EXPERIMENTS WITH GASP

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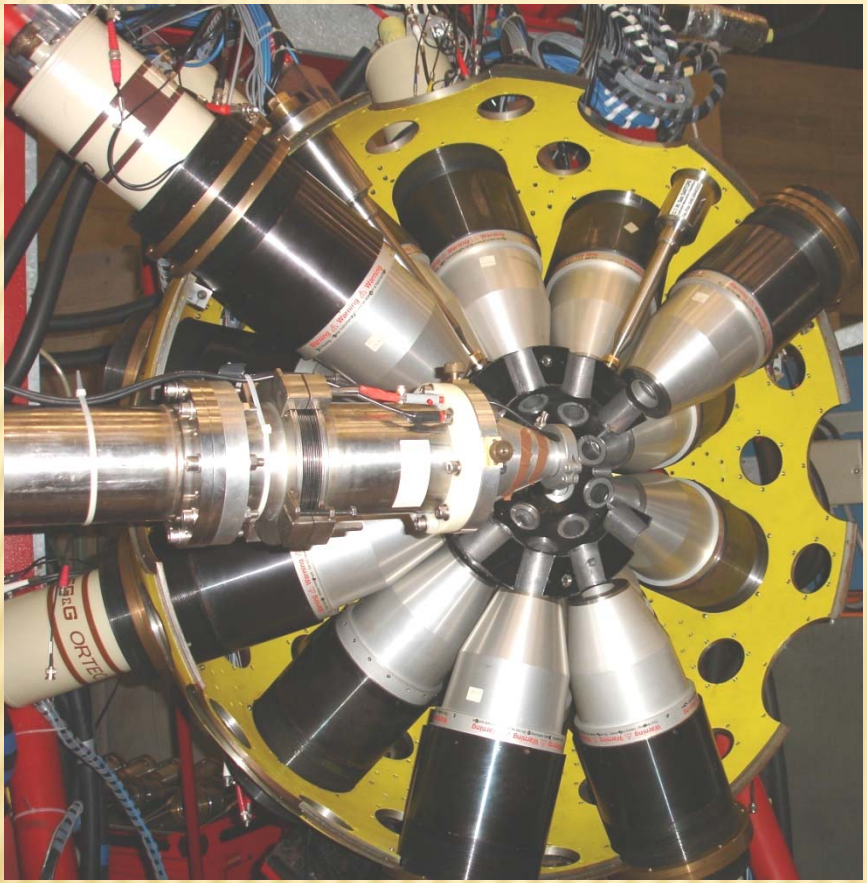
LAYOUT OF THE PRESENTATION

- Overview of GaSp and its ancillary detectors
  - Status of GaSp
  - Ancillary detectors
    - EUCLIDES
    - RFD
    - LuSiA
- Experiments with GaSp and its ancillary detectors
  - Lifetime measurements (DSAM, RDM)
    - Mirror symmetry, Shape coexistence, X(5) 'symmetry'
  - PRISMA-CLARA follow-up experiments
    - Decay-out of a resonance in ^{24}Mg + ^{24}Mg
- Concluding remarks

THE GASP ARRAY – CONFIGURATION II

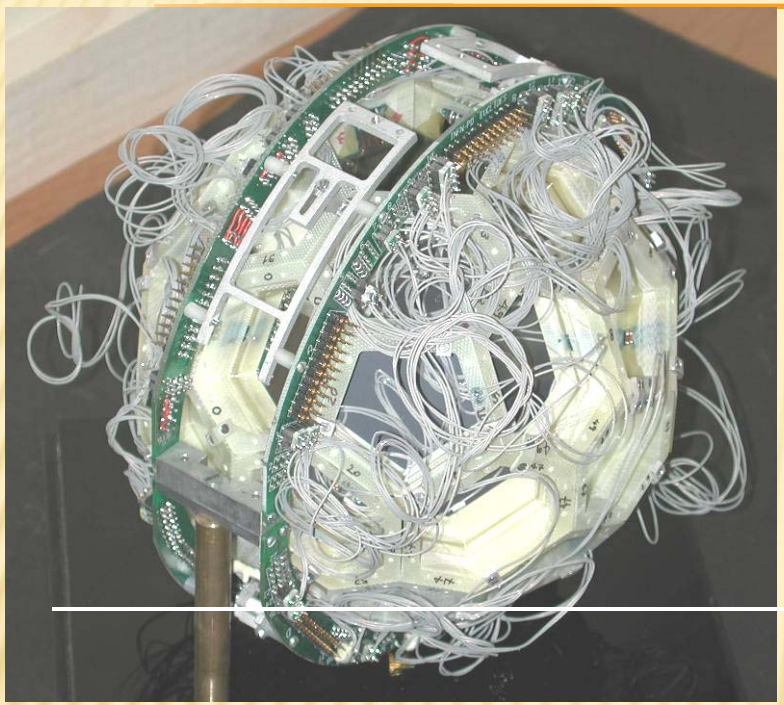


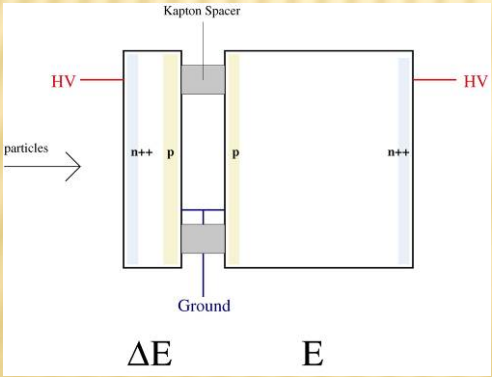
- 40 HPGe + AC
  - $d_{target-det.}$ = 22 cm
  - ε_{int} ~80% @ 1332.5 keV
  - FWHM < 2.4keV @ 1332.5 keV
  - ε_{ph}~ 5.8% @ 1332.5 keV
  - P/T ~ 60% (^{60}Co)
- Pb collimator (6 cm thick)
  - inner space R_{int} = 15 cm

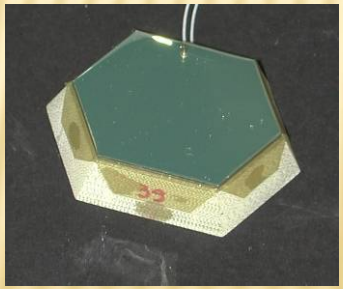
7 rings

35°	60°	72°	90°	108°	120°	145°
6	6	4	8	4	6	6

ANCILLARY DETECTORS - EUCLIDES







EUROPEAN CHARGED LIGHT IONS DETECTOR SPHERE

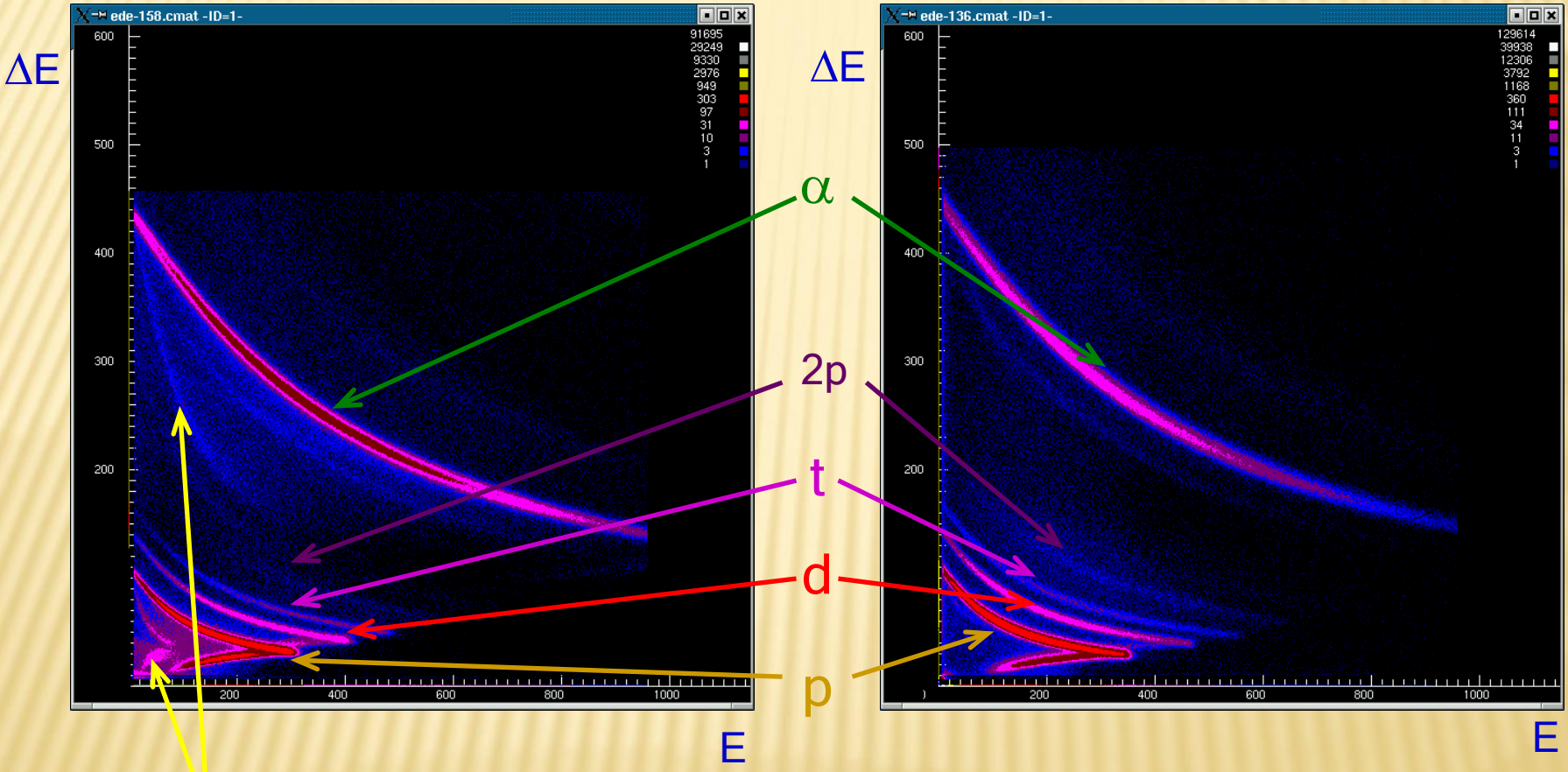
- 40 ΔE-E telescopes
  - ΔE ~ 130 μm ~ 81%
  - E ~ 1000 μm ~ 80%
- Segmented forward telescopes
- Total efficiency
  - ε_{proton} ~ 60%
  - ε_{alpha} ~ 35%
- Good transparency to γ-rays
- Specially design CAMAC electronics (Silicon Shaper Analyzer)
- Configuration I and II

E. Farnea (Padova)

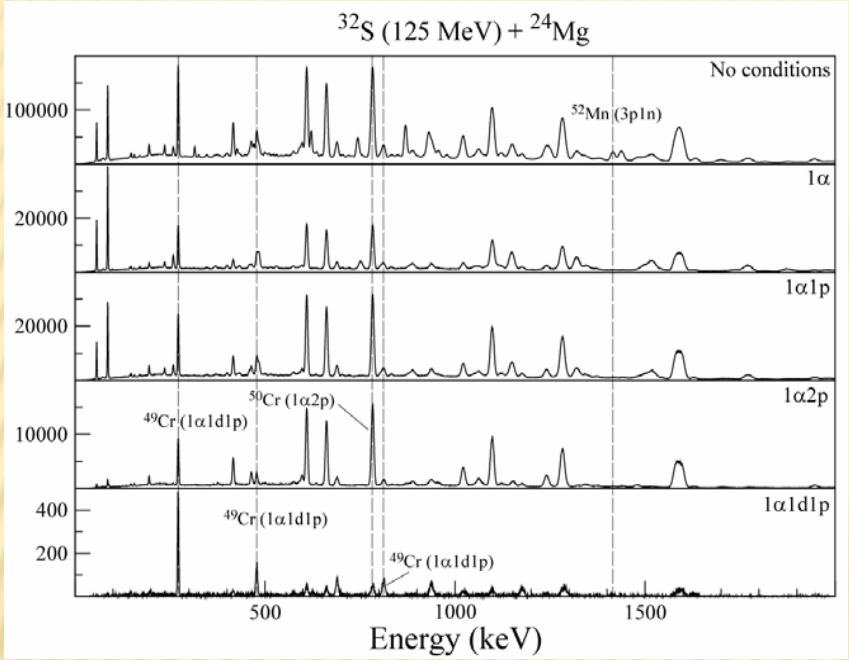
ANCILLARY DETECTORS - EUCLIDES

Segmented

Non segmented



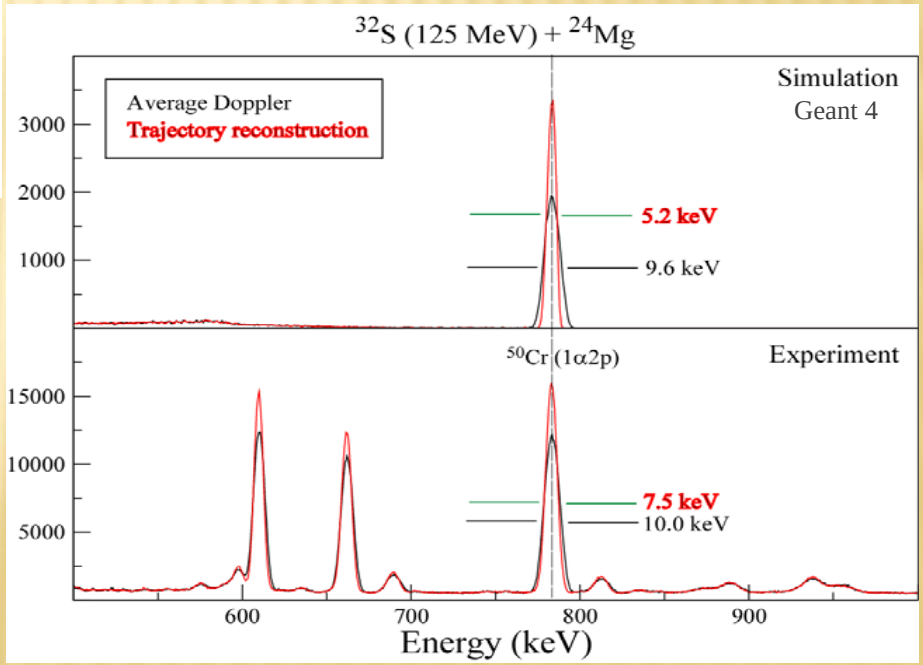
ANCILLARY DETECTORS - EUCLIDES



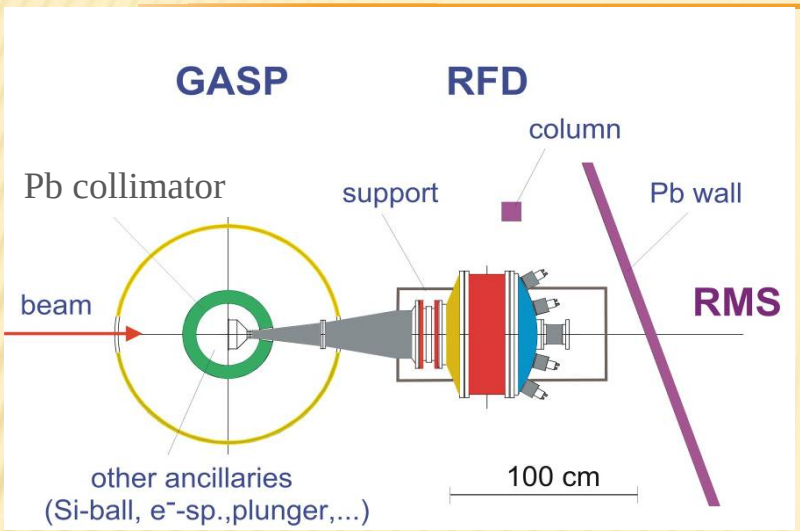
Reaction channel selection

GaSp II + EUCLIDES

Kinematical reconstruction

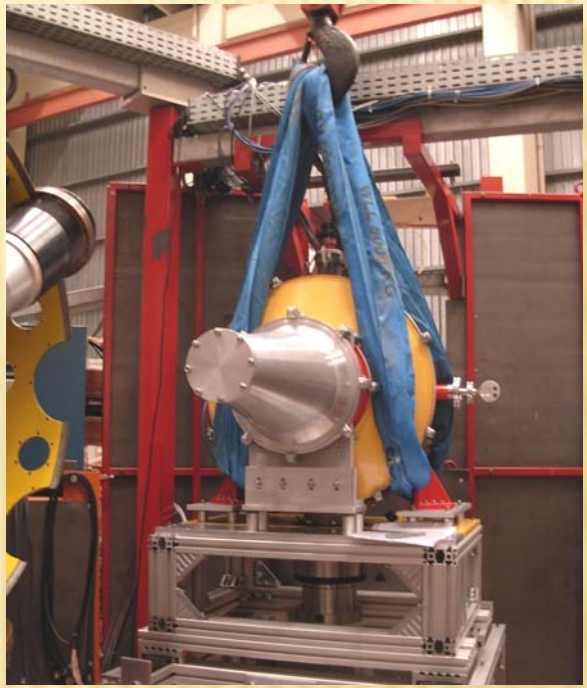


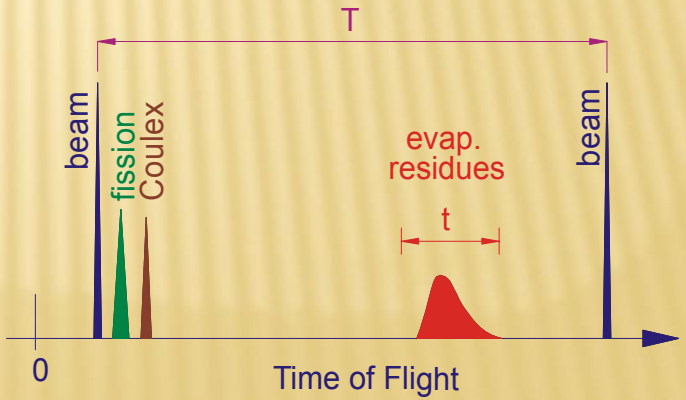
ANCILLARY DETECTORS - RFD



RECOIL FILTER DETECTOR

- RFD measures recoils in coincidence with γ-rays detected in Ge-array
  - selection of the recoils of interest by ToF technique
  - determination of the recoil velocity vector event-by-event
  - eliminate events from light contamination of the targets

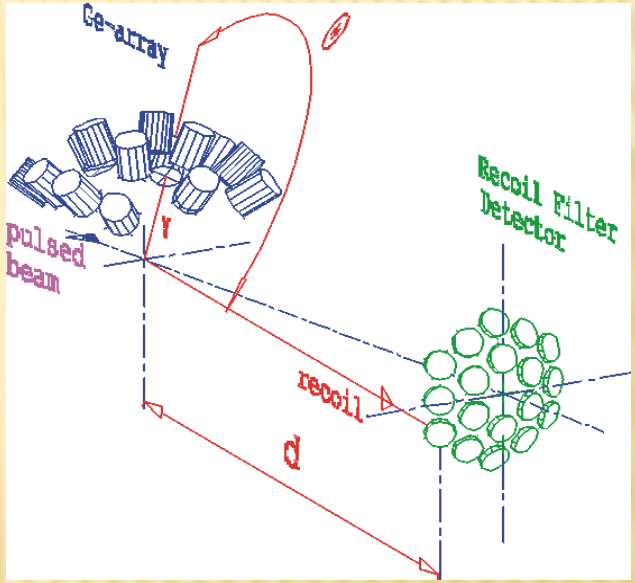


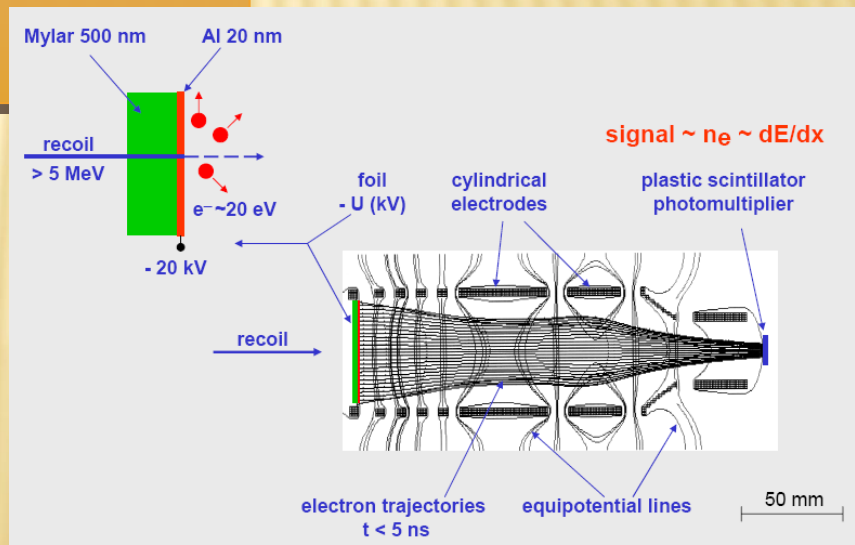


W. Męczyński and P. Bednarczyk (Kracow)

ANCILLARY DETECTORS – RFD

- RFD consists of 18 detecting elements
  - thin Mylar foils
  - plastic scintillators + phototubes
- CAMAC electronics
  - TDC – time signals
  - QDC – amplitude signals
- Mechanical mounting – tested
- GaSp DAQ integration test to be done
- Configuration I and II

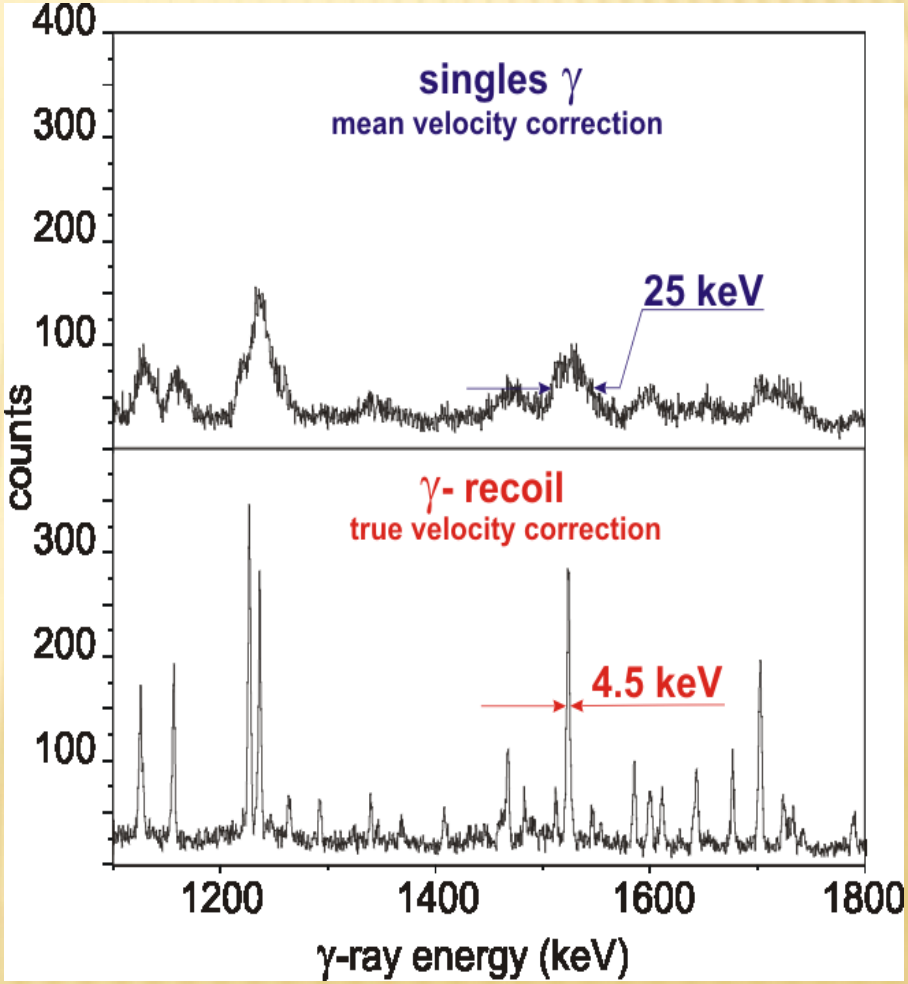




ANCILLARY DETECTORS - RFD

- Features & requirements
  - efficiency of the γ-recoil coinc: 20-50%
  - precise Doppler broadening correction for recoil velocity up to ~7%
  - detection angle 1.8° - 6.7°
  - a pulsed beam with a time interval larger than 100 ns with Δt ~1-2 ns
  - σ_{fus} > 50 mb
  - counting rate of the individual recoil detector below 3 MHz
  - kinetic energy of the recoils greater than 4 MeV

^{18}O(@67 MeV) + 0.8 mg/cm^2 ^{30}Si (EB-IV)

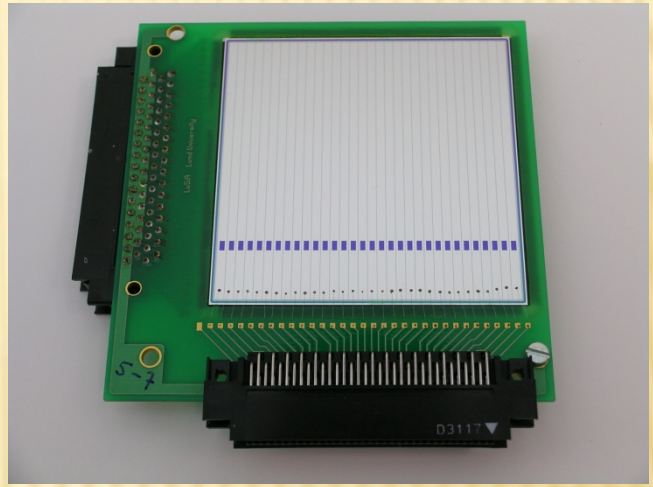


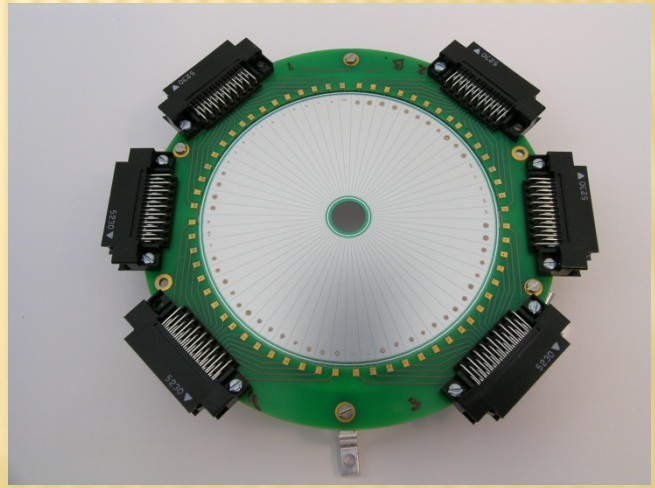
P.Bednarczyk *et al.*, Acta Phys. Polon. **B32**, 747 (2001)

ANCILLARY DETECTORS - LUSIA (GASP)

LUND SILICON ARRAY

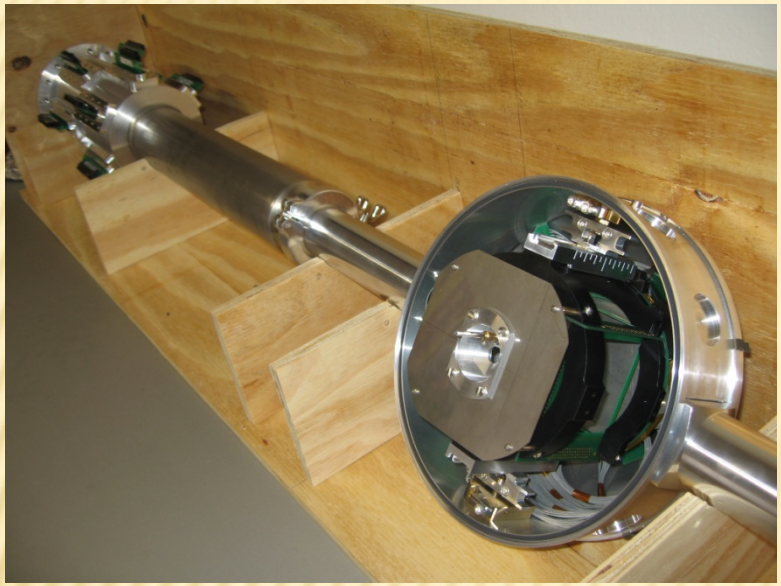
- PCB mounted DSSSD (ΔE type)
  - 4 squared-shaped detectors
    - 32 strips on each side
    - 58 x 58 mm^2 active area
    - 510 μm & 303 μm
  - 1 circular-shaped detector
    - 64 sectors & 32 rings
    - outer diameter 85
    - hole diameter 10 mm or 28 mm
- Configuration I and II
- Kinematical reconstruction of events
  - COULEX
  - Transfer reactions

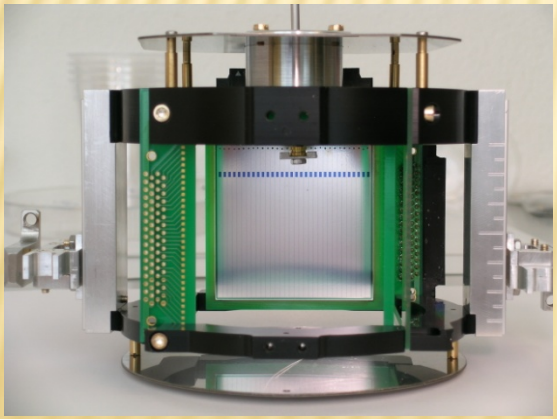




C. Fahlander and P.Golubev (Lund)

ANCILLARY DETECTORS - LUSIA (GASP)

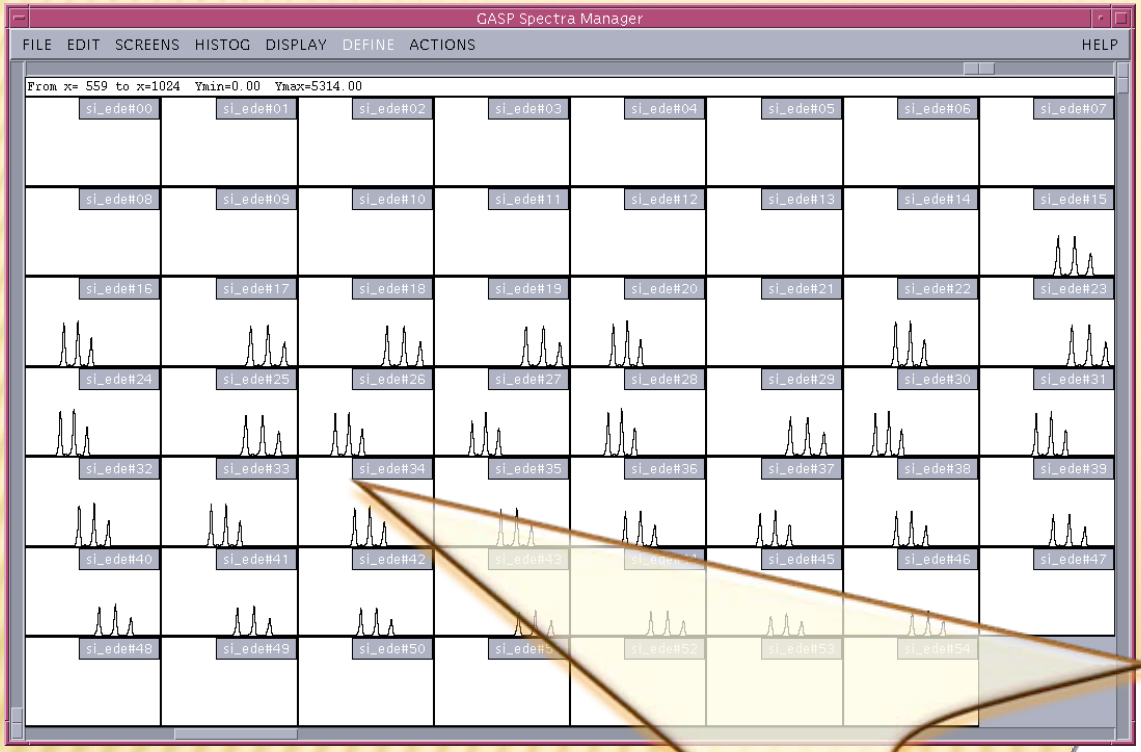




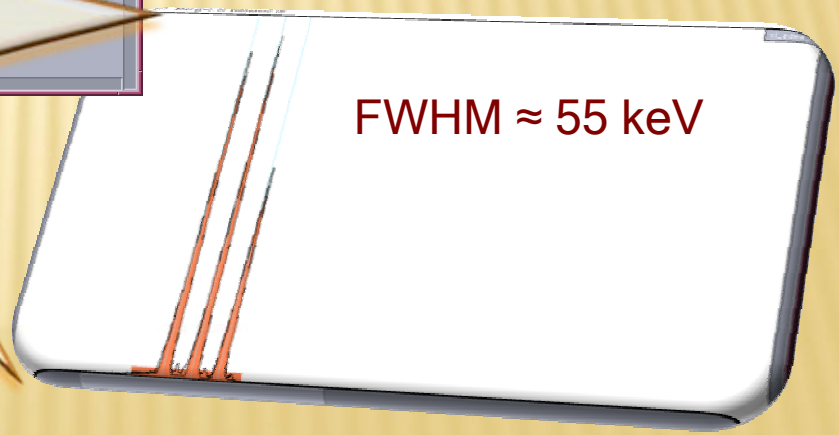
Test in Legnaro

- One square DSSSD
- CSP_07 (G. Pascovici - IKP Köln)
  - 32 channels
  - dynamic range: 200 MeV
  - sensibility 50 mV/200MeV
  - rise time 15ns/0pF (+2ns/10pF)
  - fall time 10μs
  - differential output (64 pin connect.)
- Mesytec (STM-16) - 16 channels
  - differential input from CSP_07
  - amplifier output
  - ECL timming output
- EUCLIDES CAMAC ADC&TDC&DDL
- GaSp acquisition system

ANCILLARY DETECTORS - LUSIA

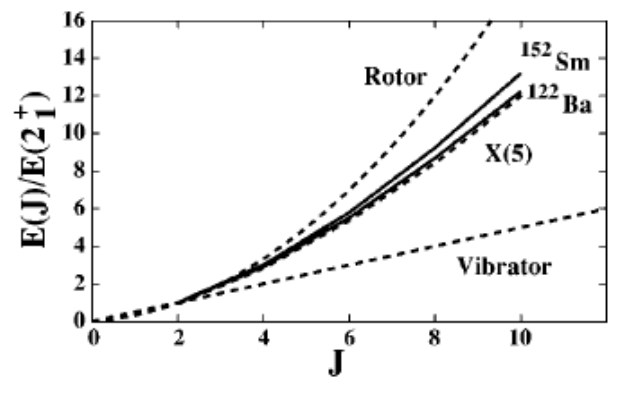


$^{239}Pu/^{241}Am/^{244}Cm$ alpha source

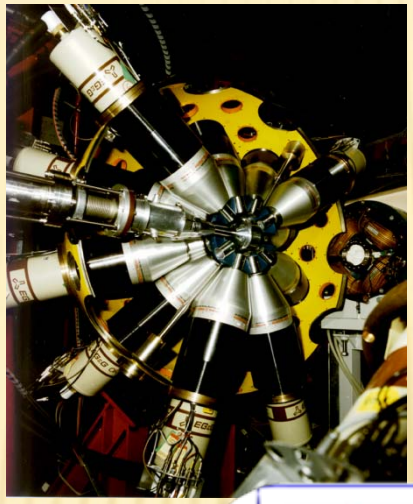


- GaSp spectra manager
  - 32 channels

X(5) – SYMMETRY IN ^{122}Ba

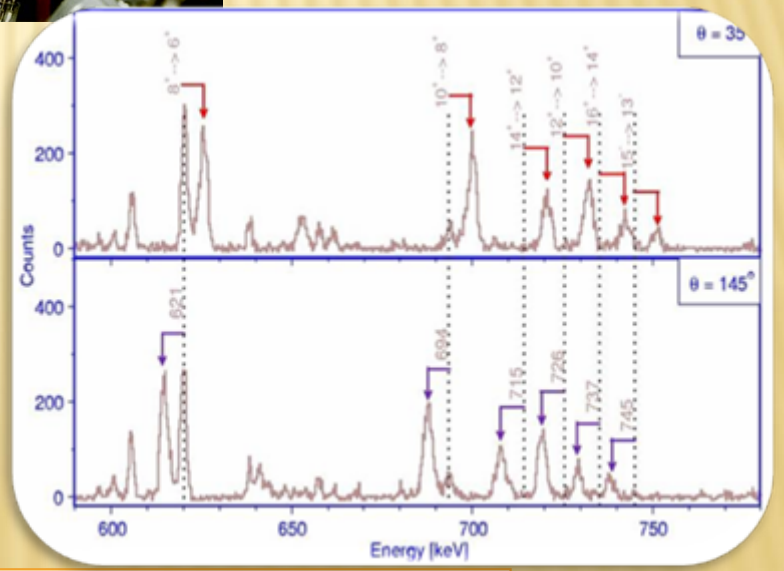


C.Fransen et al.,
Phys.Rev. C 69, 014313 (2204)



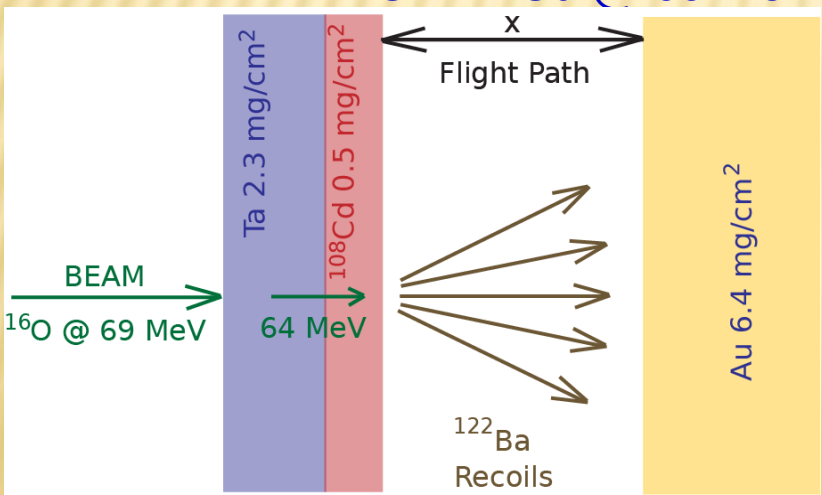
GaSp Conf.II +
Köln plunger

P.G. Bizzetti et al.,
LNL Annual Report 2007



What about
B(E2)'s?

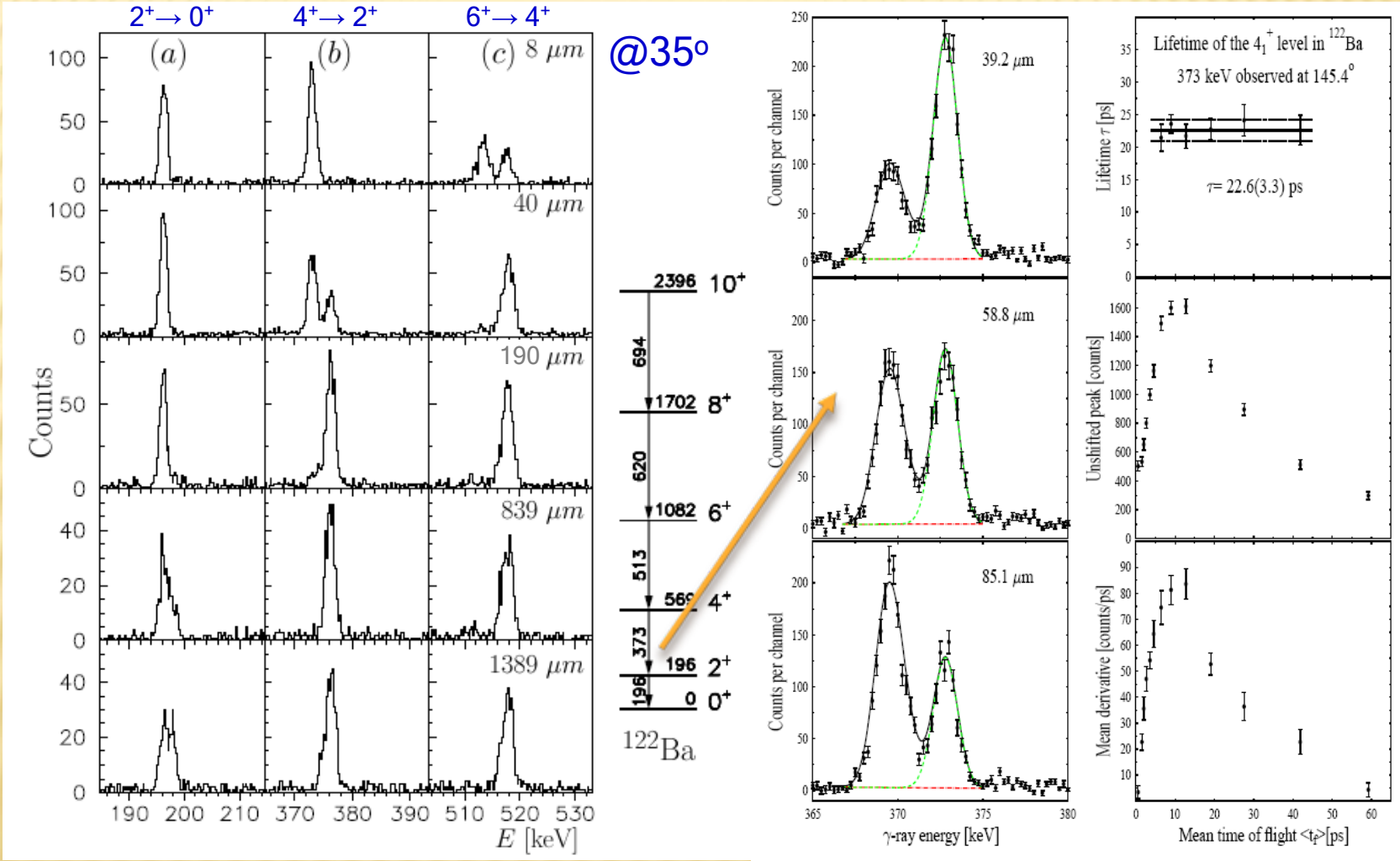
^{16}O + ^{108}Cd @ 69 MeV



17 distances: 1.5 μm ÷ 1.4 mm
→ ~ 0.5 ÷ 463 ps

X(5) - SYMMETRY IN ^{122}BA

DDCM analysis of the yrast band



X(5) – SYMMETRY IN ^{122}Ba

- the lifetime of the 2_1^+ state longer than previously reported – 428 (39) ps

  T.Morikawa *et al.*, Phys.Rev. C 46, R6 (1992)

  - need to measure at larger distances

- contamination at 198 keV

  - impossible to use the forward angles

    ⇨ difficult to extract the lifetime of the 2_1^+ state with small error from the present data

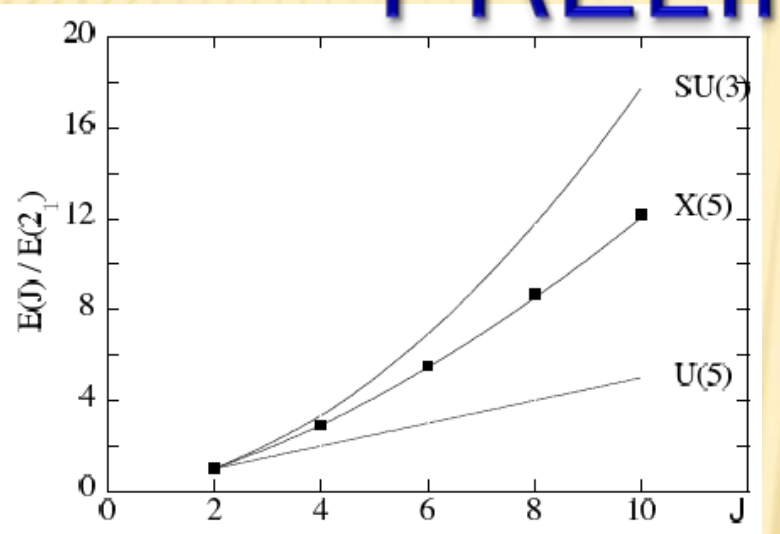
new plunger measurement at IKP Koln:

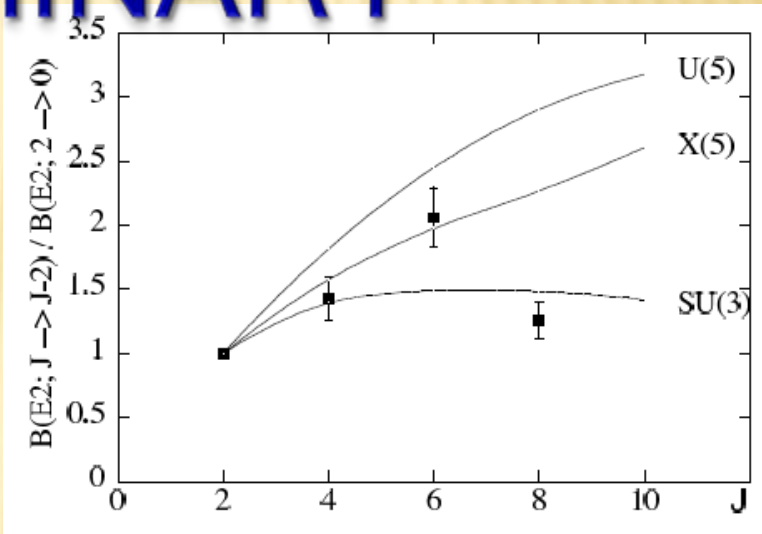
^{13}C + ^{112}Sn @ 61 MeV / distances: 10 μm ÷ 3.0 mm

⇨ new lifetime: $\tau(2_1^+)$ = 749(66) ps

X(5) – SYMMETRY IN ^{122}BA

PRELIMINARY



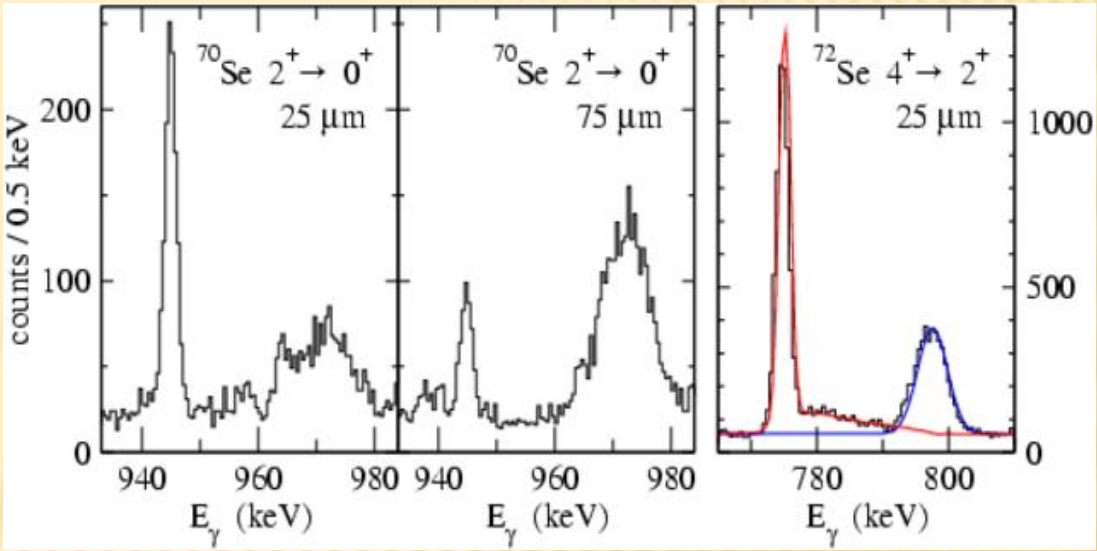


Analysis in progress for the higher lying states (DSAM)

SHAPE COEXISTENCE IN LIGHT SE ISOTOPES

GaSp Conf.II + Köln plunger
ALPI - PIAVE
$^{40}Ca(^{36}Ar,\alpha 2p)^{70}Se$
$^{40}Ca(^{36}Ar,\ 4p)^{72}Se$

J. Ljungvall *et al.*, PRL 100, 102502 (2008)



γγ-gated GASP spectra

^{70}Se

τ (ps)		$B(E2;\downarrow)$ (e^2fm^4)	
new	old	exp.	theo
3.2(2)	1.5(3)	342(19)	549
1.4(1)	1.4(3)	370(24)	955
1.9(3)	3.9(9)	530(96)	1404

New lifetimes together with REX/Isolde results (A. M. Hurst *et al.*, PRL 98, 072501 (2007)) give strong support for oblate ground-state shape in light Se isotopes

Details from Joa in the next talk

MIRROR SYMMETRY IN A=31 NUCLEI

MED and B(E1) in $T_z = \pm 1/2$ mirror nuclei

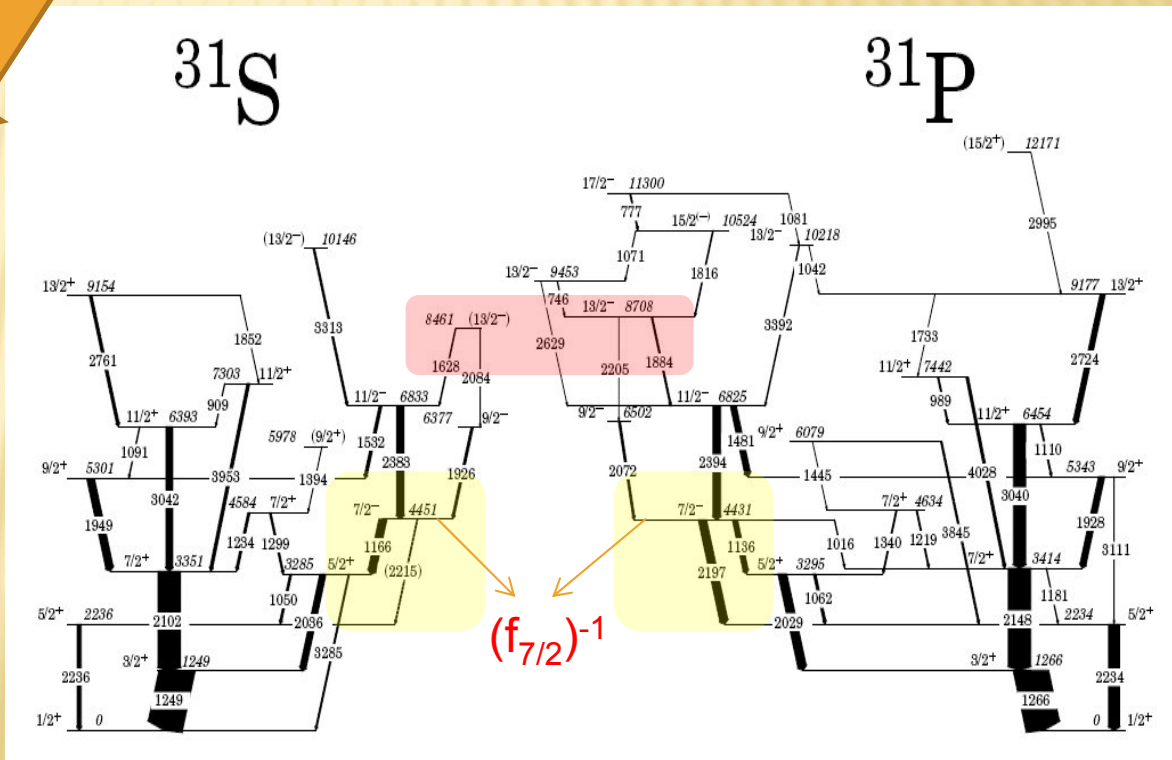
A = 35 mirror nuclei J. Eckman *et. al.*, Phys. Rev. Lett. 92,132502 (2004)

F. Della Vedova *et al.*, Phys. Rev. C 75, 034317 (2007)

- large MED values for the yrast $13/2^-$ states
- different decay patterns of the yrast $7/2^-$ states

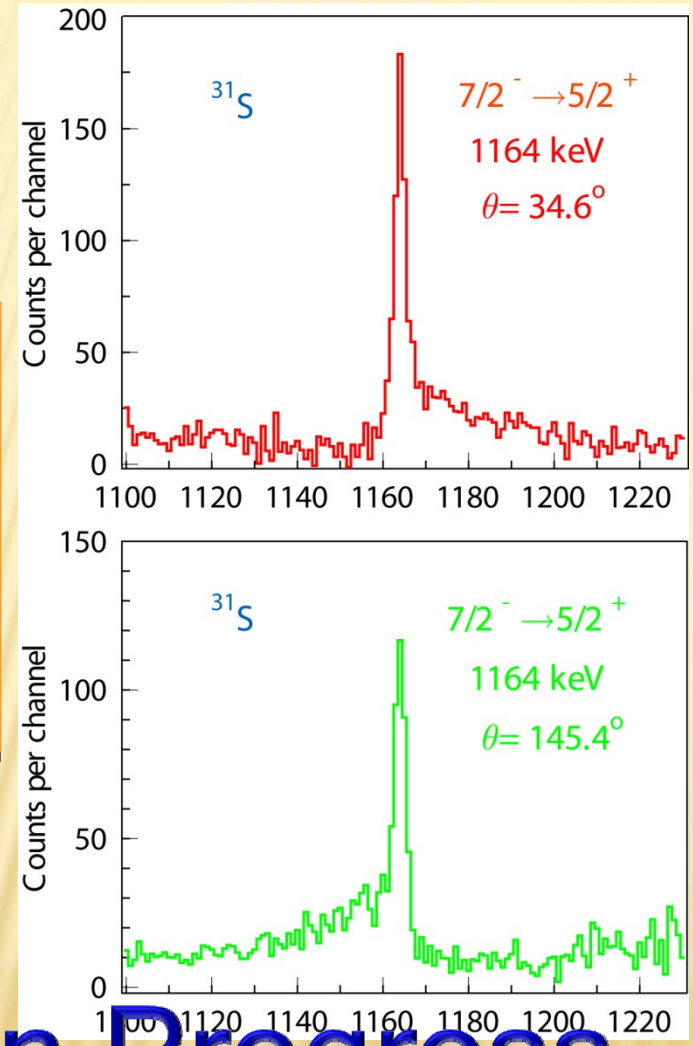
- nature and magnitude of the various contributions to MED (BM, CM, Cm)
  - ➢ important EMSO term
- excellent test for the *sdpf* interaction used in LSSM

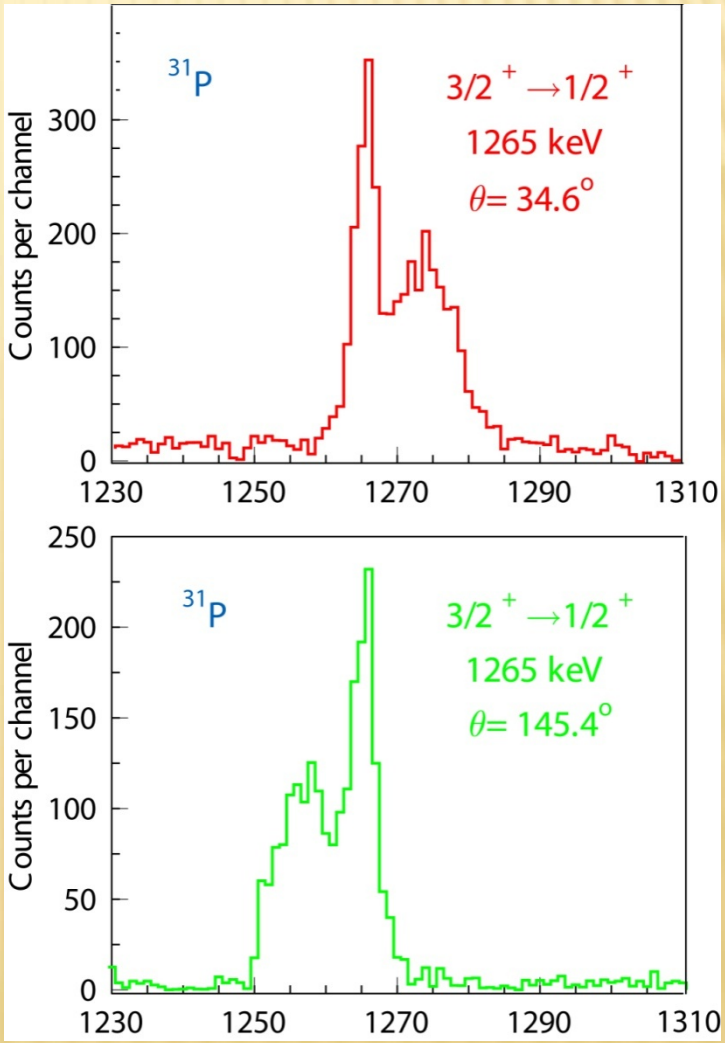
- comparison of E1 transition probabilities in mirror nuclei
  - ⇨ isospin mixing



MIRROR SYMMETRY IN A=31 NUCLEI

GaSp Conf.II
+ EUCLIDES
ALPI - PIAVE
$^{12}C(^{20}Ne, n)^{31}S$
$^{12}C(^{20}Ne, p)^{31}P$
@ 33 MeV





Work in Progress

D. Tonev, Private comm.

RESONANCE IN ^{24}MG+^{24}MG

^{24}Mg + ^{24}Mg → resonance $J^{\pi} = 36^{+}$, E_{CM} = 45.7 MeV, Γ = 170 keV

⇨ study the decay into - the inelastic channel (PRISMA - CLARA)

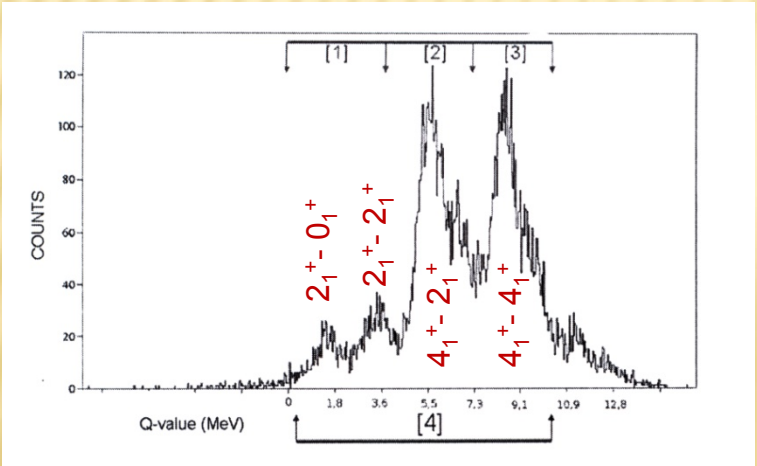
- the fusion-evaporation channel (GaSp + EUCLIDES)

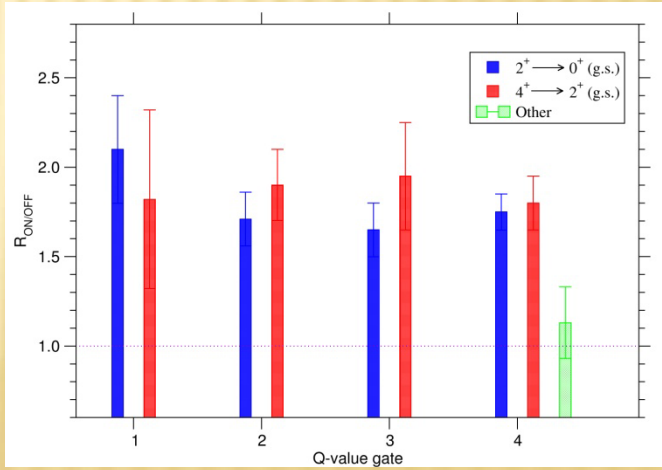
XTU Tandem: ^{24}Mg beam: 91.72 MeV (±110 keV) ON resonance

92.62 MeV OFF resonance

^{24}Mg target: 40 μg/cm^2 on 15 μg/cm^2 ^{12}C

PRISMA - CLARA





M.-D. Salsac *et al.*, NPA 801, 1 (2008)

RESONANCE IN ^{24}MG+^{24}MG

GaSp + EUCLIDES

^{24}Mg + ^{24}Mg resonance ⇔ J = 36^{+}, strongly prolate deformed state in ^{48}Cr predicted by LSD calc. after Jacobi transition and before fission (at J = 40ħ)

identified fusion-evaporation product nuclei

Nuclei	Channels	E (MeV)	Spins	$R_{ON/OFF}$
^{45}Ti	2pn	6.2	12	1.07(2)
^{44}Sc	3pn	3.6	11	0.96(2)
^{42}Ca	α2p	7.8	11	1.03(1)
^{41}K	α3p	2.8	7	0.83(4)
^{41}Ca	α2pn	5.9	9	0.92(2)
^{39}K	2αp	8.0	10	1.00(1)
^{38}Ar	2α2p	4.6	5	0.97(3)
^{37}Ar	2α2pn	6.5	8	0.88(3)

Fusion pre-equilibrium decay from the deformed composite system

Statistical decay from lower ang. mom. After complete fusion

CONCLUDING REMARKS

- Deadline for the next LNL PAC proposals is June 15, 2008
  - We welcome proposals for experiments with
    - GaSp in Configurations II and ancillary detectors
      - EUCLIDES
      - RFD
      - LuSiA – GaSp
      - Cologne Plunger
    - Available beams:

      XTU Tandem (14.5 MV)

      ± ALPI