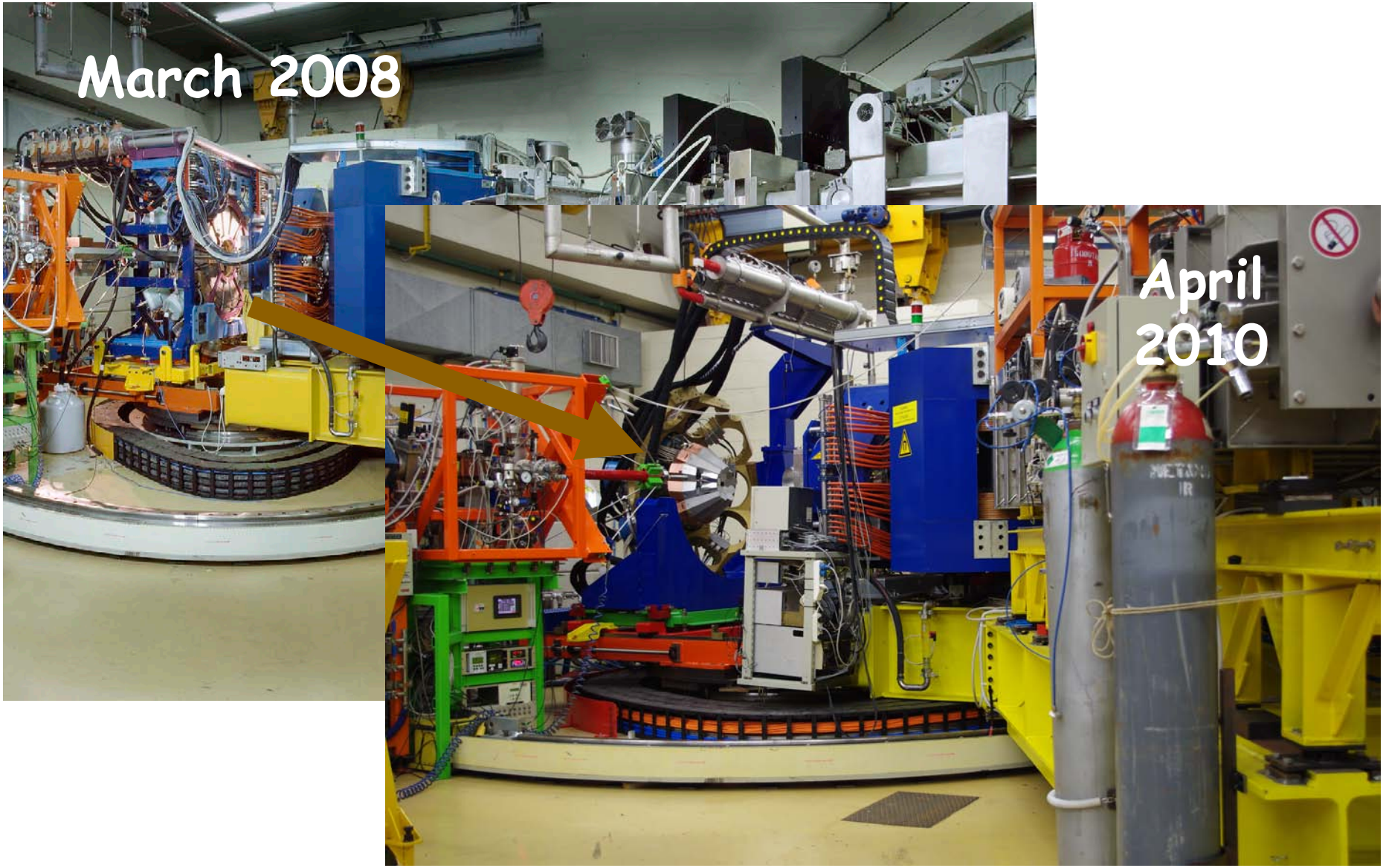
First installation site for the Demonstrator: the PRISMA spectrometer at LNL



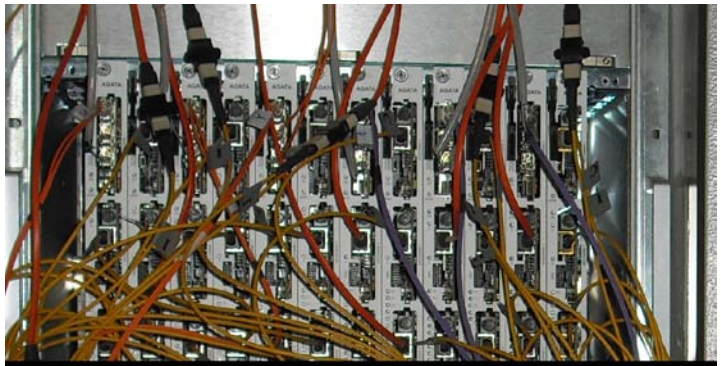


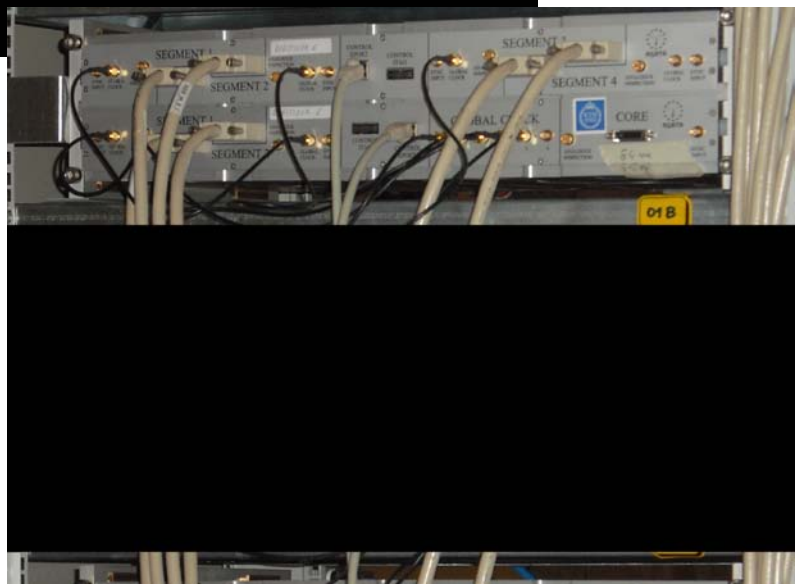
E. Fioretto
INFN - LNL

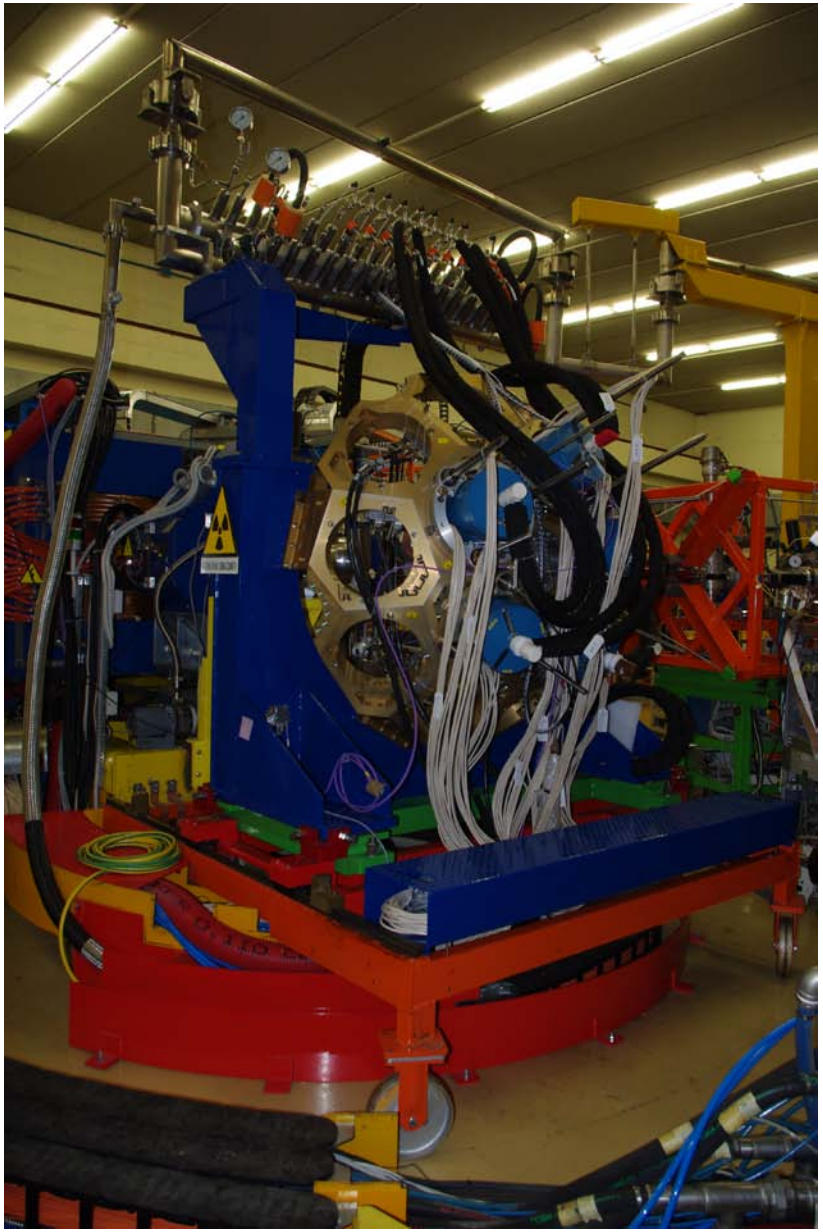
From CLARA to AGATA



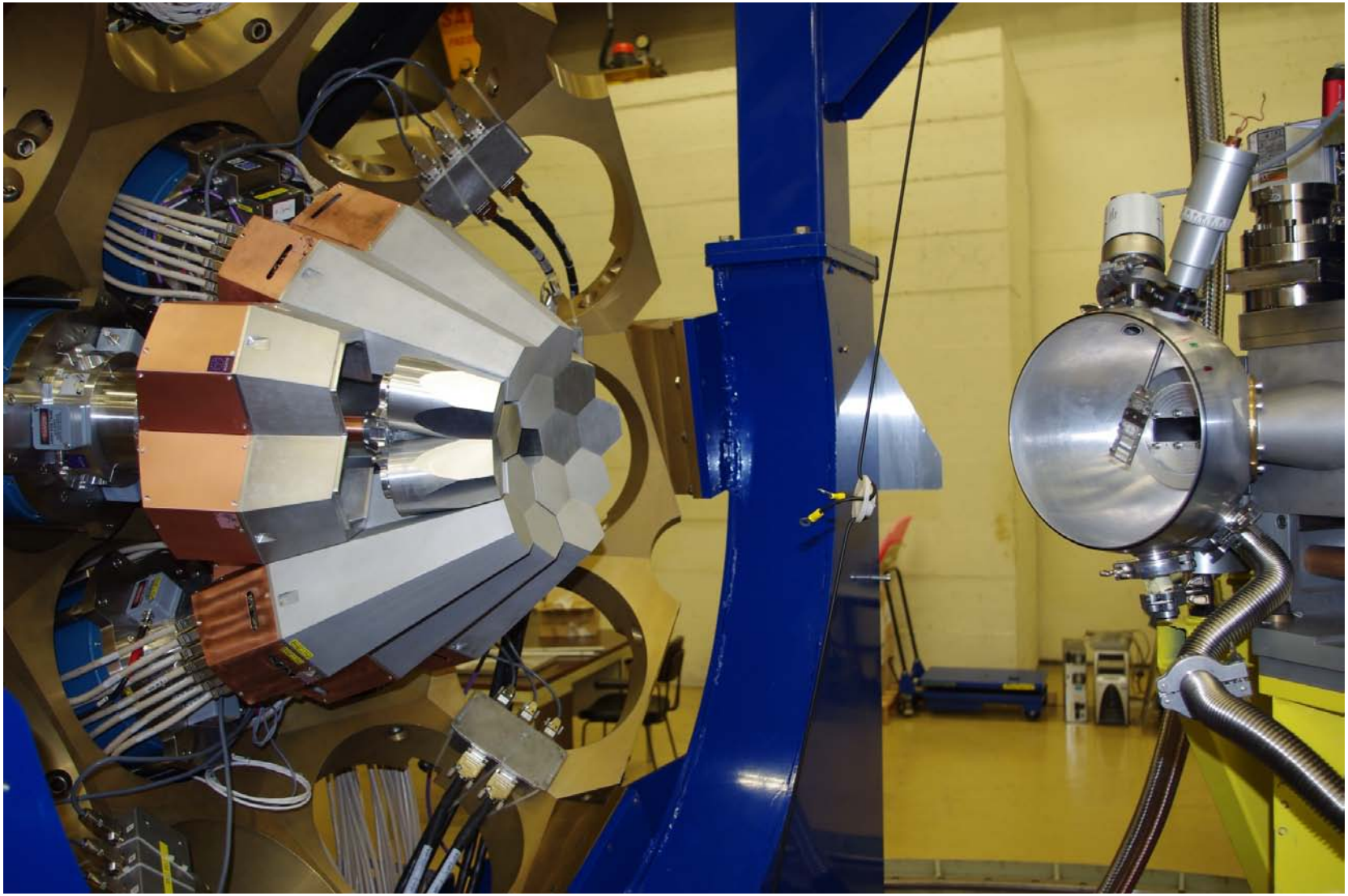
Some pictures



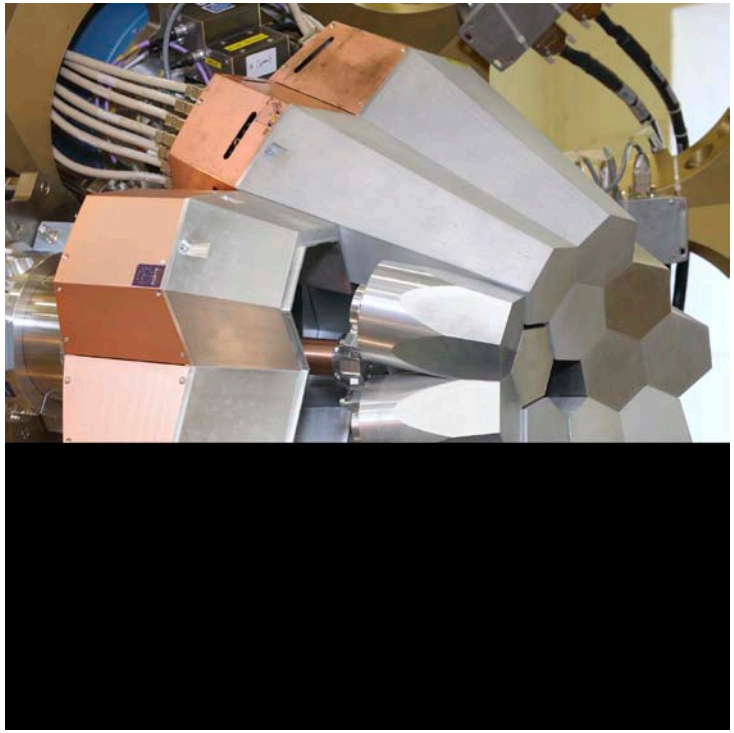




Some pictures



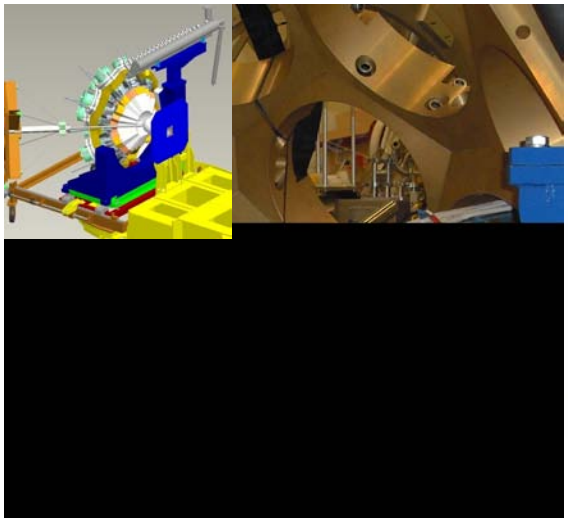
Present status



- Commissioning (demonstration) campaign concluded end of 2009
- Experimental campaign started officially February 2010 with 3 ATCs
- Four ATCs available since April 2010
- Performance of the array very satisfactory so far (also at singles rates as high as 50 kHz!)
- ATC5: supply of good crystals way behind schedule, missing "B" crystal. Will soon be delivered as "double" cluster.

AGATA Demonstrator/1π Experimental Program

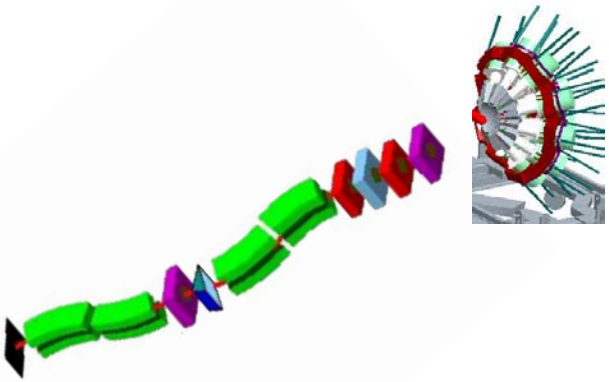
2010 → LNL
5TC



AGATA D.+PRISMA

Total Eff. ~6%

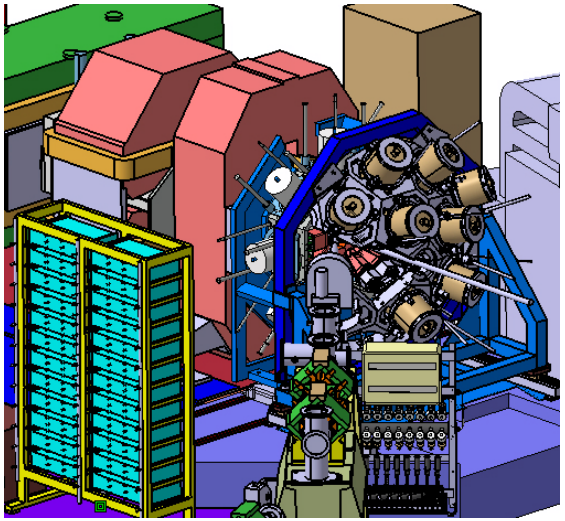
2012 → GSI/FRS
≥8TC



AGATA D. @ FRS

Total Eff. > 10%

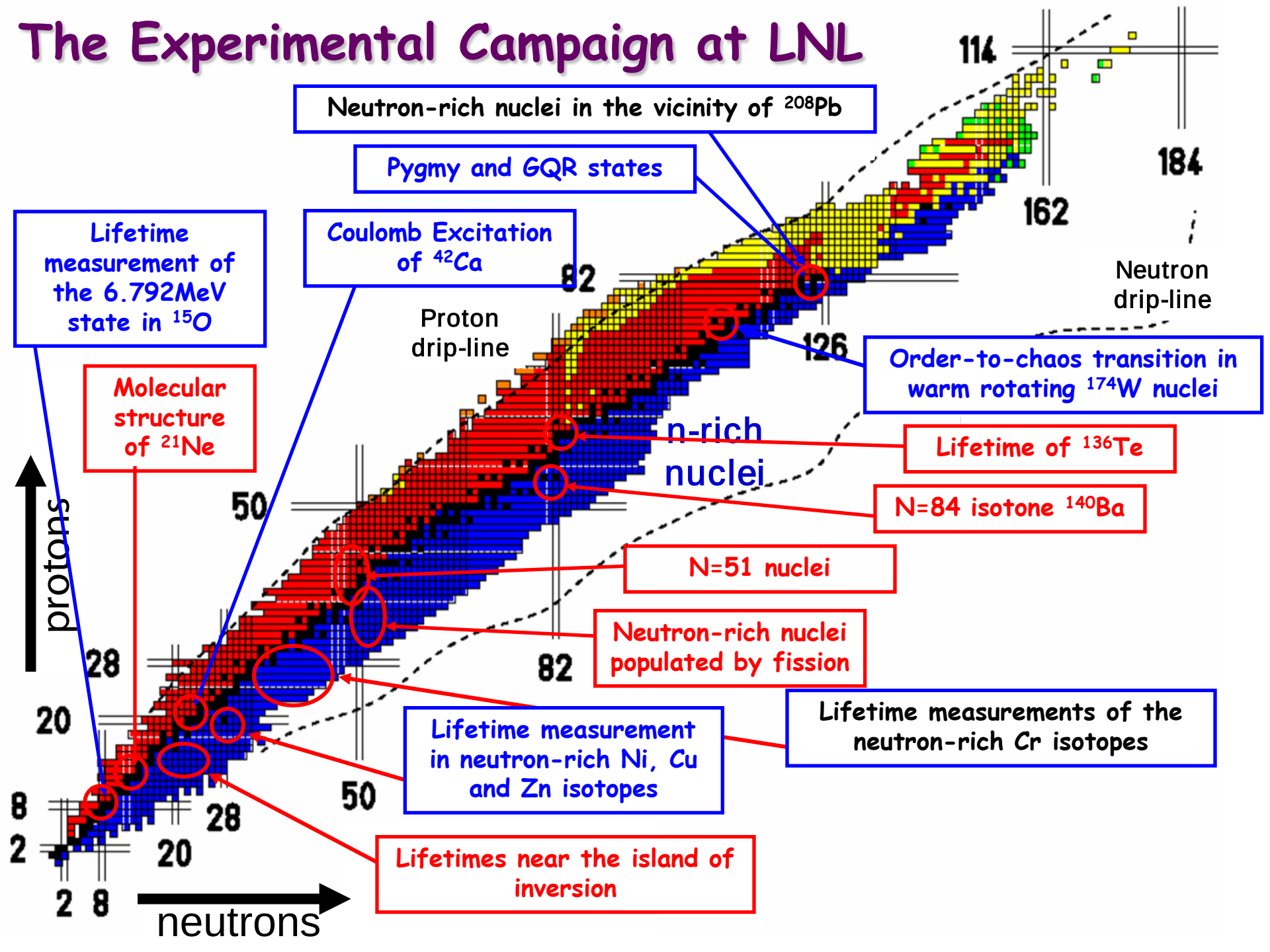
2014 → GANIL/SPIRAL2
~15TC



AGATA D. + VAMOS
+ EXOGAM

Total Eff. > 20%

The Experimental Campaign at LNL

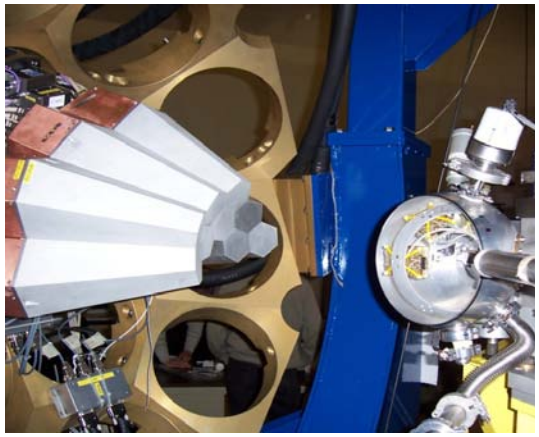


Performed experiments (so far)

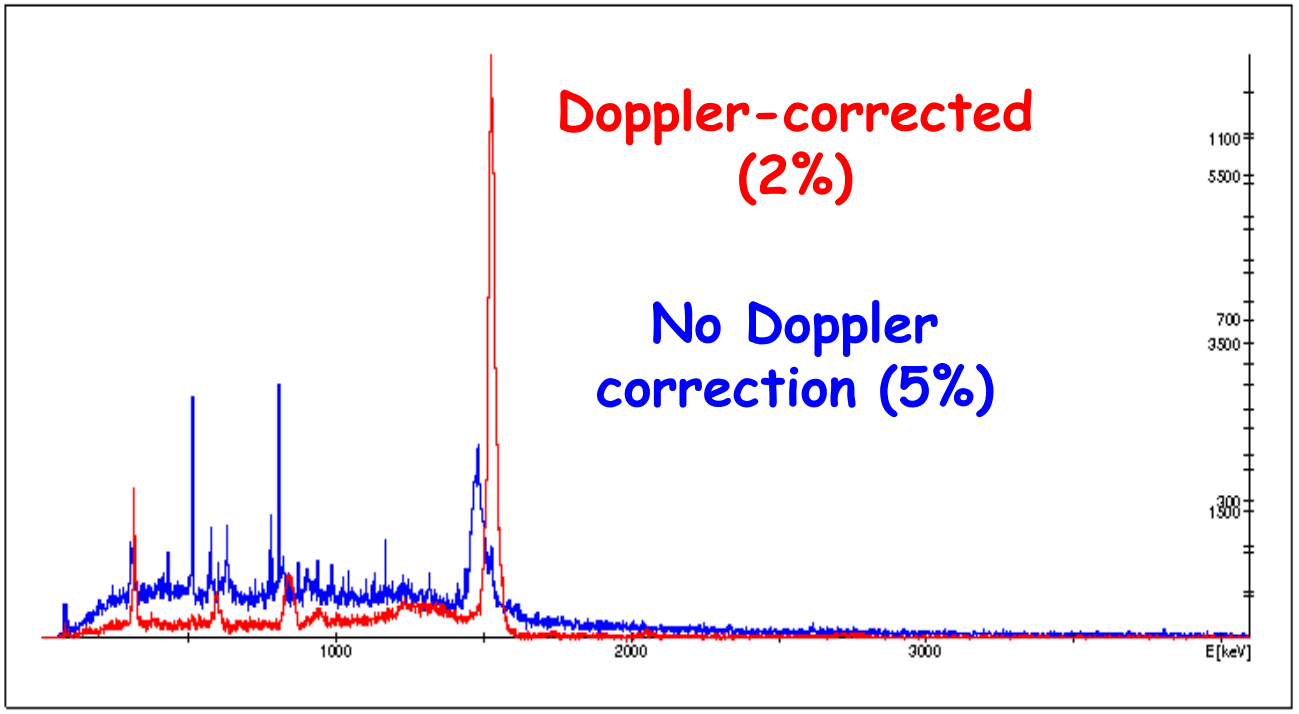
- Coulomb Excitation of the Presumably Super-Deformed Band in ^{42}Ca (A.Maj, F.Azaiez, P.Napiórkowski)
- Neutron-rich nuclei in the vicinity of ^{208}Pb (Zs.Podolyák)
- Inelastic scattering as a tool to search for highly excited states up to the region of the Giant Quadrupole Resonance (R.Nicolini)
- Lifetime measurement in neutron-rich Ni, Cu and Zn isotopes (E.Sahin, M.Doncel, A.Görgen)
- Lifetime measurements of the neutron-rich Cr isotopes (J.J.Valiente-Dobón)
- Order-to-chaos transition in warm rotating ^{174}W nuclei (V.Vandone)
- Lifetime measurement of the 6.792MeV state in ^{15}O (R.Menegazzo)

Coulomb excitation of the presumably super-deformed band in ^{42}Ca

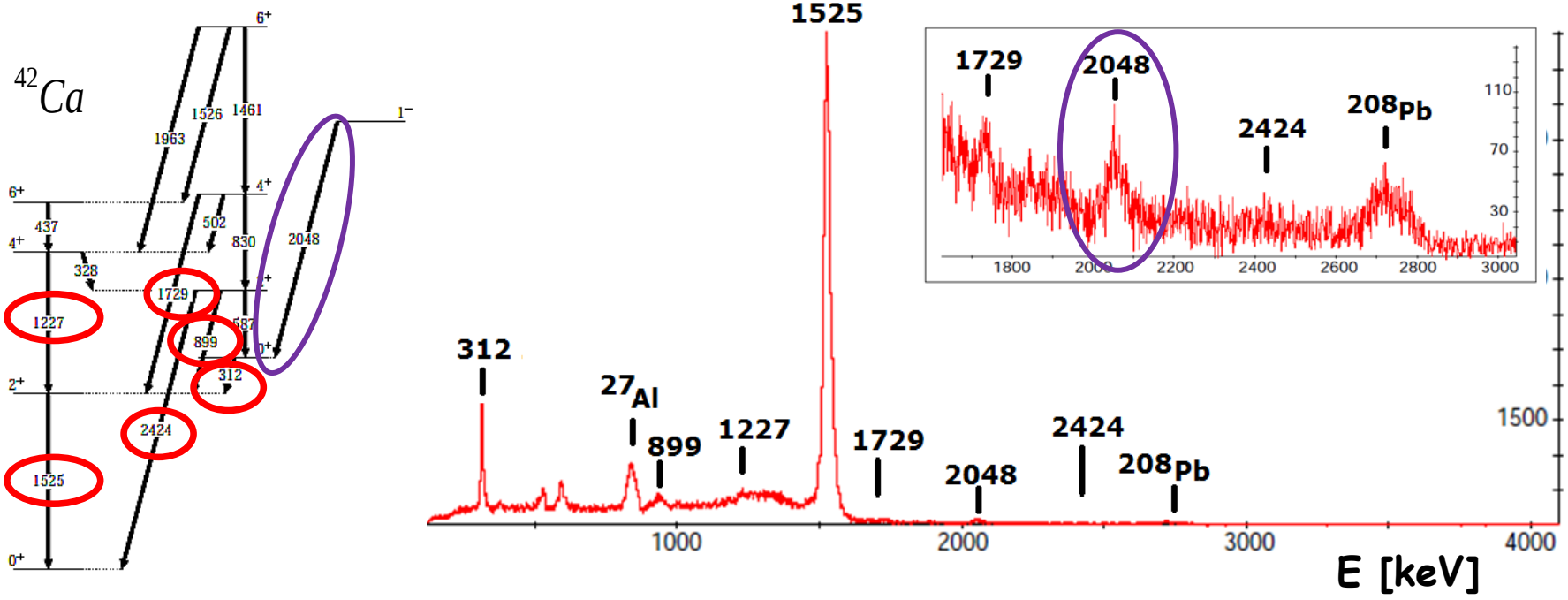
- Goal: verify whether the structure observed in ^{42}Ca is SD as in ^{40}Ca and can be populated via Coulex
- Coulex of ^{42}Ca(170MeV) on ^{208}Pb, detecting the backward scattered ions with DANTE
- 3 ATCs available



K. Hadyńska-Klęk,
F. Azaiez, A. Maj,
P. Napiorkowski



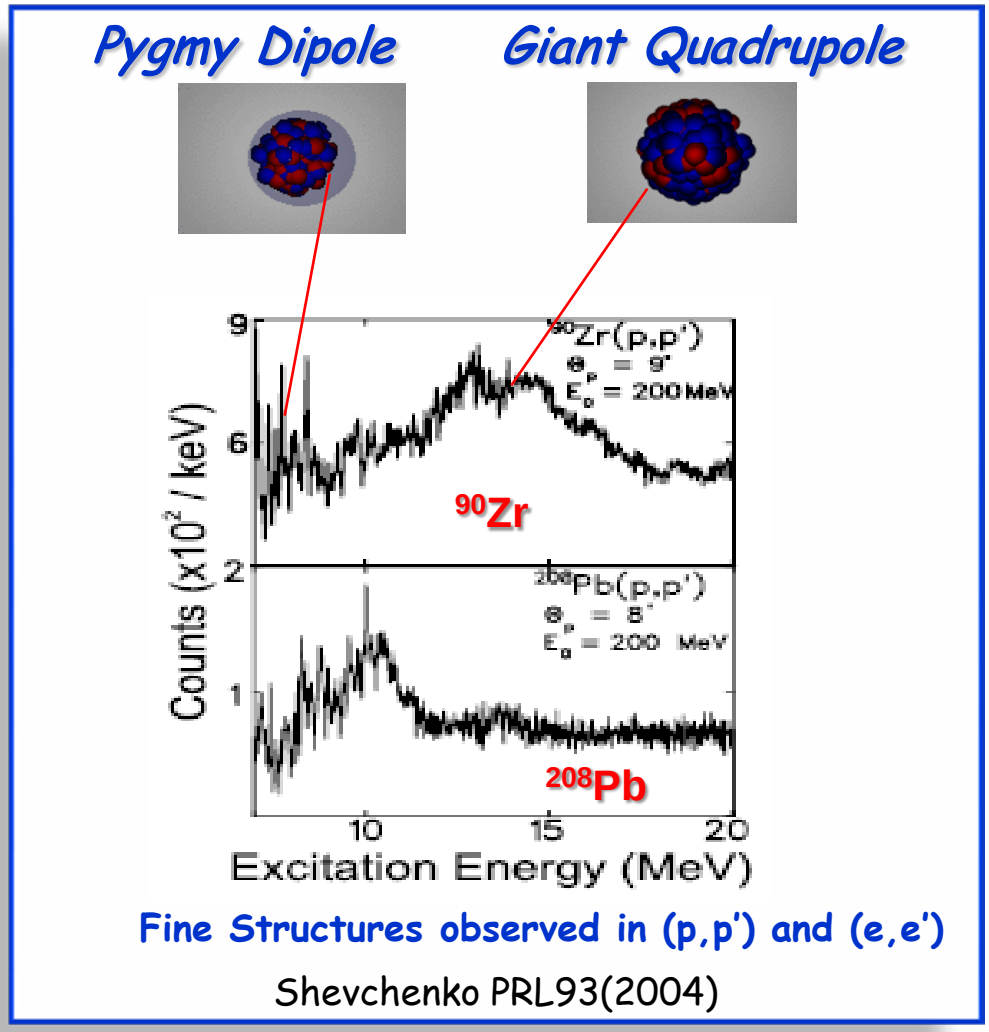
Coulomb excitation of the presumably super-deformed band in ^{42}Ca



The observed intensity for the 2048keV line is not consistent with the theoretical expectations from GOSIA code, suggesting that the previous assignment as a $1^- \rightarrow 0^+$ transition is wrong and that probably it originates from another 2^+ state.

Search for γ-decay of Pygmy and GQR states in ^{208}Pb and ^{90}Zr

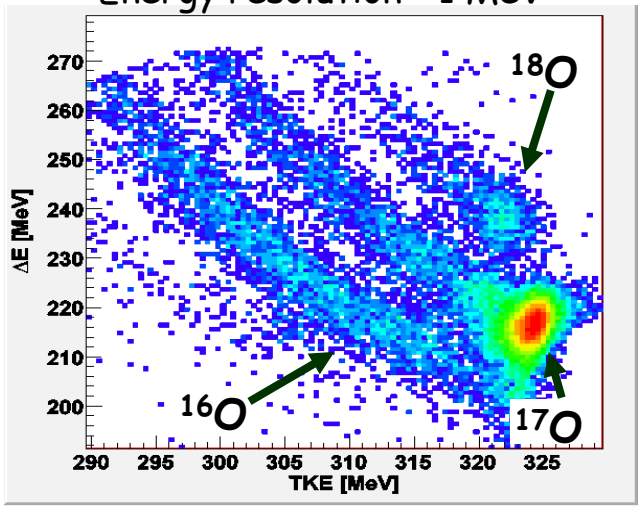
Inelastic Scattering ^{17}O @20 MeV/A

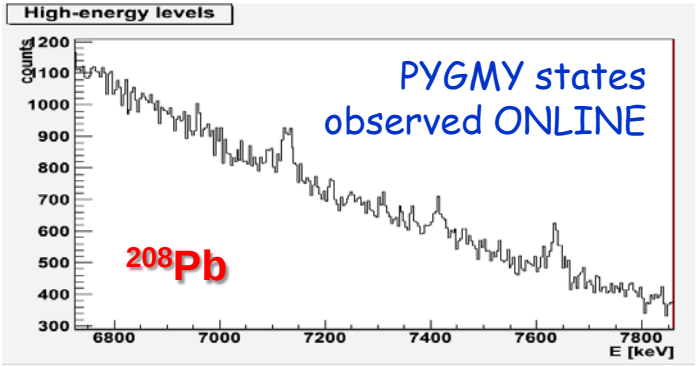


Fine Structures observed in (p,p') and (e,e')

Shevchenko PRL93(2004)

CLEAN Isotope Separation
Energy resolution < 1 MeV

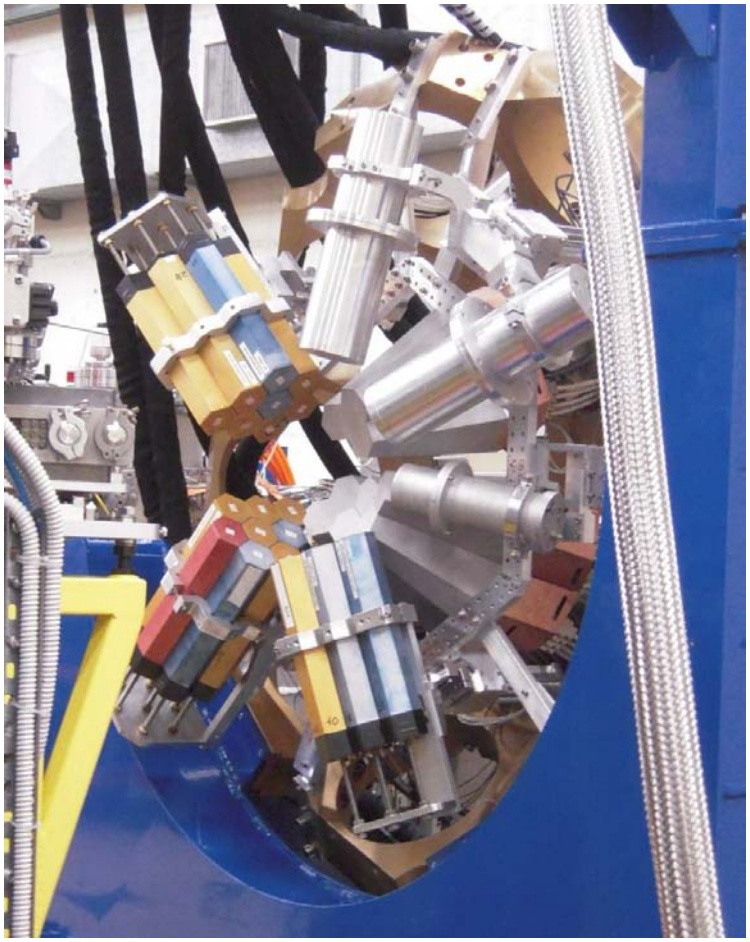




R.Nicolini,
D.Mengoni

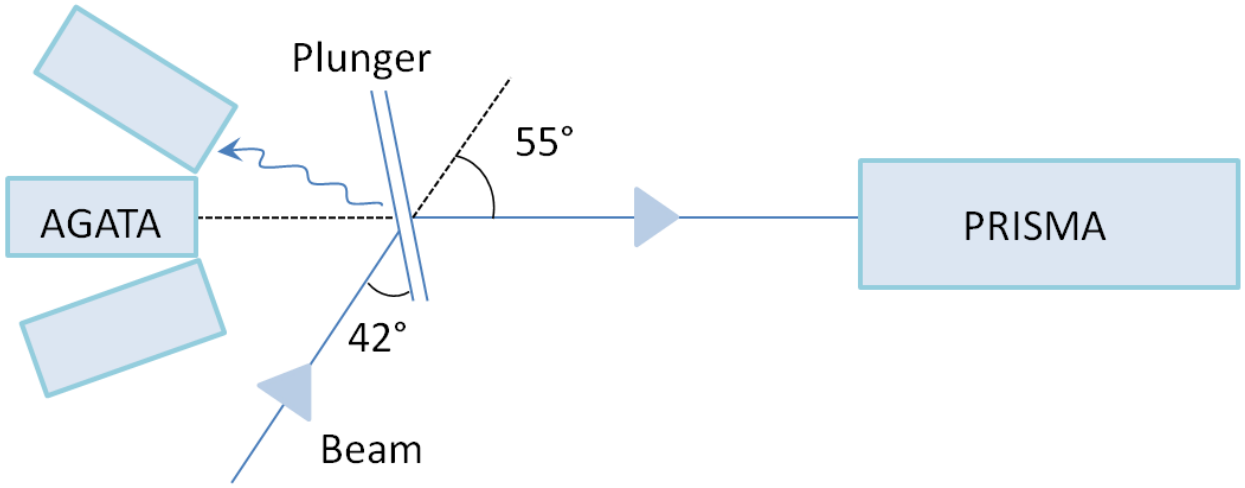
Silicon Telescopes and Scintillator Array in AGATA

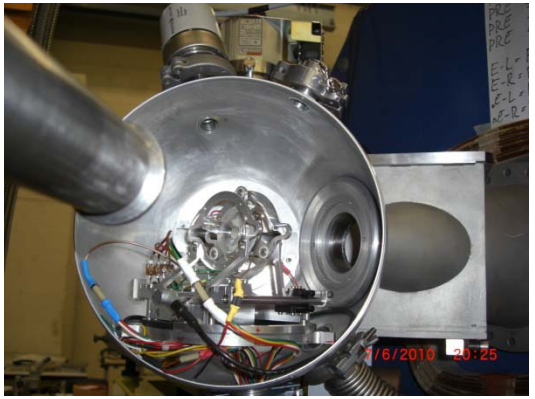
- Si-pad technology: 60 (5x12) pixels
- Active area of 20x50 mm^2
- Pixel area of 4x4 mm^2
- Cooled to -30 °C
- E detector: 1 mm thick
- ΔE detector: 200 μm thick



- 3 $LaBr_3$:Ce detectors
- Large volume (up to 9x20 cm)
- 20 Helena BaF_2 clusters

Lifetime measurement in neutron-rich Ni, Cu and Zn isotopes





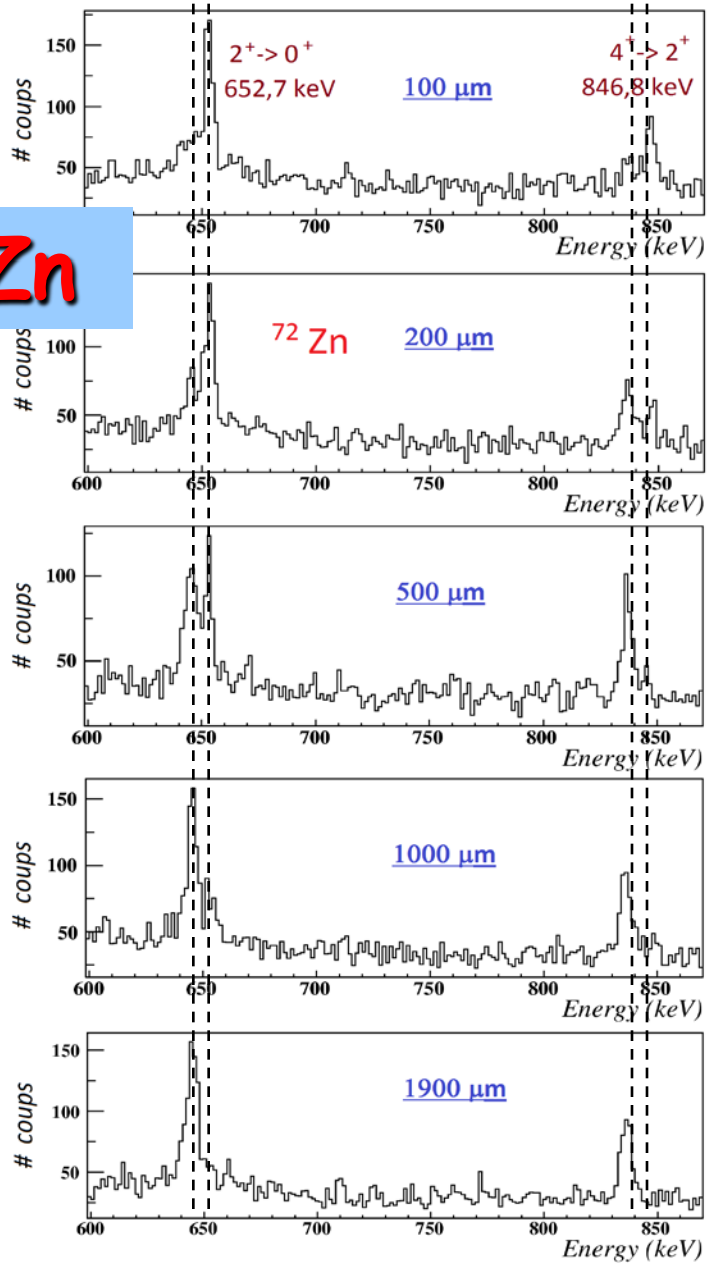
AGATA+PRISMA+differential plunger

^{76}Ge(577MeV) + ^{238}U, Nb degrader

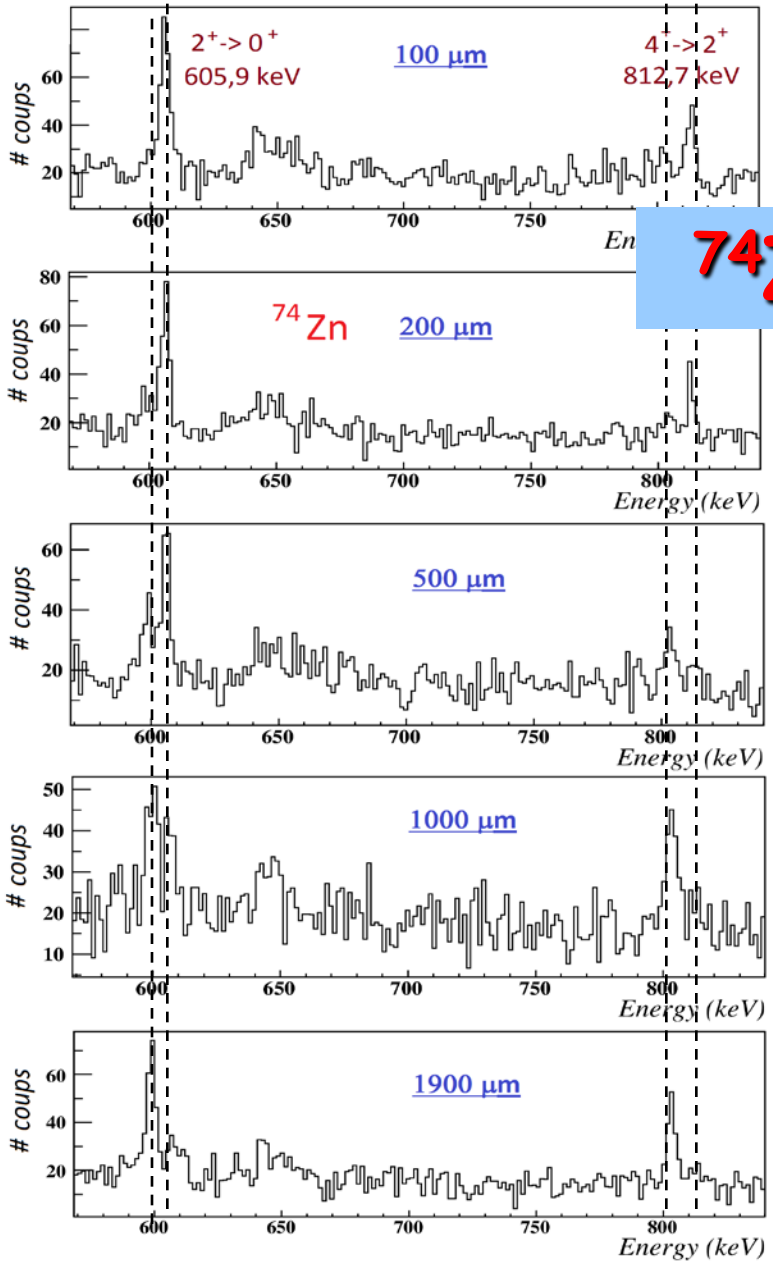
C.Louchart, E.Sahin, M.Doncel, A.Goergen

Preliminary spectra

^{72}Zn



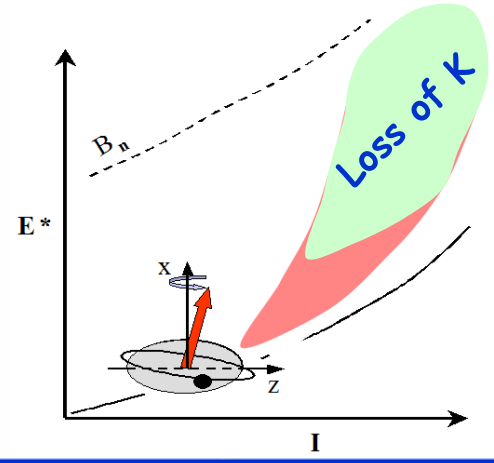
^{74}Zn



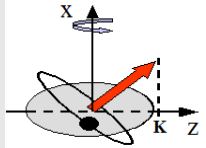
Order-to-chaos in ^{174}W

High-Spin Fusion Evaporation
^{50}Ti on ^{128}Te @ 217 MeV, I ≥ 60ħ

Loss of selection rules on K with temperature

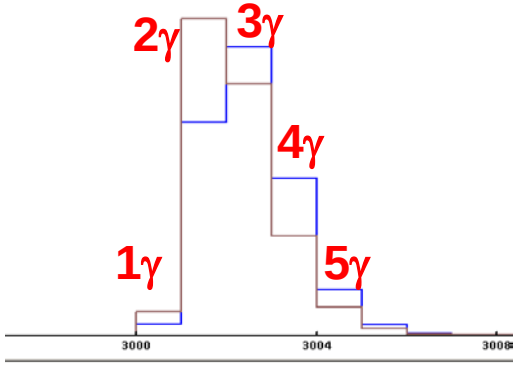


K-quantum number

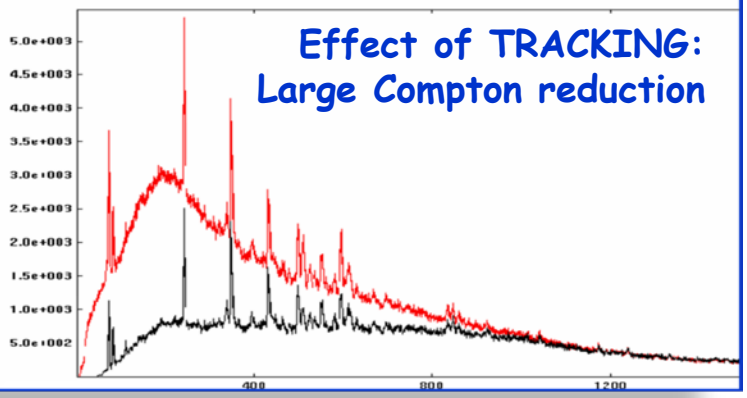


K is robust at T=0
(K-isomers …)

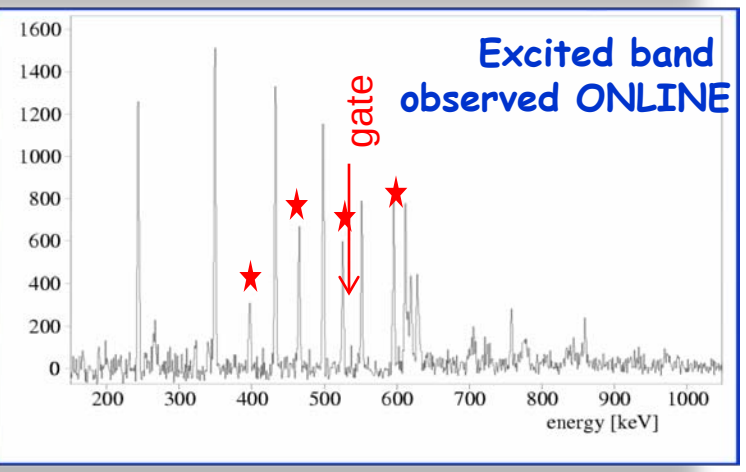
FOLD Distribution
(with different TRIGGERS)



Effect of TRACKING:
Large Compton reduction



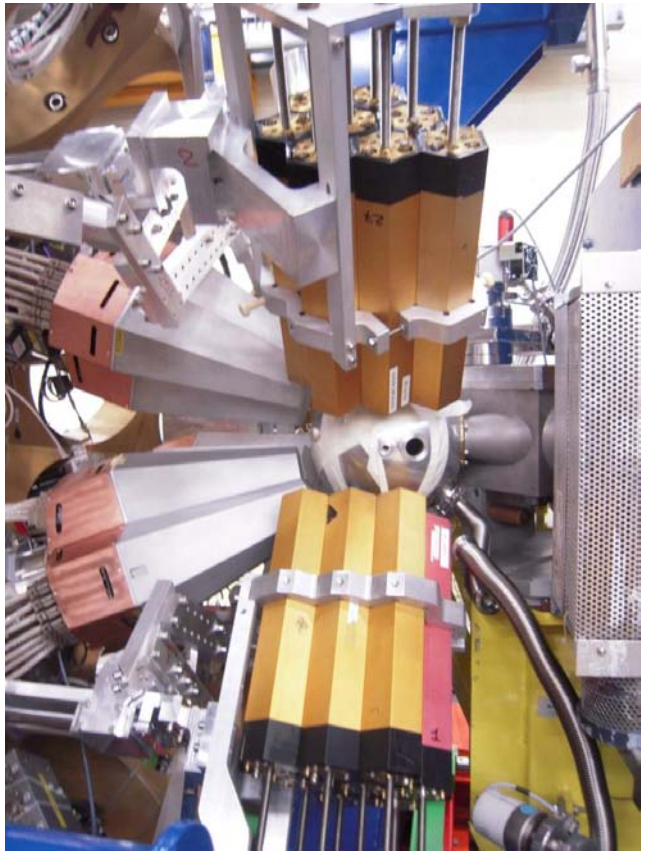
Excited band observed ONLINE

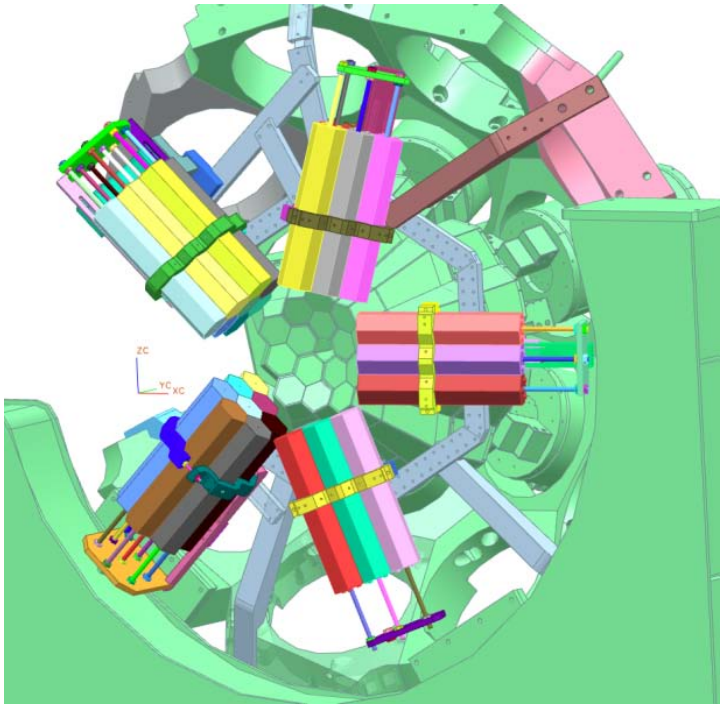


V.Vandone

Helena BaF_2 Multiplicity Filter in AGATA

27 detectors: 5 clusters of BaF_2 (3"×3", exagonal)
Distance from the target: 15cm
Total solid angle: 25% of 4π
Total efficiency: 16% @ 500keV



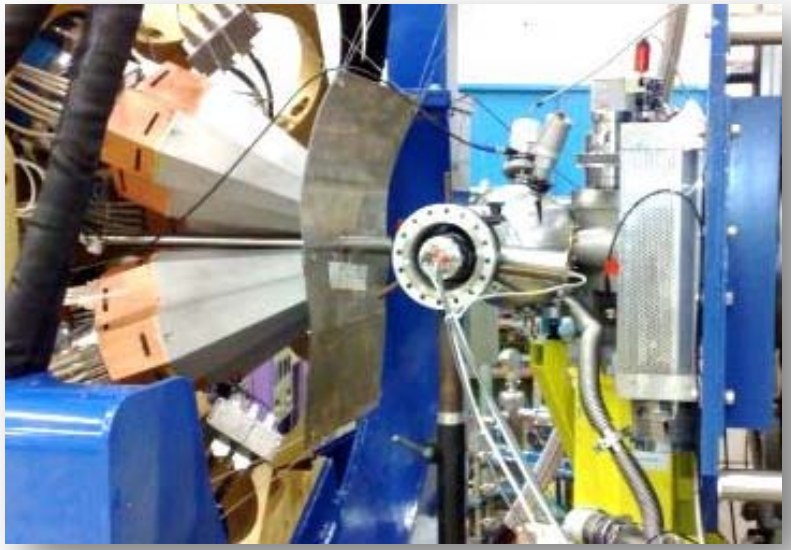


Lifetime measurement of the 6.792MeV state in ^{15}O

Direct measurement of the lifetime of the $3/2^+$ state in ^{15}O with the Doppler Shift Attenuation technique using the AGATA Demonstrator. The width (lifetime) of this state might affect significantly the estimates of the cross section of the astrophysically relevant $^{14}N(p,\gamma)^{15}O$ reaction to the Gamow peak region.

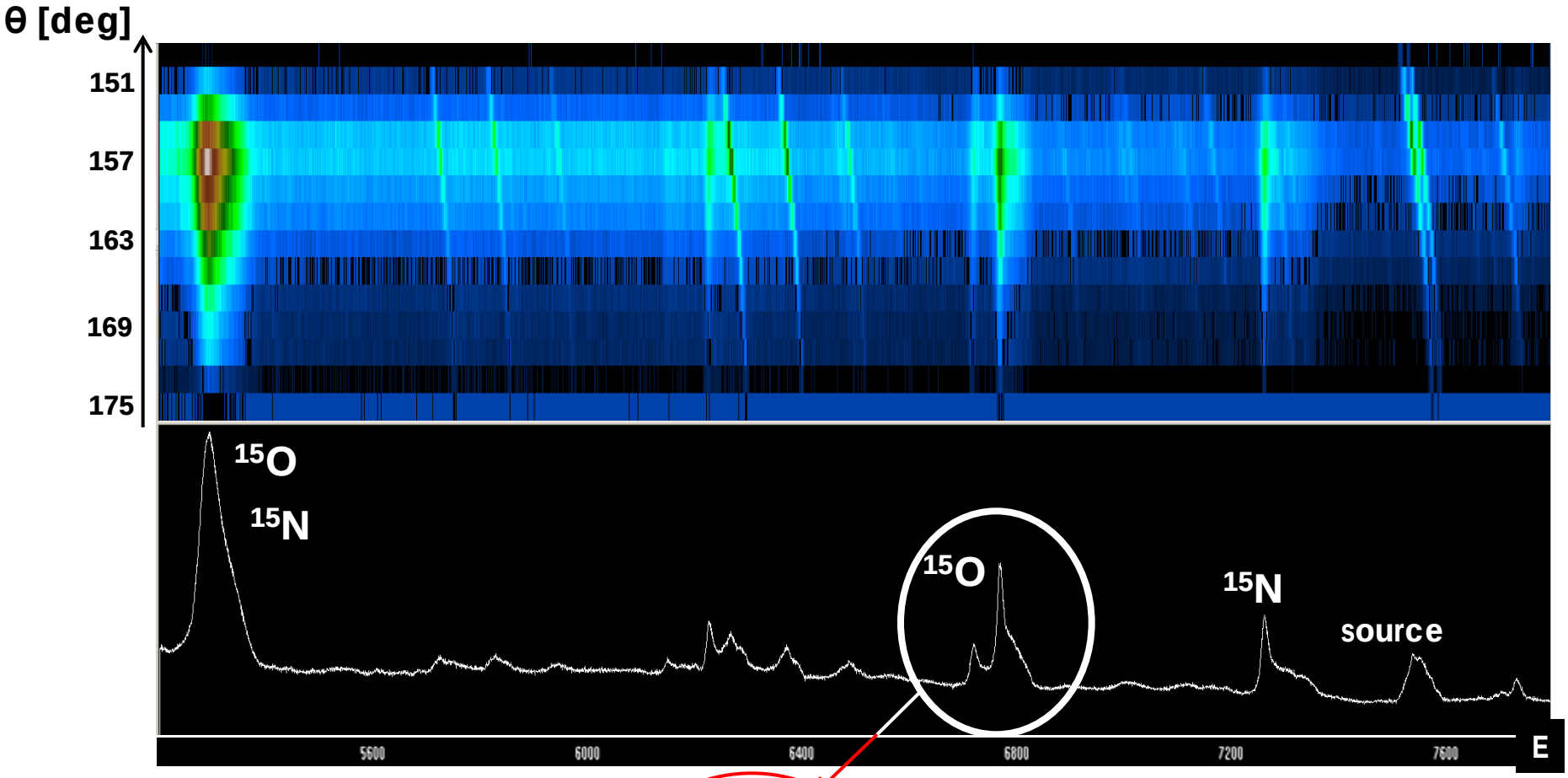
$^{14}N(32MeV)+^{2}H$

^{197}Au deuterated target

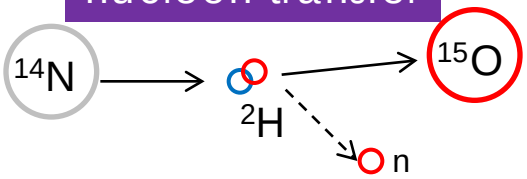


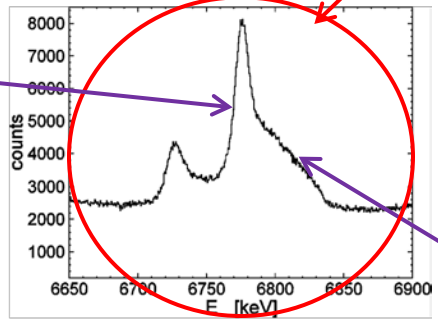
C.Michelagnoli, R.Depalo,
R.Menegazzo, C.A.Ur

Ongoing data analysis

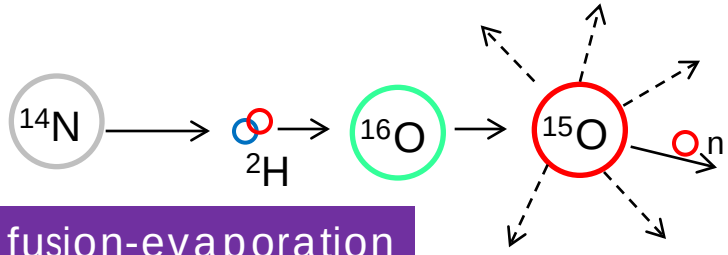


nucleon-transfer





fusion-evaporation



Approved experiments

- Precision lifetime study in the Neutron-rich N=84 isotone ^{140}Ba from DSAM measurements following Coulomb-barrier alpha-transfer reactions on a ^{136}Xe (J.Leske)
- Structure beyond the N=50 shell closure in neutron-rich nuclei in the vicinity of ^{78}Ni: The case of N=51 nuclei (D.Verney, G.Duchene, G.de Angelis)
- Lifetimes of intruder states in N~20 sd-pf-shell neutron-rich Nuclei (F.Haas, R.Chapman)
- RDDS lifetime measurement in the region of the neutron-rich doubly magic ^{132}Sn: Lifetime of the 6+ state in ^{136}Te (A.Gadea)
- Development of the nuclear structure of neutron–rich isotopes in the Z»38 region populated by heavy–ion induced fission (C.A.Ur, N.Mărginean, E.Merchan)
- Confirmation of the molecular structure of excited bands in ^{21}Ne (C.Wheldon)

Outlook

- Following the commissioning campaign, the physics campaign has started in February 2010
- Performance of the array is satisfactory, in close coupling with several ancillary devices
- Analysis of the experiments performed so far is ongoing, exciting results soon