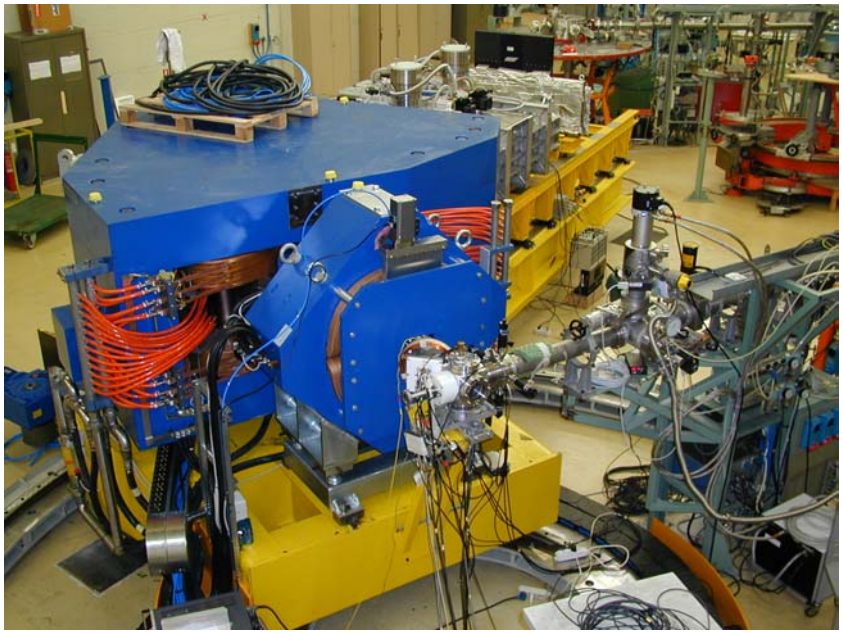
The CLARA – PRISMA setup: Status and perspectives at LNL

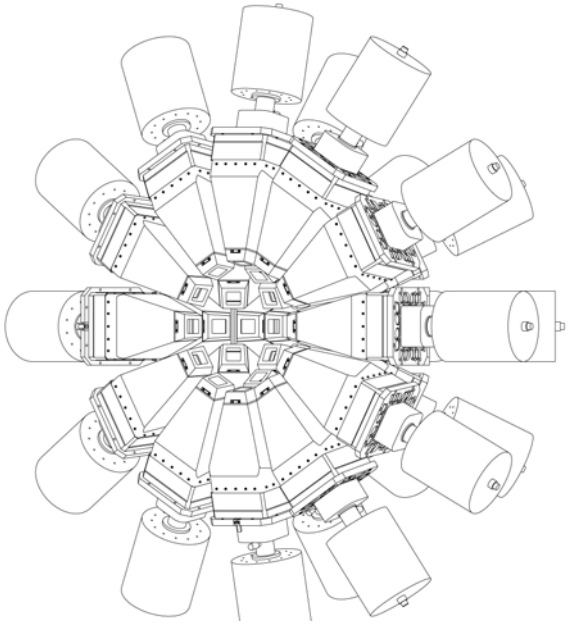
Spokesperson: A.Gadea INFN-LNL Legnaro

Gamma Spectroscopy in products of binary reactions with intense stable beams

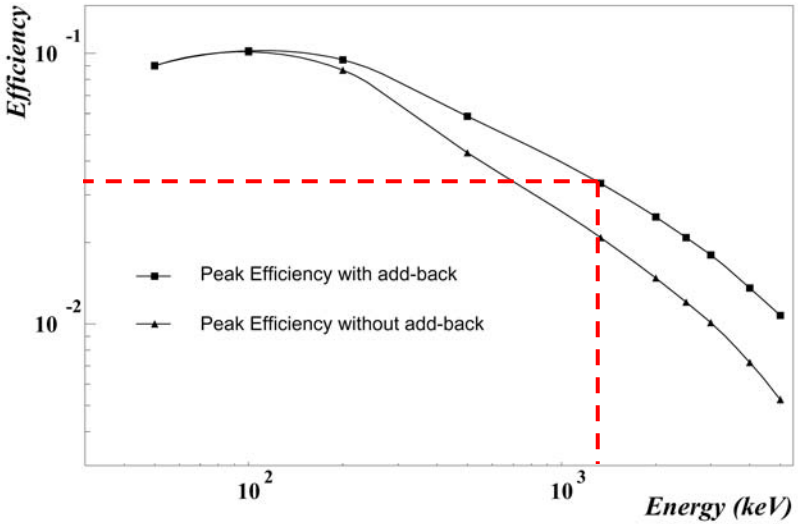
- Moderately neutron rich nuclei produced by Multi-nucleon transfer or deep inelastic collisions
- Non-Yrast states populated in quasielastic reactions

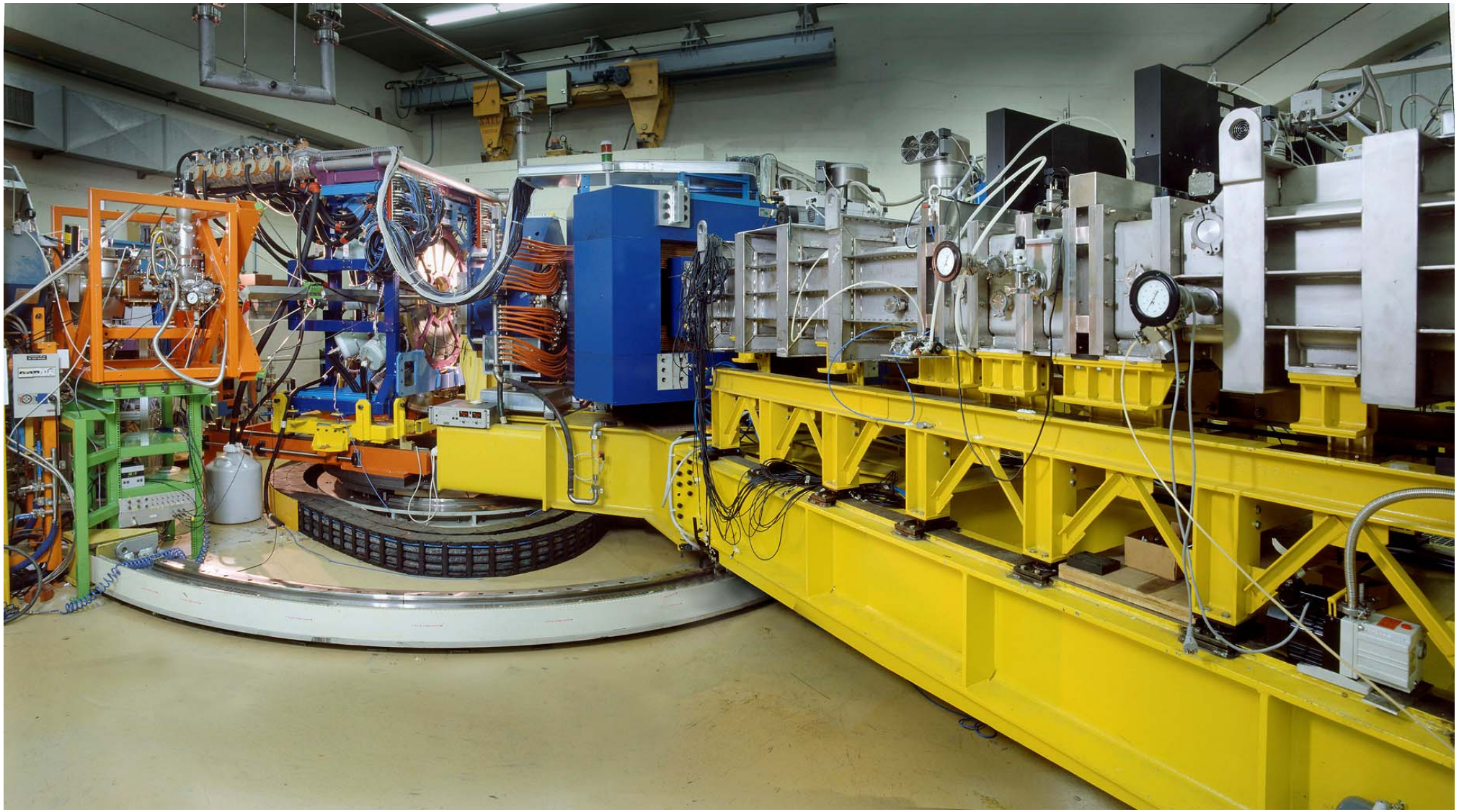
The CLARA (Clover array)+ Prisma set-up

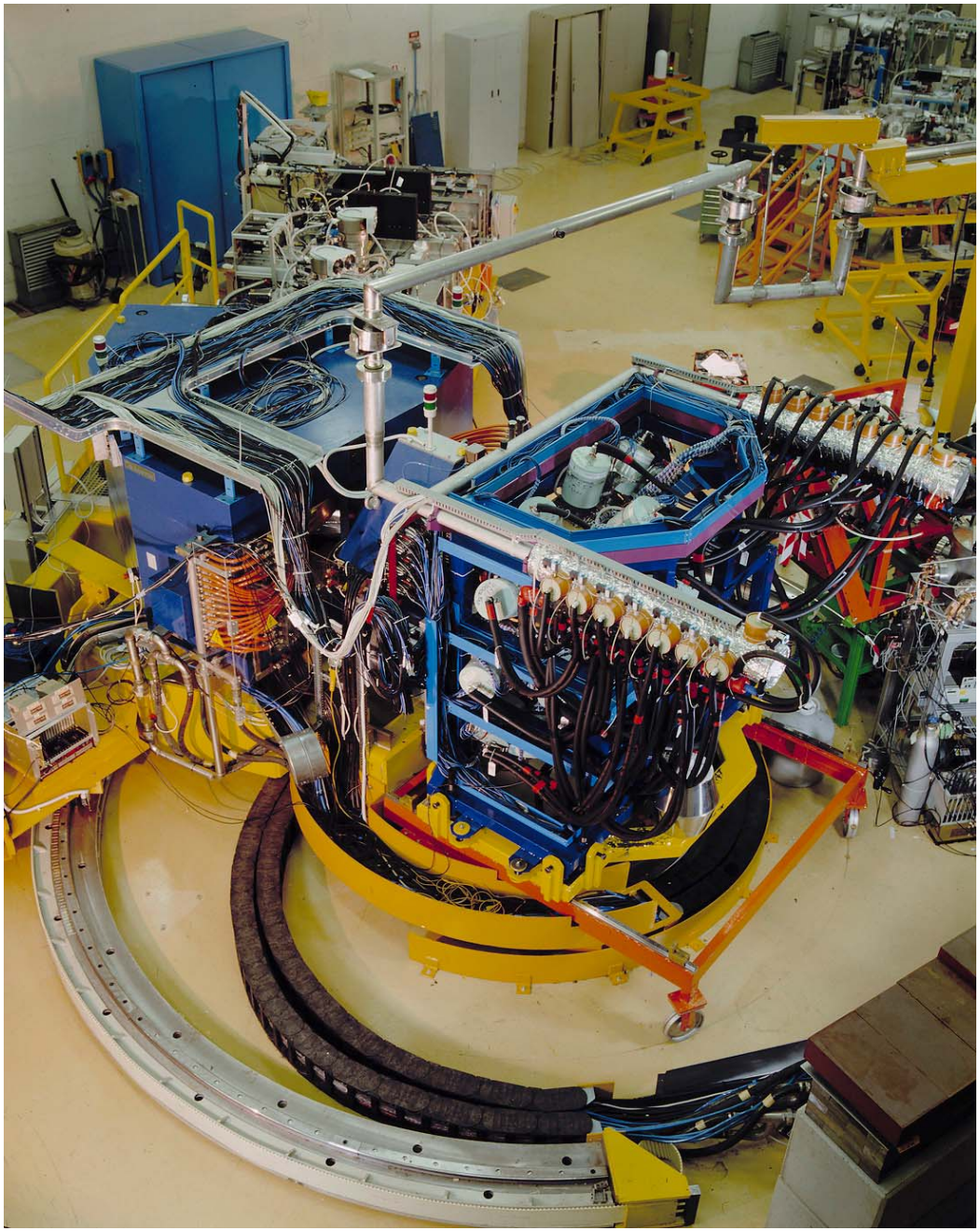




- 25 Clovers setup
- Efficiency ~ 3 %
- Peak/Total ~ 45 %
- Position θ = 104°-180°
- FWHM ~ 10 keV for E_γ= 1.3 MeV
  at v/c = 10 %

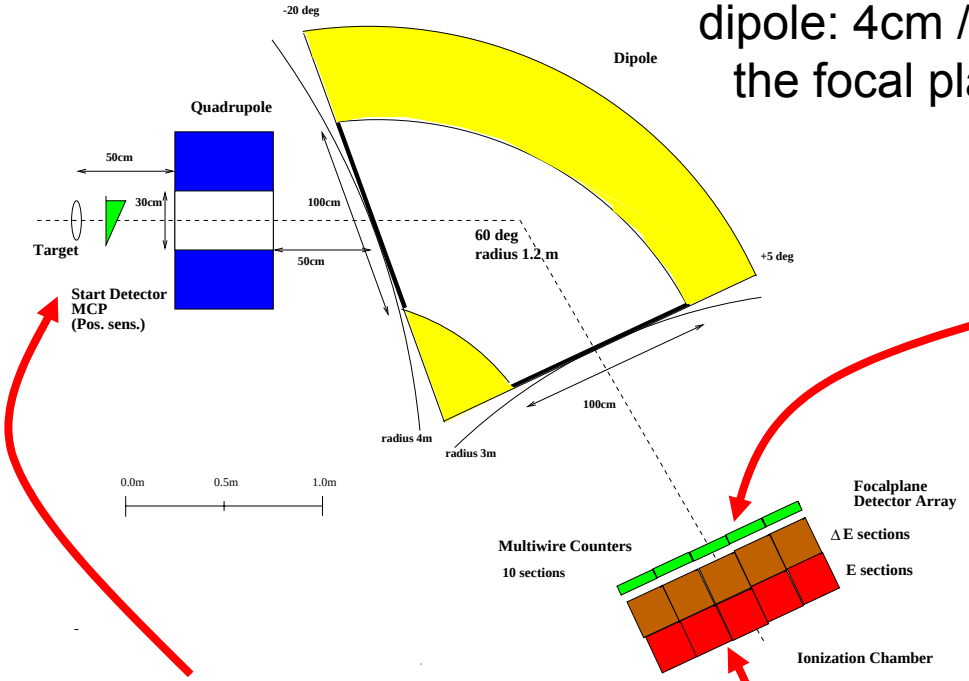




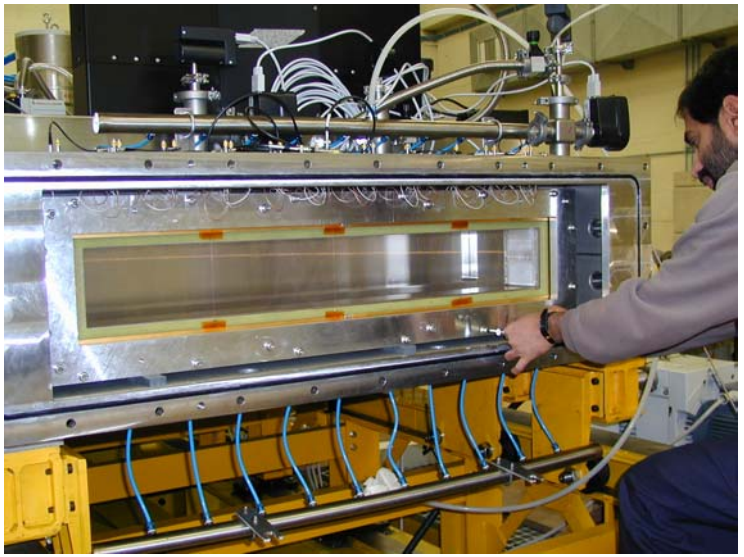


The PRISMA Spectrometer Detectors

Large dispersion dipole: 4cm / % at the focal plane

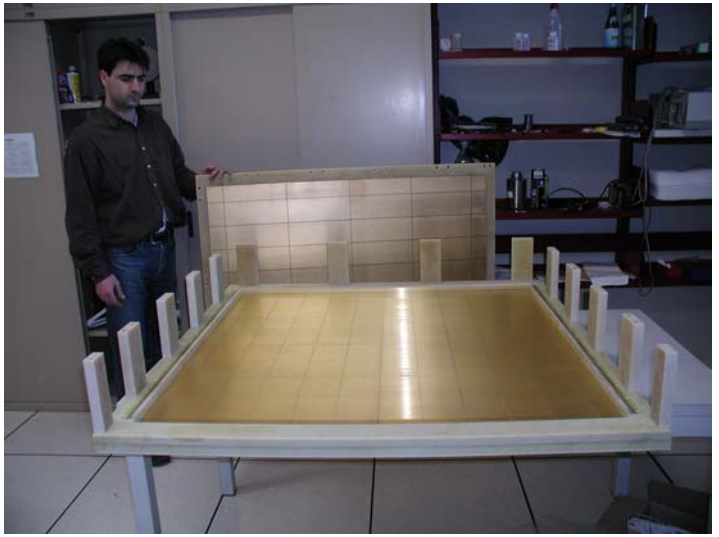


10 sections Multiwire PPAC

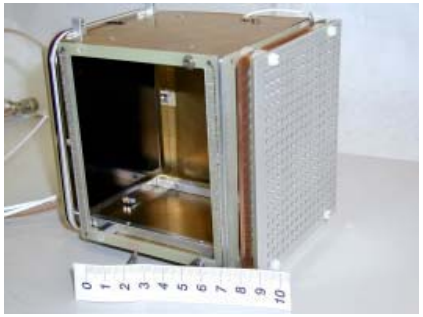


S.Beghini et al. LNL annual Report 2000 pg.163

10 x 4 sections Ionization Chamber

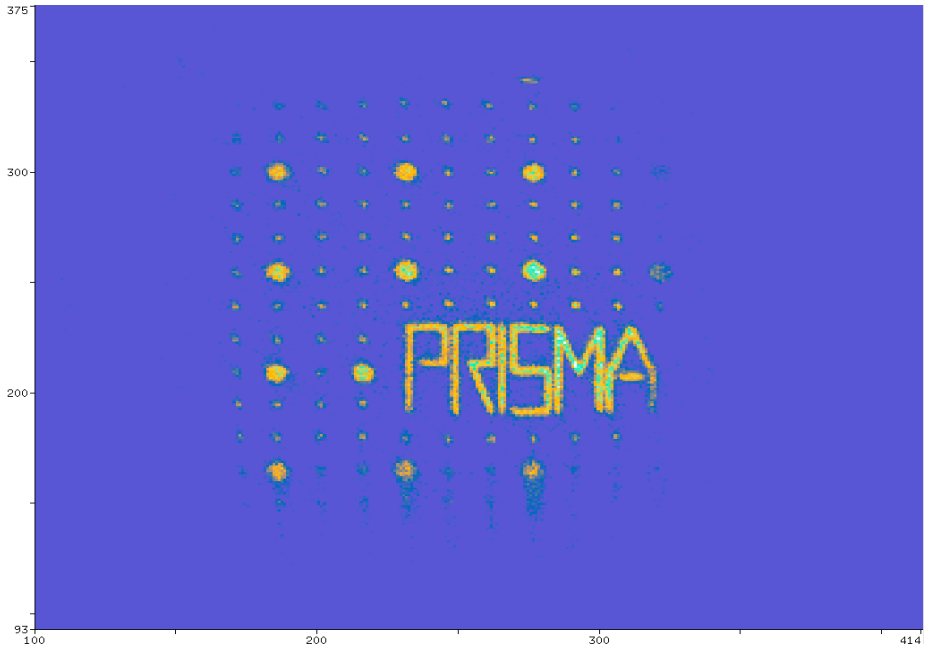


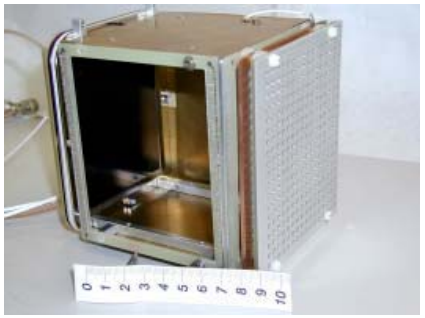
Position sensitive MCP



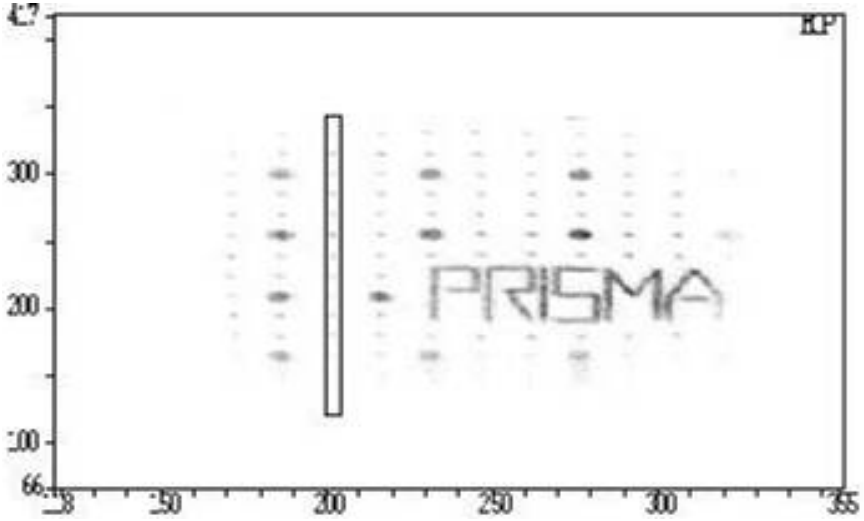
G.Montagnoli et al. LNL annual Report 2000 pg.165

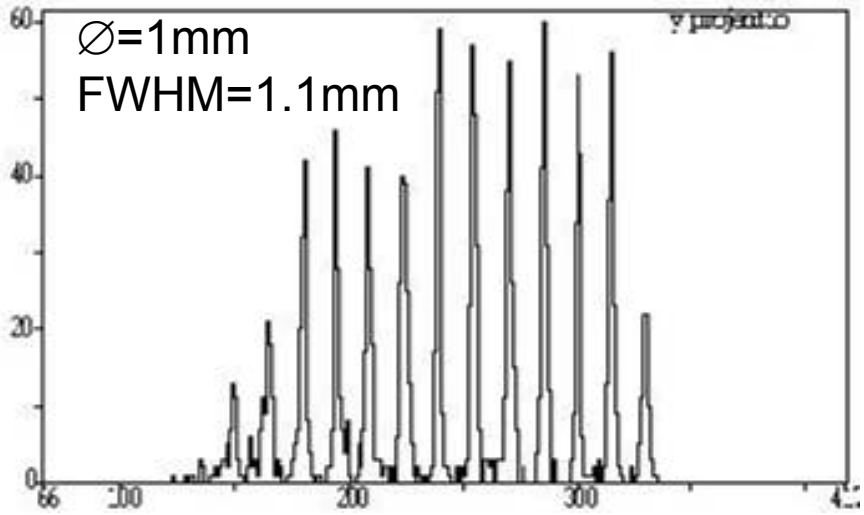
Position sensitive MCP

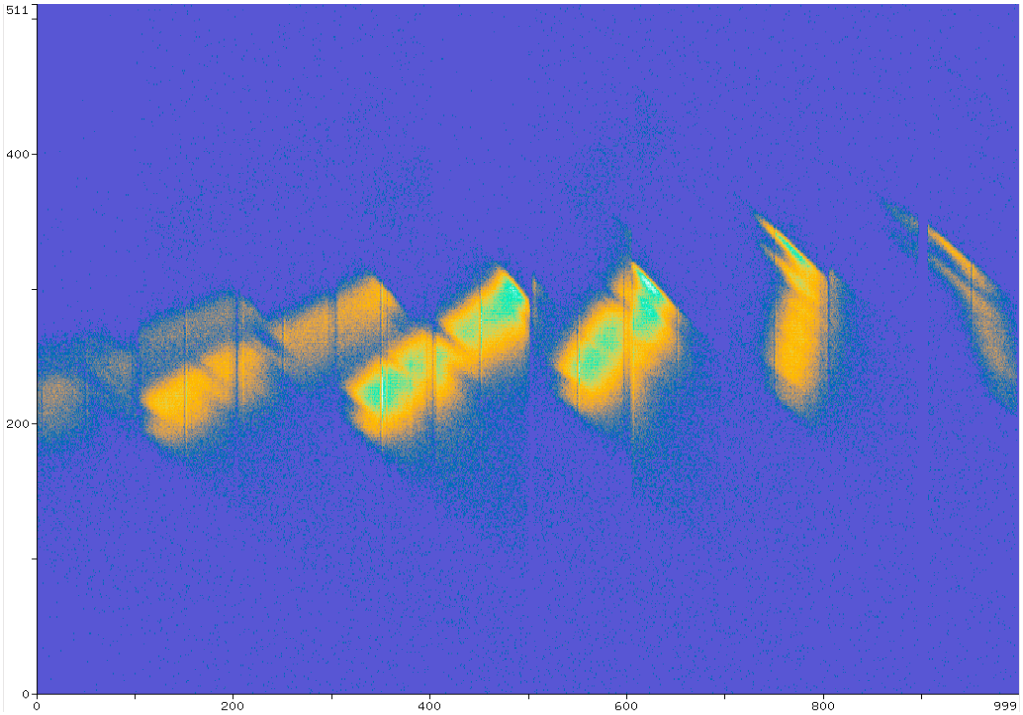




Developed in the collaboration: INFN-Padova, JINR Dubna, INFN-LNL





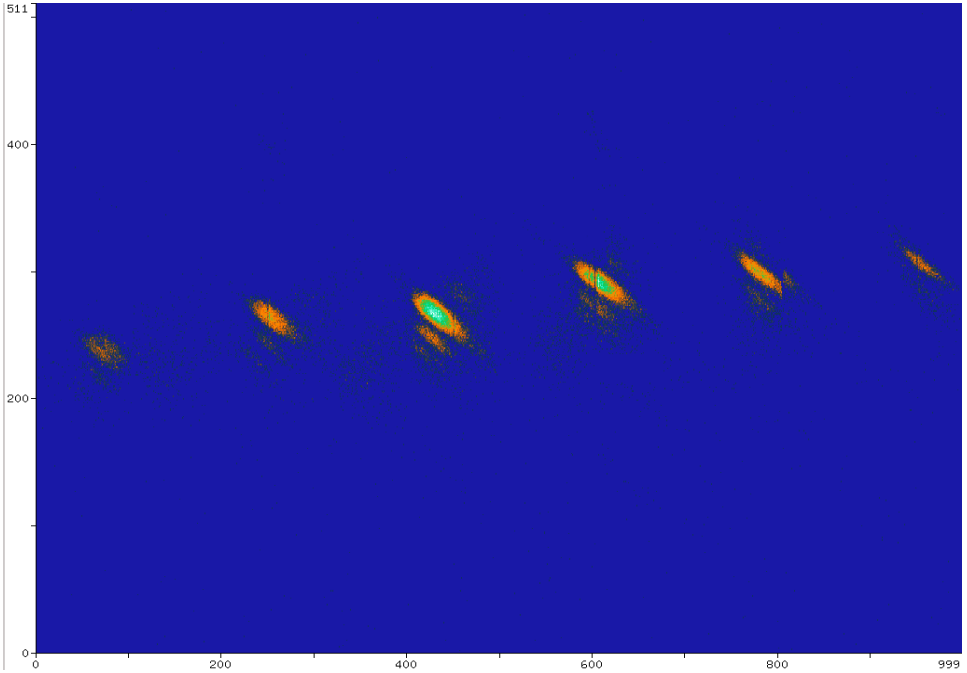


Commissioning X-TOF matrix for: 56Fe + 197Au

$\theta_{PRISMA} = 70^{\circ}$

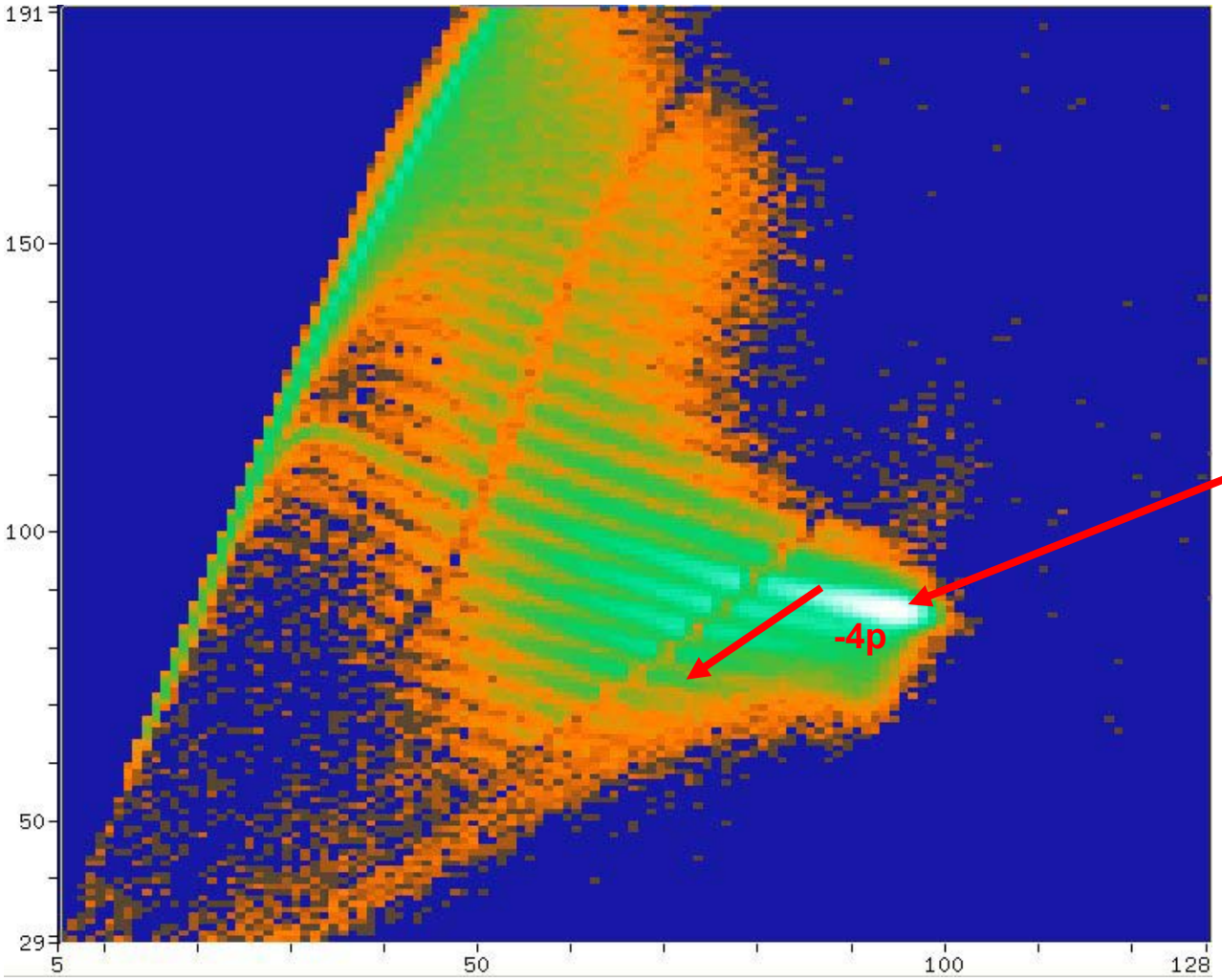
Without condition in the entrance MCP detector

With gate 69.7-70.3 in the entrance MCP detector



Analysis performed by A.Latina

Ionization Chamber ΔE-E matrix
64Ni 400MeV + 238U



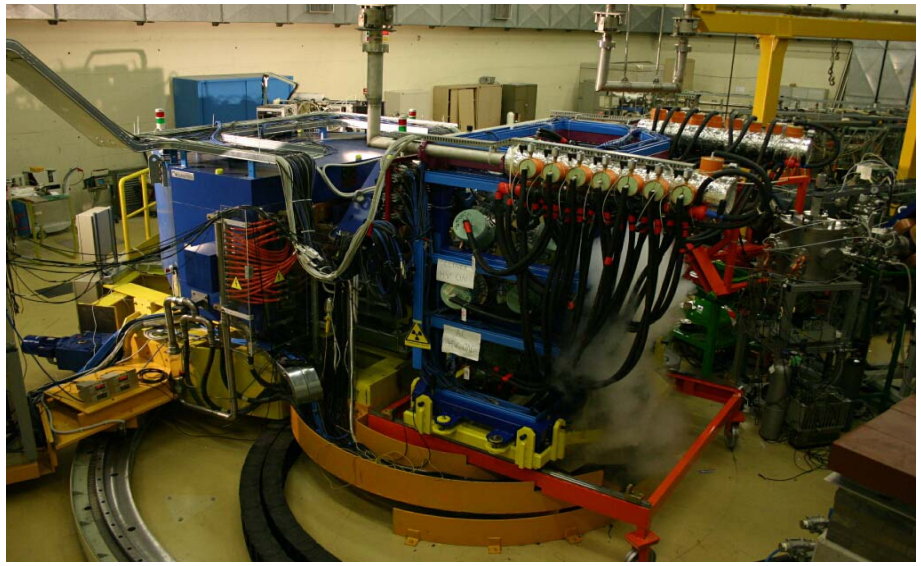
CLARA status

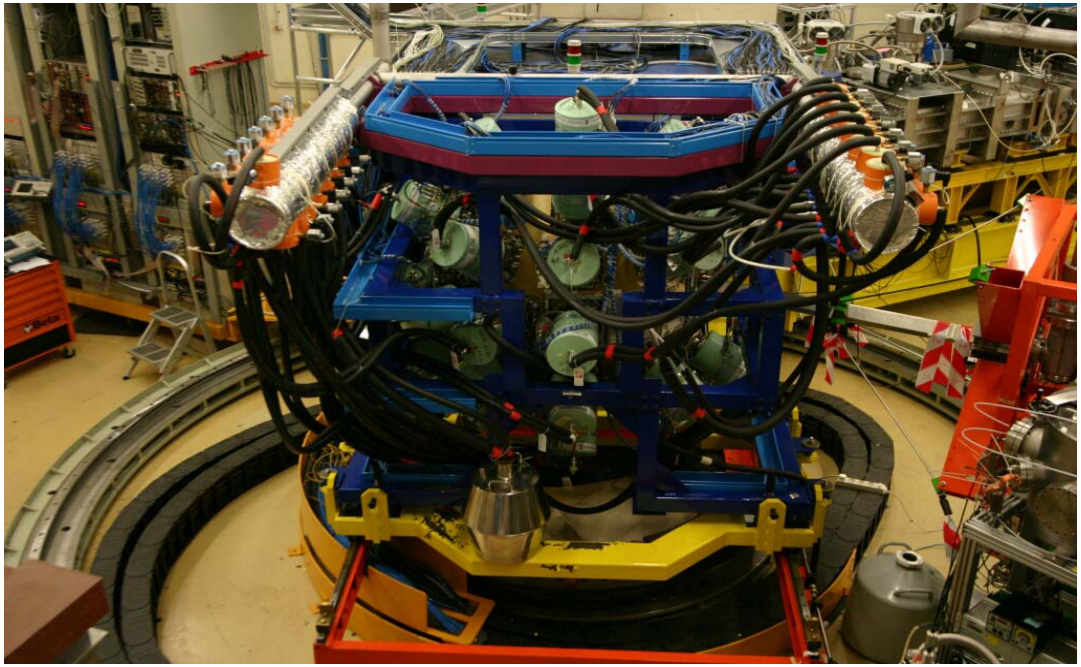
22 CLOVER detectors installed in the frame. Average resolution ~2.3 keV

Experimental P/T ratio ~44%

New beam line mechanics ready.

LN2 Filling system (IReS) stable.





Data acquisition, merging and VXI electronics stable.

DAQ rates ~20KHz at ~50% dead time

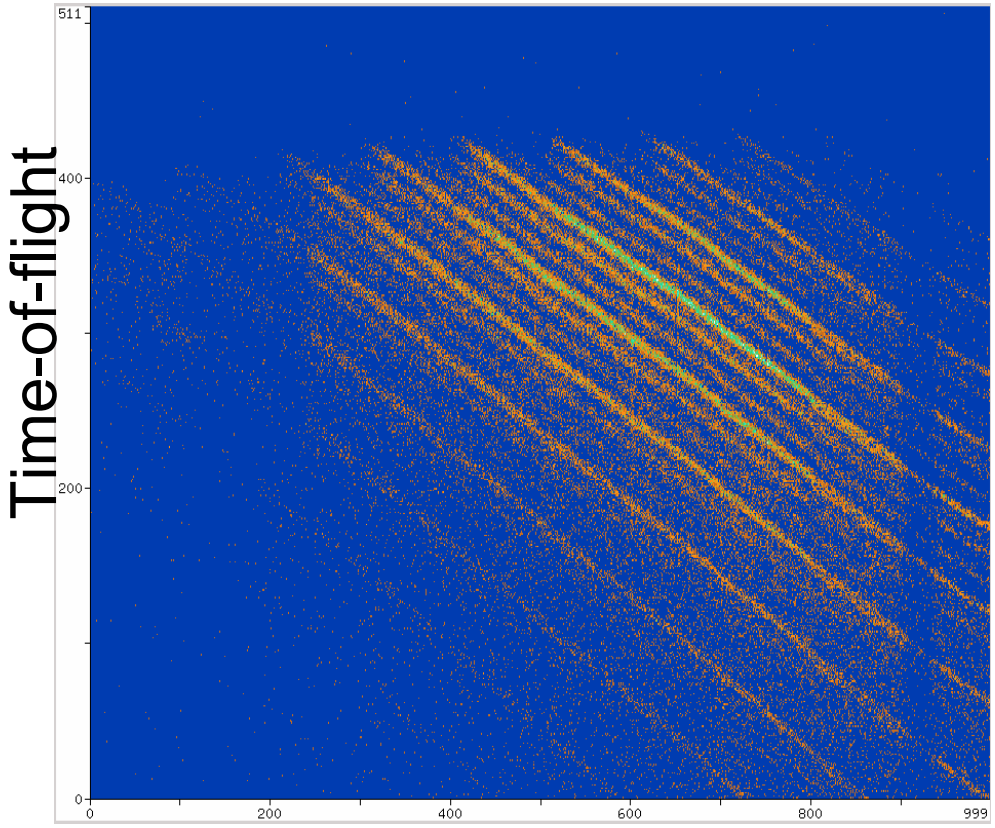
GUI (OCP + MIDAS) ready.

HV control system ready

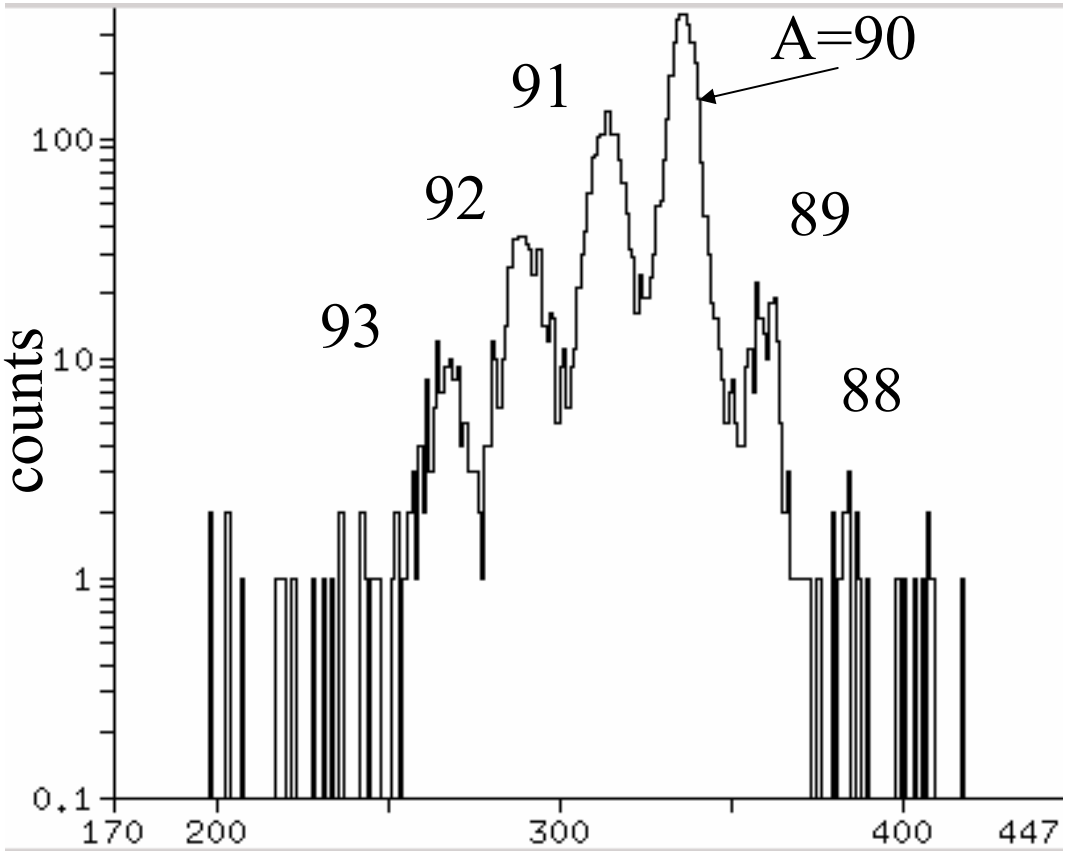
Trigger electronics ready

90Zr 560MeV + 208Pb

Spokesperson: L.Corradi



Distance along focal plane



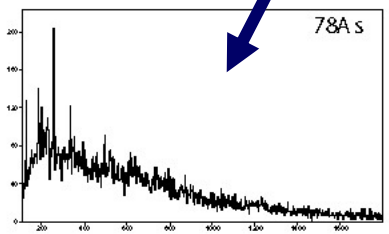
A

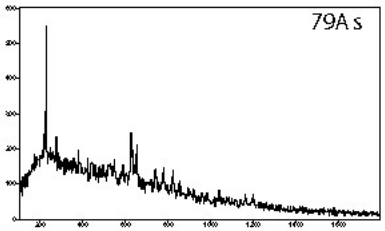
Very Preliminary Results

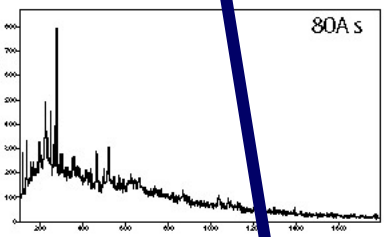
Spokespersons: G.Duchêne & G. de Angelis

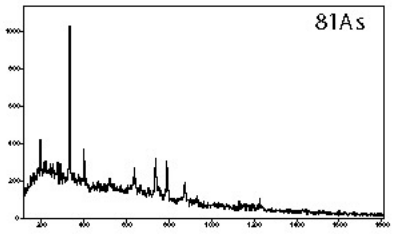
82Se 515MeV + 238U θ_{PRISMA} = 64

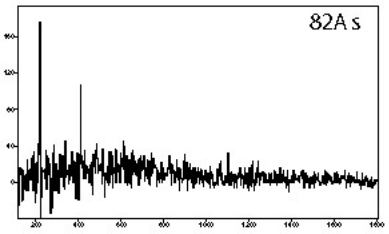
Se76 0+ 9.36	Se77 1/2- * 7.63	Se78 0+ 23.78	Se79 1.13E6 y 7/2+ * β-	Se80 0+ 49.61	Se81 18.45 m 1/2- * β-	Se82 1.08E+20 y 0+ β-β-	Se83 22.3 m 9/2+ * β-	Se84 3.1 m 0+ β-
As75 3/2- * 100	As76 1.0778 d 2- β-	As77 38.83 h 3/2- β-	As78 90.7 m 2- β-	As79 9.01 m 3/2- β-	As80 15.2 s 1+ β-	As81 33[illegible] s 3/2- β-	As82 19.1 s (1+) * β-	As83 13.4 s (5/2,3/2-) β-
Ge74 0+ 35.94	Ge75 82.78 m 1/2- * β-	Ge76 0+ 7[illegible]4	Ge77 11.30 h 7/2+ * β-	Ge78 88.0 m 0+ β-	Ge79 18.98 s (1/2)- * β-	Ge80 29.5 s 0+ β-	Ge81 7.6 s (9/2+) * β-	Ge[illegible] 4.6[illegible] s 0+ β-
Ga73 4.86 h 3/2- β-	Ga74 8.12 m (3-) * β-	Ga75 [illegible]26 s 3/2- β-	Ga76 32.6 s (2+,3+) β-	Ga77 13.2 s (3/2-) β-	Ga78 5.09 s (3+) β-	Ga79 2.847 s (3/2-) β-n	Ga80 1.697 s (3) β-n	Ga8[illegible] 1.217 (5/2-) β-n
Zn72 46.5 h 0+ β-	Zn73 23.5 s (1/2[illegible] * β-	Zn74 95.6 s 0+ β-	Zn75 10.2 s (7/2+) β-	Zn76 5.7 s 0+ β-	Zn77 2.08 s (7/2+) * β-	Zn78 1.47 s 0+ β-	Zn79 995 ms (9/2+) β-n	Zn80 0.545 s 0+ β-n

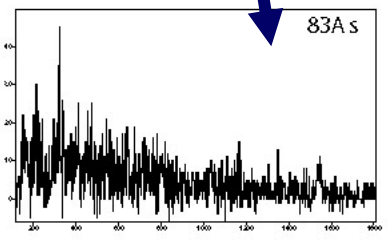




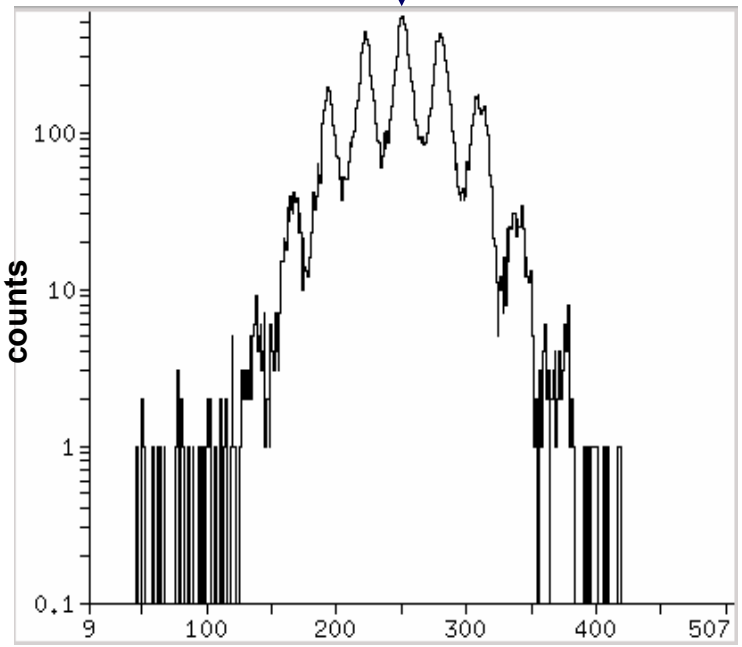








78Ge



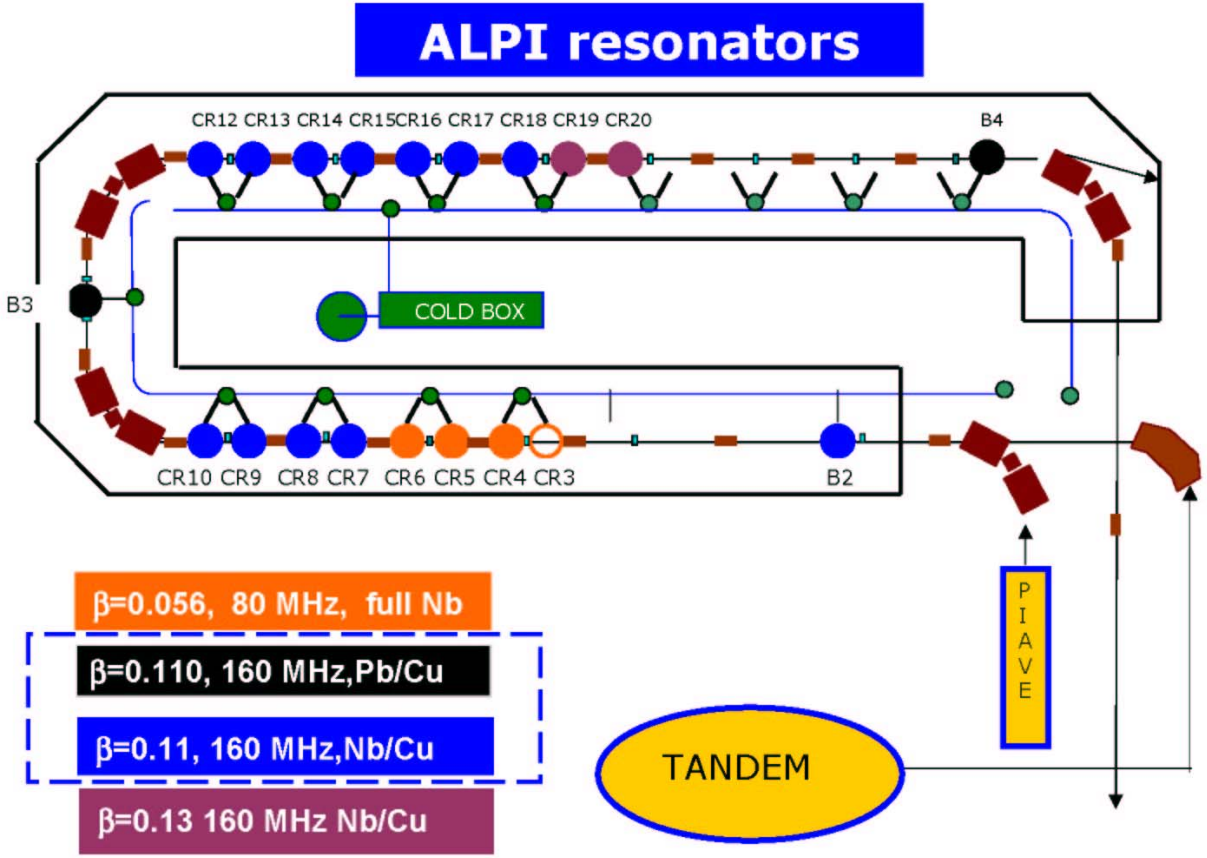
← **A**

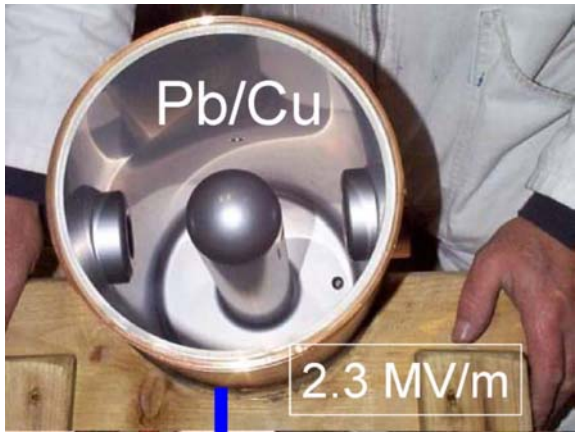
Mass distribution of Ge isotopes

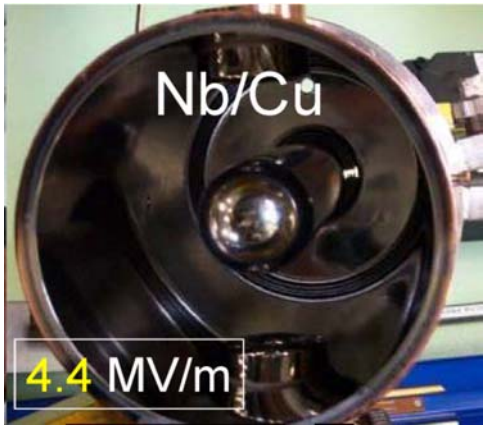
ϑ_{lab} = 66.70± 0.70

q = 26+, RUN32 to 38

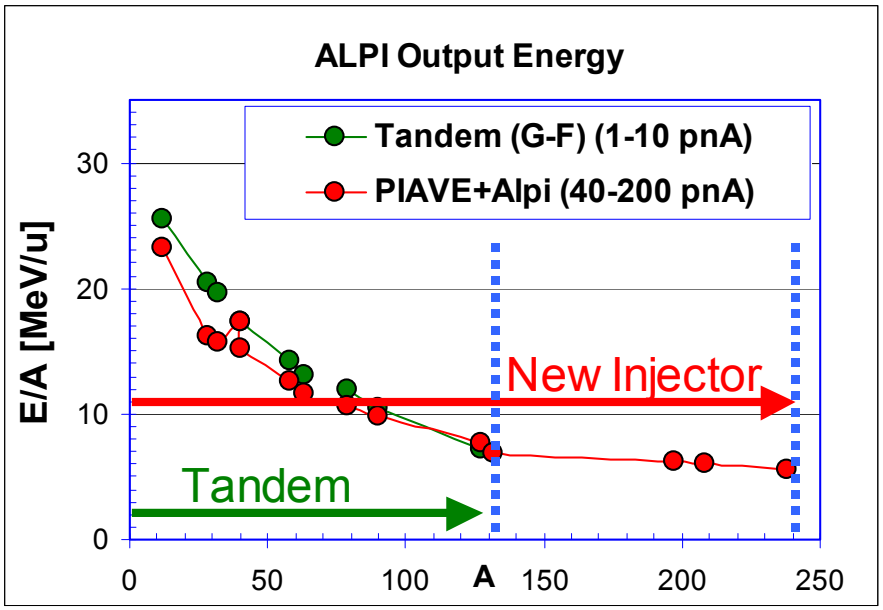
Present constrains at LNL :
Tandem – ALPI beams (therefore Tandem beams) up to A~100.
Beam intensities increased up to few pnA (6pnA for 82Se, 4pnA for 90Zr) due to the ALPI energy upgrade (equivalent to ~32MV).







Developments:



Positive ion injector ECRIS + PIAVE (commissioning with ALPI expected September 2004). Ar, Kr and Xe (also Ag and Cu) beams early 2005, program to develop Sn, Cd, Sm and Pb beams at the ECR started

Physics Program

- **Experiments already performed:**

  F.Azaiez-X.Liang: N=20 shell closure
  G.Duchene-G.de Angelis: N=50 shell closure
  S.Lenzi-S.Freeman: Deformed N-rich A~60 nuclei
  L.Corradi: Pairing vibrational states in 90Zr

- **To be performed:**

  Shell model in the ^{48}Ca
  The N=32 Shell closure
  Mirror Energy differences in the sd and f7/2 shells

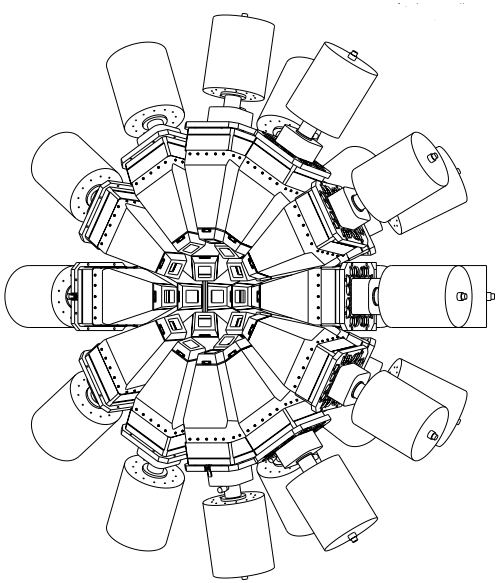
- **Perspectives:**

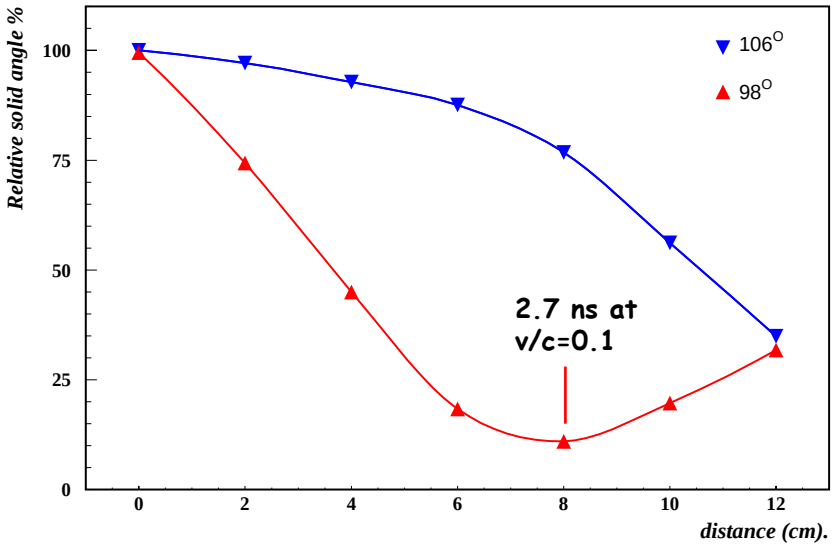
  Dynamic symmetries
  Non-yrast exotic shapes
  Shell model in the ^{132}Sn region (PIAVE-ALPI) and in the neighbourhood of ^{78}Ni
  High spin states in light n-rich nuclei in the N=20-28 region

Lifetime measurements with the Clover array at Prisma

- Recoil Shadow anisotropy method:
  Based on the array-collimator geometry.
  Lifetimes ranging from ~0.5 to ~20 ns.
  E.Gueorguieva et al. NIM A 474 (2001) 132.
- Differential Plunger method (to be developed):
  Needs a degrader foil at different distances form target.
  Lifetimes ranging from ~1 ps to ~1 ns.
- RFD method:
  Developed at the Krakow Recoil Filter Detector.
  Based on the line shape analysis of the Doppler shifted lines and the change of momentum introduced by the straggling of the products in the target.
  Needs an accurate position sensitive detector as the PRISMA start MCP .
  Lifetimes ranging from ~50 fs to ~1 ps.
  P.Bednarczyk, W.Meczynski, J.Styczen et al.

Recoil Shadow Anisotropy Method

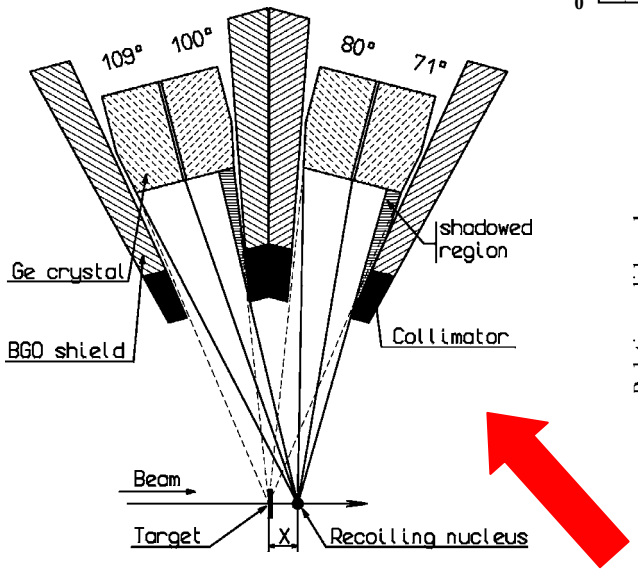


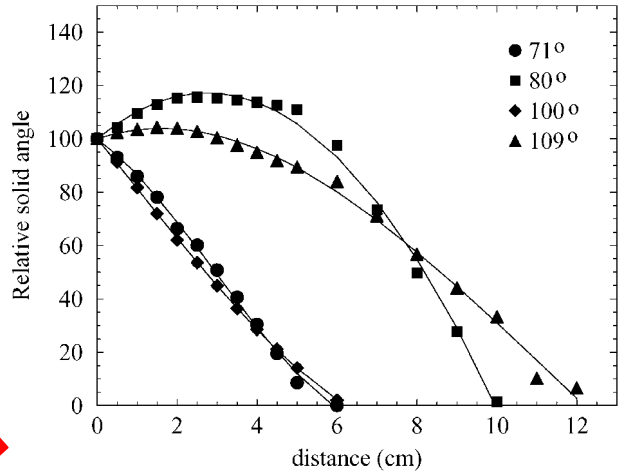


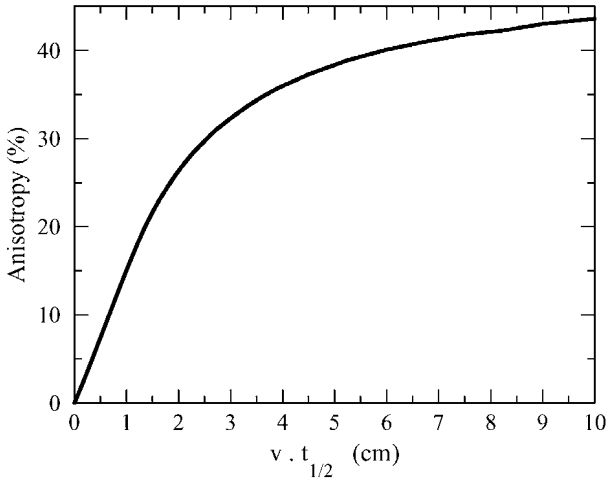
Angles for the Ge crystals of the Clover array ring:

θ = 106 °

θ = 98 °

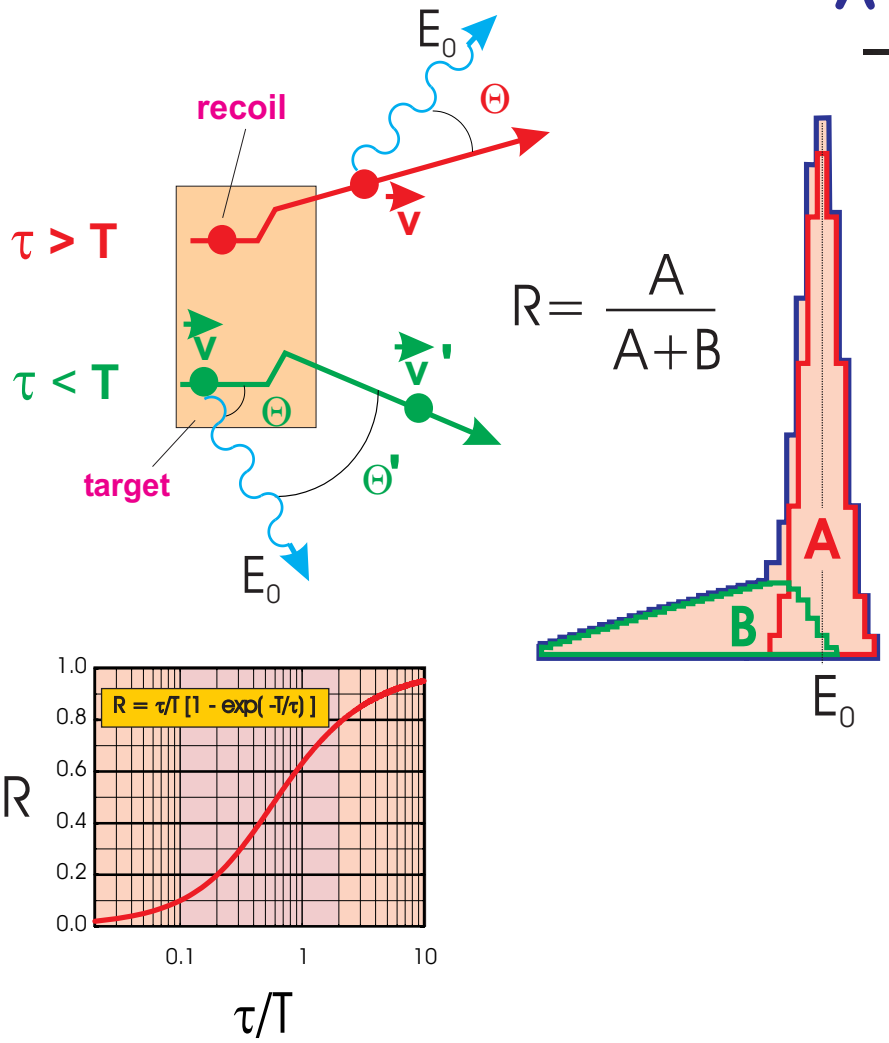




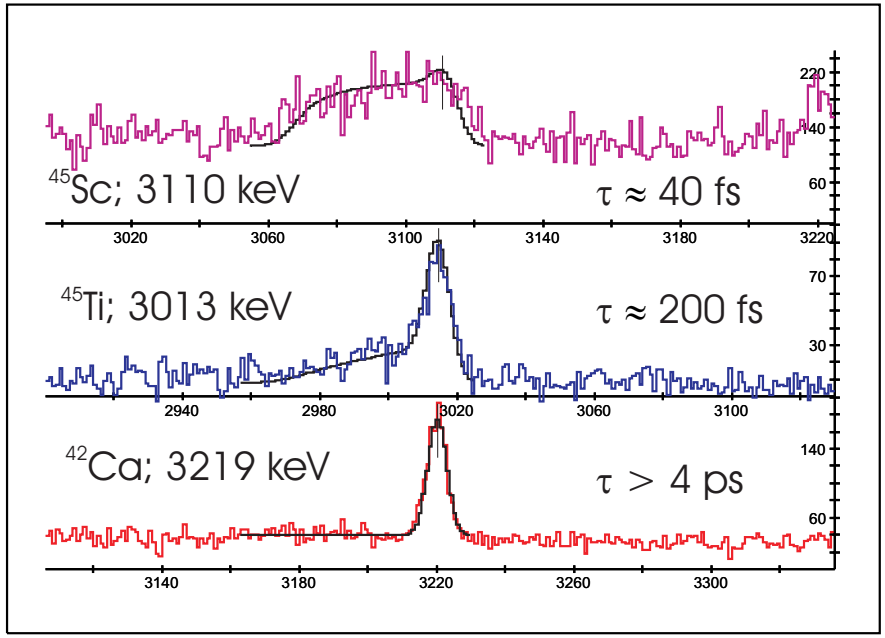


For EUROBALL: E.Gueorguieva et al. NIM A 474 (2001) 132

A short lifetime determination with RFD



68MeV ^{18}O + 0.8mg/cm^2 ^{30}Si;
Recoil transit time ≈ 0.4 ps



The range of measured lifetimes can be chosen by a selection of the target thickness.

In the measurement τ ranging from 40 to 800 fs could be determined.

P.Bednarczyk, W.Meczynski, J.Styczen et al.

The CLARA-PRISMA collaboration

•France

IReS Strasbourg

•U.K.

University of Manchester
Daresbury Laboratory
University of Surrey
University of Paisley

•Germany

HMI Berlin

GSI Darmstadt

•Italy

INFN LNL-Legnaro
INFN and University Padova
INFN and University Milano
INFN and University Genova
INFN and University Torino
INFN and University Napoli
INFN and University Firenze
University of Camerino

•Spain

University of Salamanca

•Romania
Horia Hulubei NIPNE Bucharest