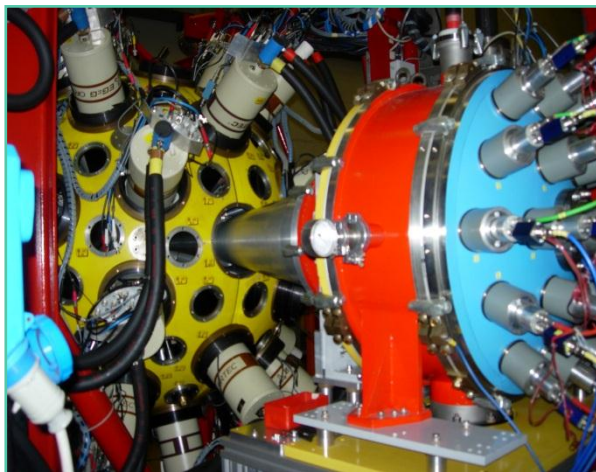
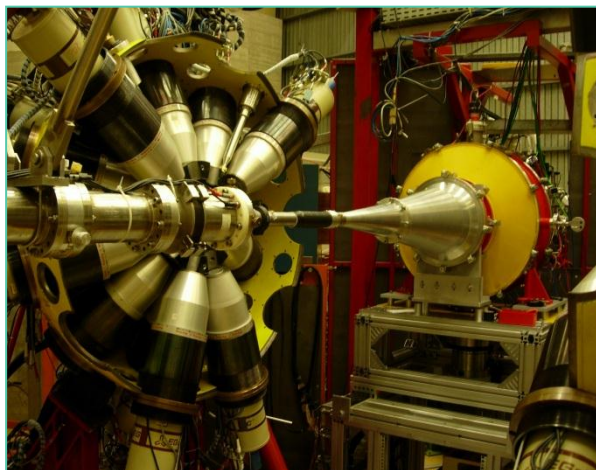


„Lifetime measurement of high-lying short-lived states in ^{69}As ”

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2nd Copigal Workshop, June 4-6, 2012, Kraków

Experiment: GASP + RFD setup



- Reaction: ^{32}S (95MeV) + ^{40}Ca (0.8mg/cm²)
- Tandem XTU at LNL , pulsing 400ns
- November 2009

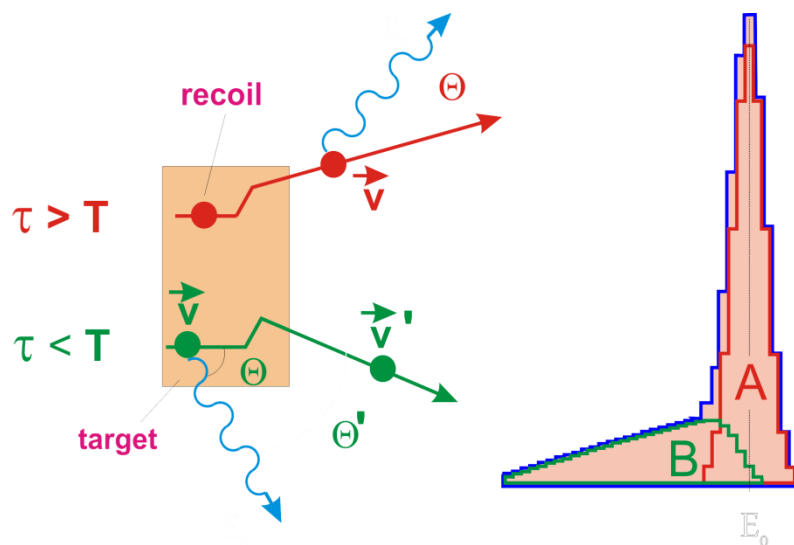
- Measured: recoils in coincidence with γ -rays
- Evaporation residues:
 $^{67,69}\text{As}$, $^{66,68}\text{Ge}$, $^{69,70}\text{Se}$, $^{63,65}\text{Ga}$

Goal:

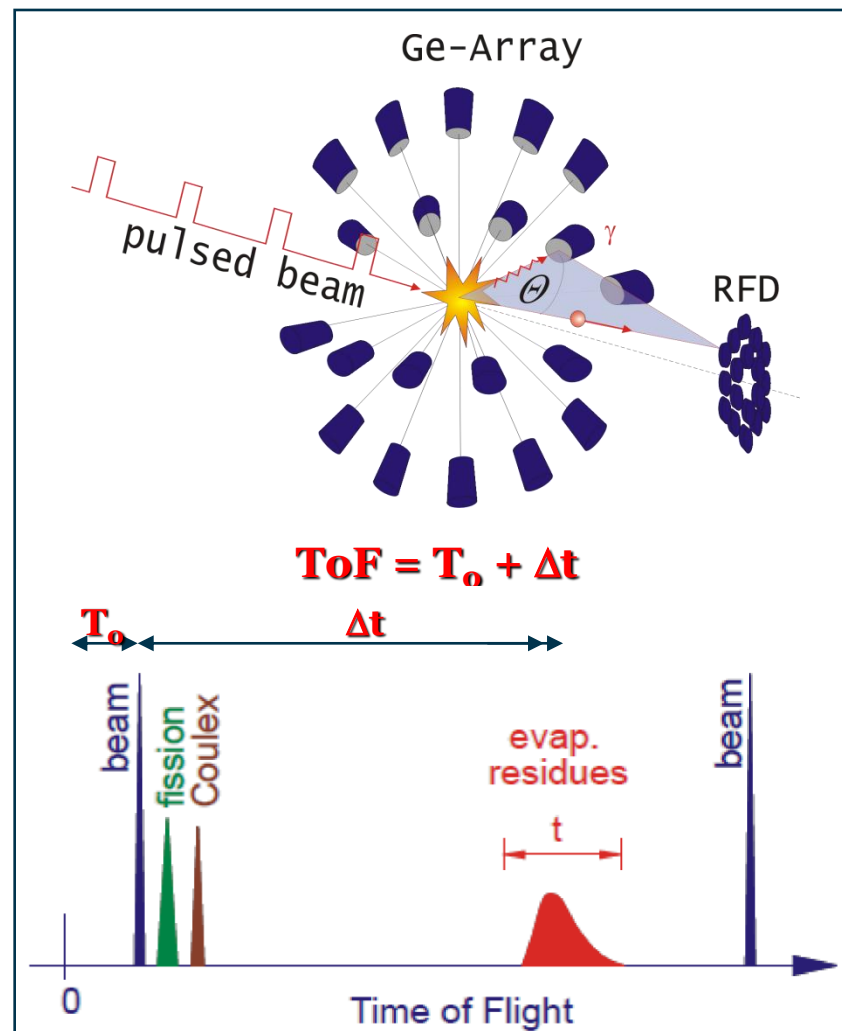
- measure the lifetimes of excited states in the vicinity of $A \sim 70$
- verify predictions of various theoretical models

Measurement technique

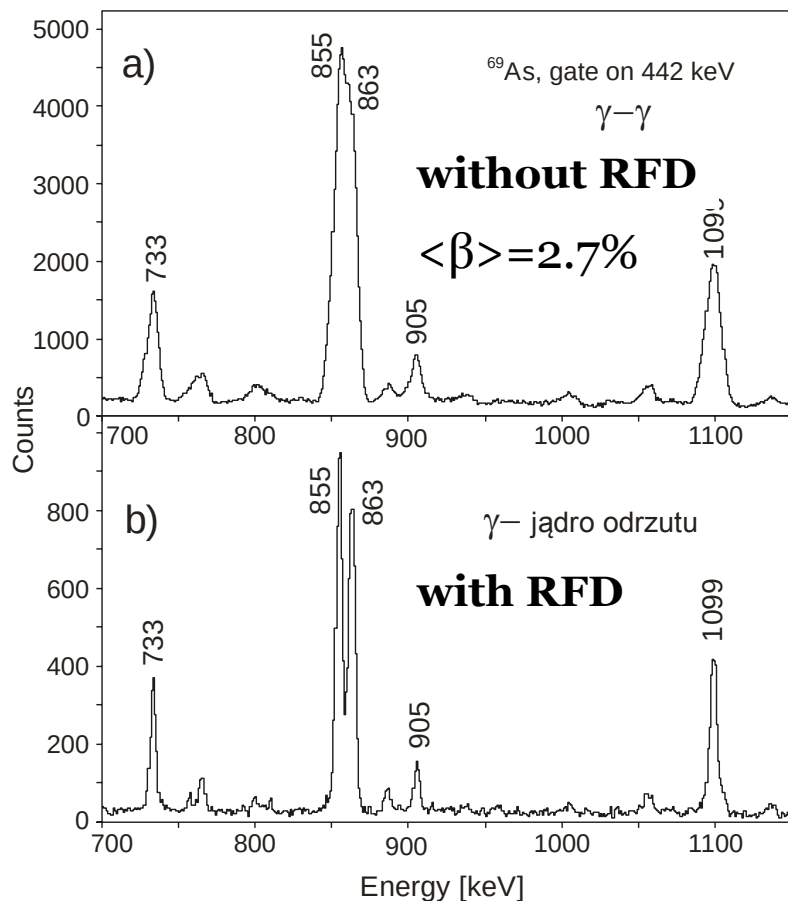
Lifetime estimation based on the recoil velocity measurement



$$R = \frac{A}{A + B} \rightarrow \tau$$

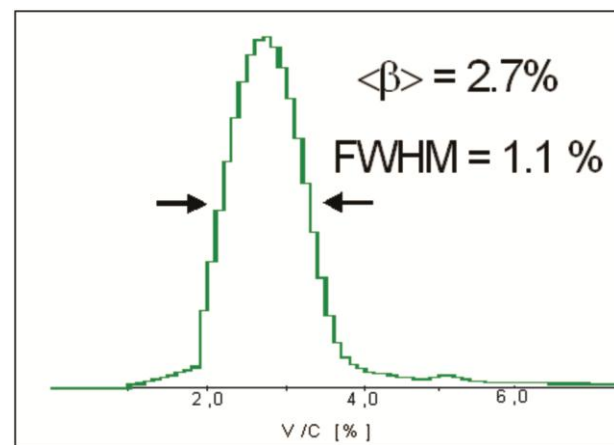


Experimental spectra



Upper panel: average correction
Lower one: event-by-event correction

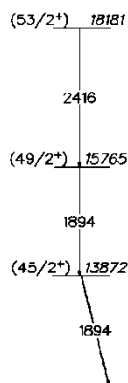
Exp. recoil velocity spectrum - wide



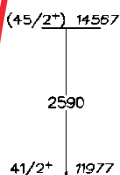
Only by measuring recoil velocity -
Energy resolution – gain by factor 2!

The nuclei of interest

Band 4

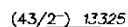


Band 3

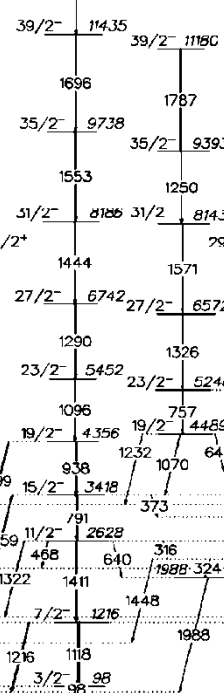


^{69}As

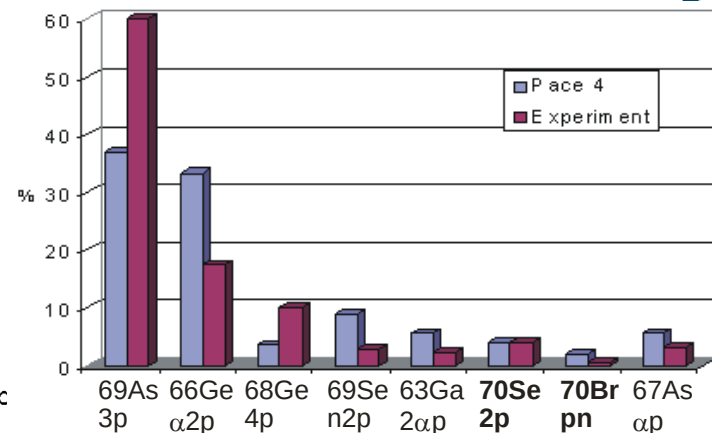
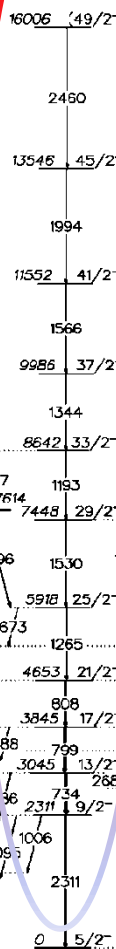
Band 6



Band 5

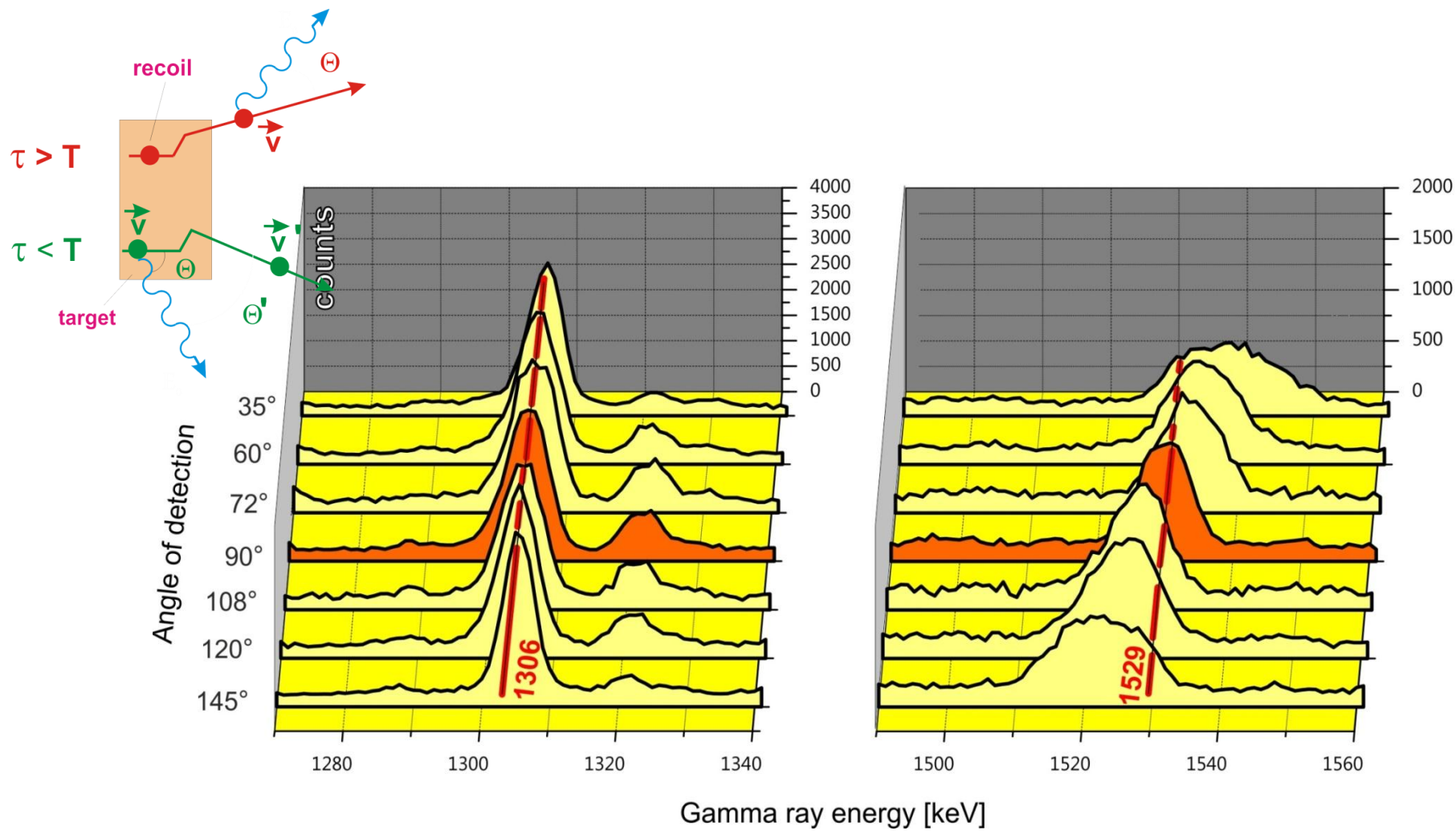


Band 7

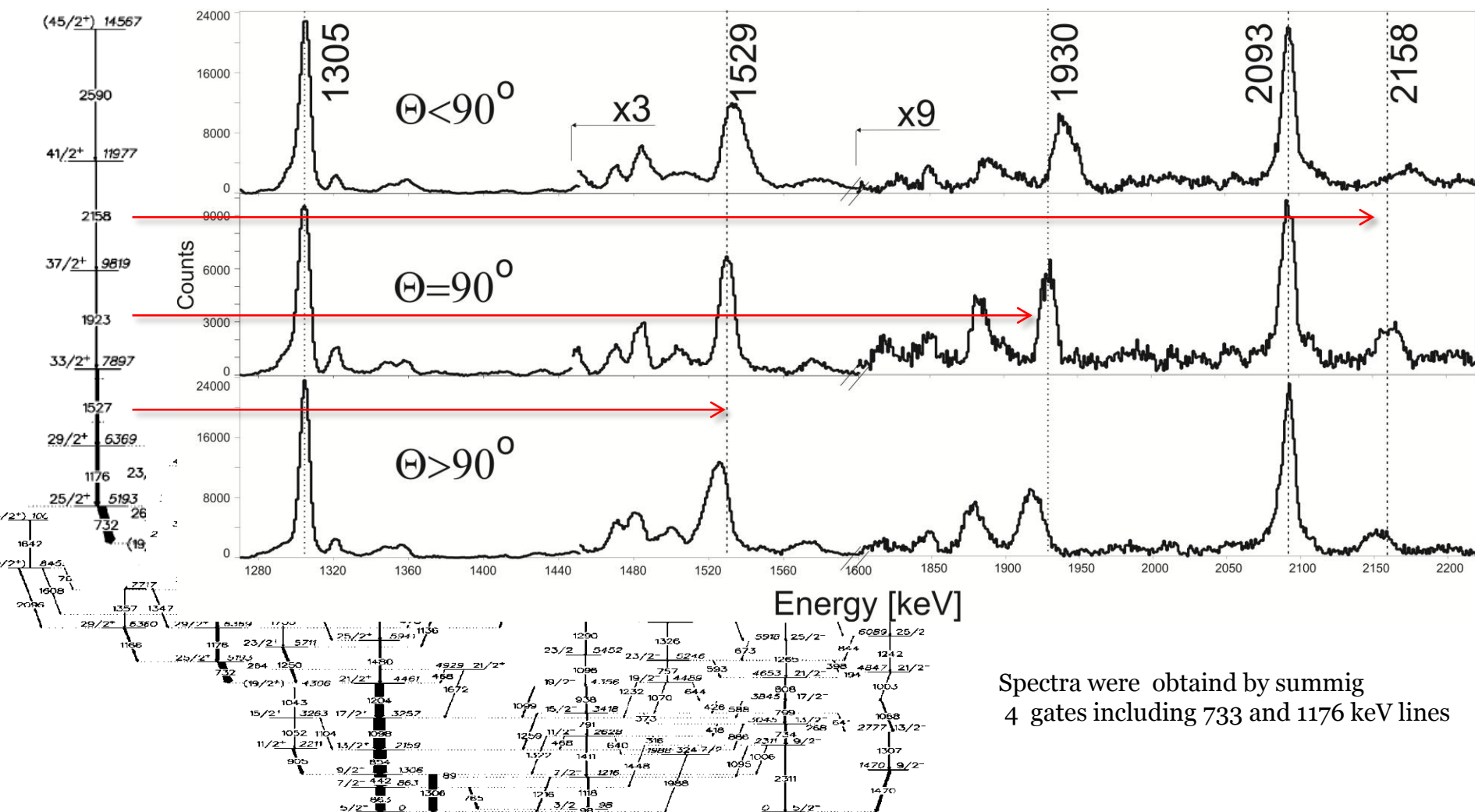


Stefanescu et al., Phys. Rev. C 70, 044304 (2004)

Lifetime effect

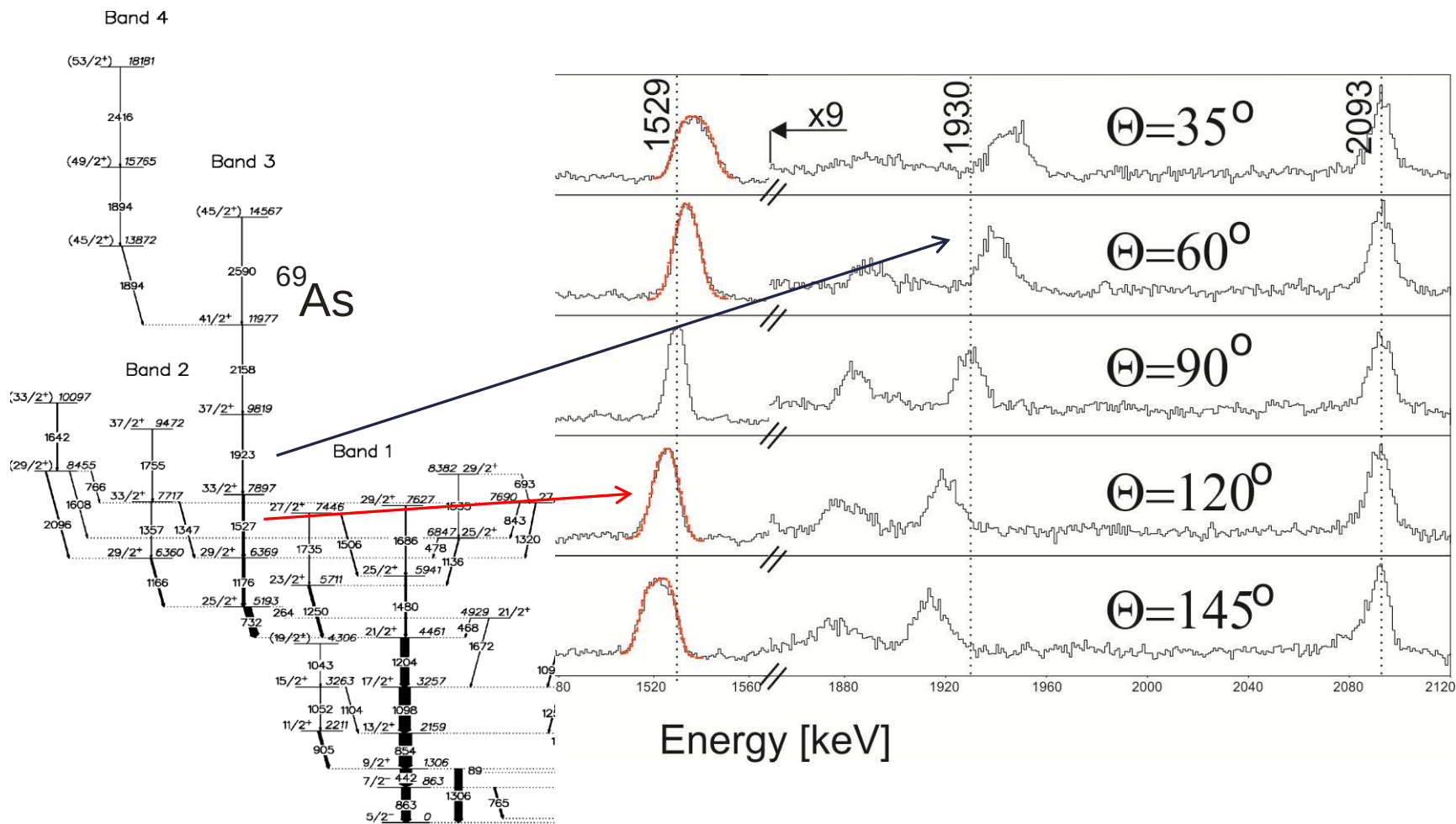


Short lifetimes for all lines in band „3”



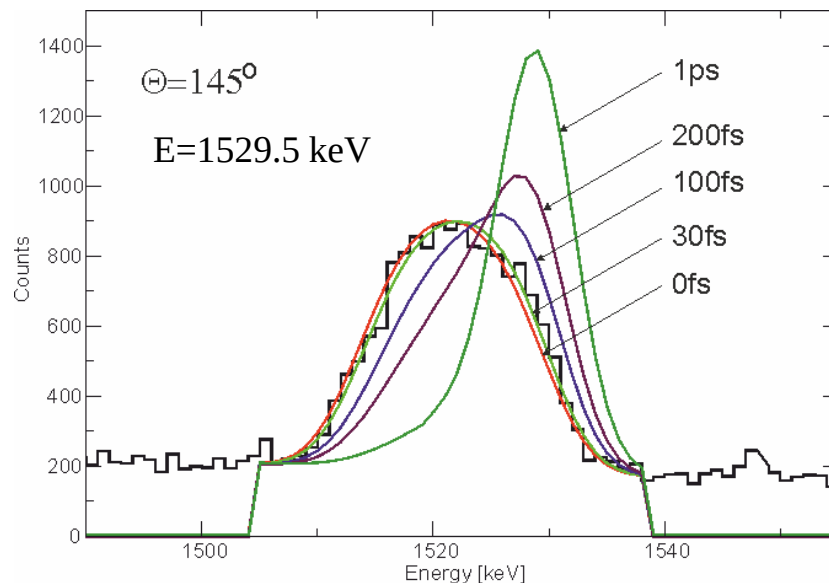
Spectra were obtained by summing 4 gates including 733 and 1176 keV lines

Short lifetimes in band „3”



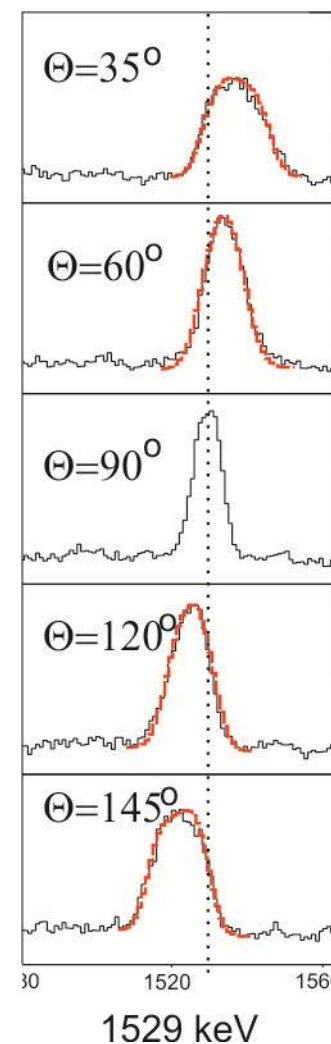
Lifetime estimation for 1529 keV line

Calculated line shapes



Taking into account all spectra we get:

$$E=1529.5 \text{ keV} \Rightarrow \tau=20 \text{ } (-20, +30) \text{ fs}$$



Lifetime vs deformation

$$B(E2) = \frac{8.196 \cdot 10^{-10}}{E^5 [MeV] \cdot \tau [s]} [e^2 fm^4] \rightarrow \beta_2$$

Experimental B(E2) and β_2 values

➤ E=1529.5 keV, $\tau < 50$ fs

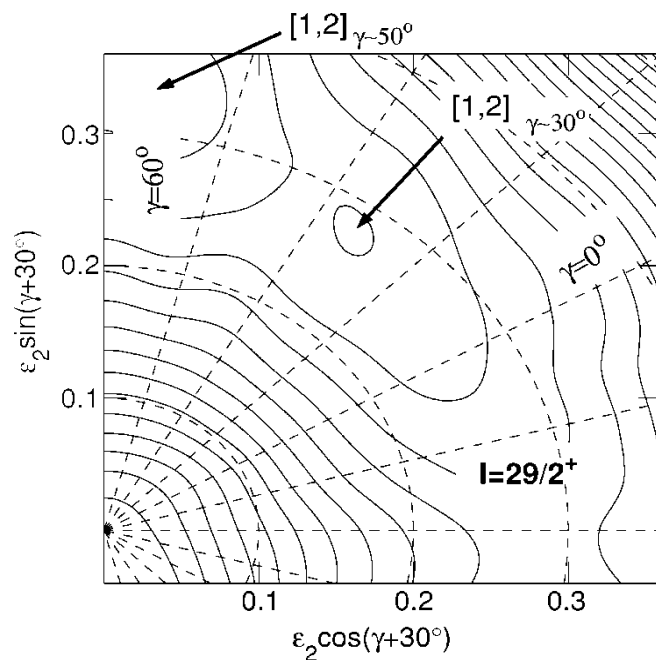
- ✓ **B(E2) > 1958 e²fm⁴ (115 W.u.)**
- ✓ **Q_s > 108 fm²**
- ✓ **Q₀ > 236 fm²**
- ✓ **$\beta_2 \geq 0.5$**

➤ E=1930 keV, $\tau < 40$ fs

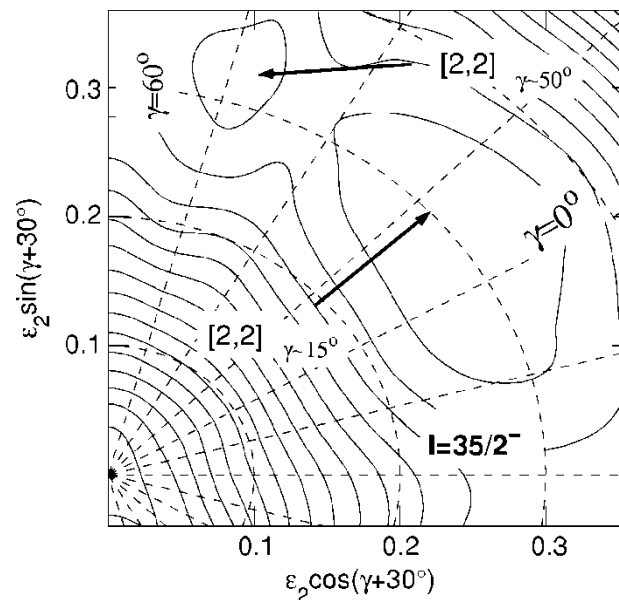
- ✓ **B(E2) > 1015 e²fm⁴ (60 W.u.)**
- ✓ **Q_s > 78 fm²**
- ✓ **Q₀ > 169 fm²**
- ✓ **$\beta_2 \geq 0.4$**

Theoretical predictions for ^{69}As - CNS cal.

I. Stefanescu et al., Phys. Rev. C 70, 044304 (2004)

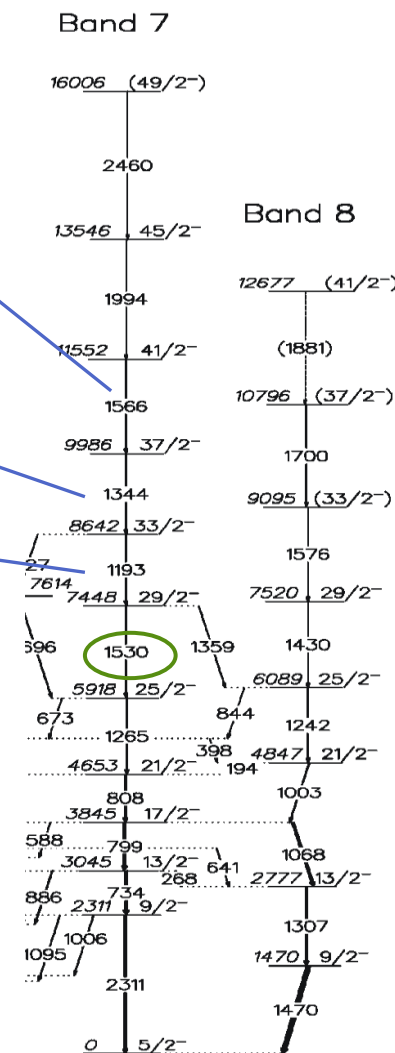
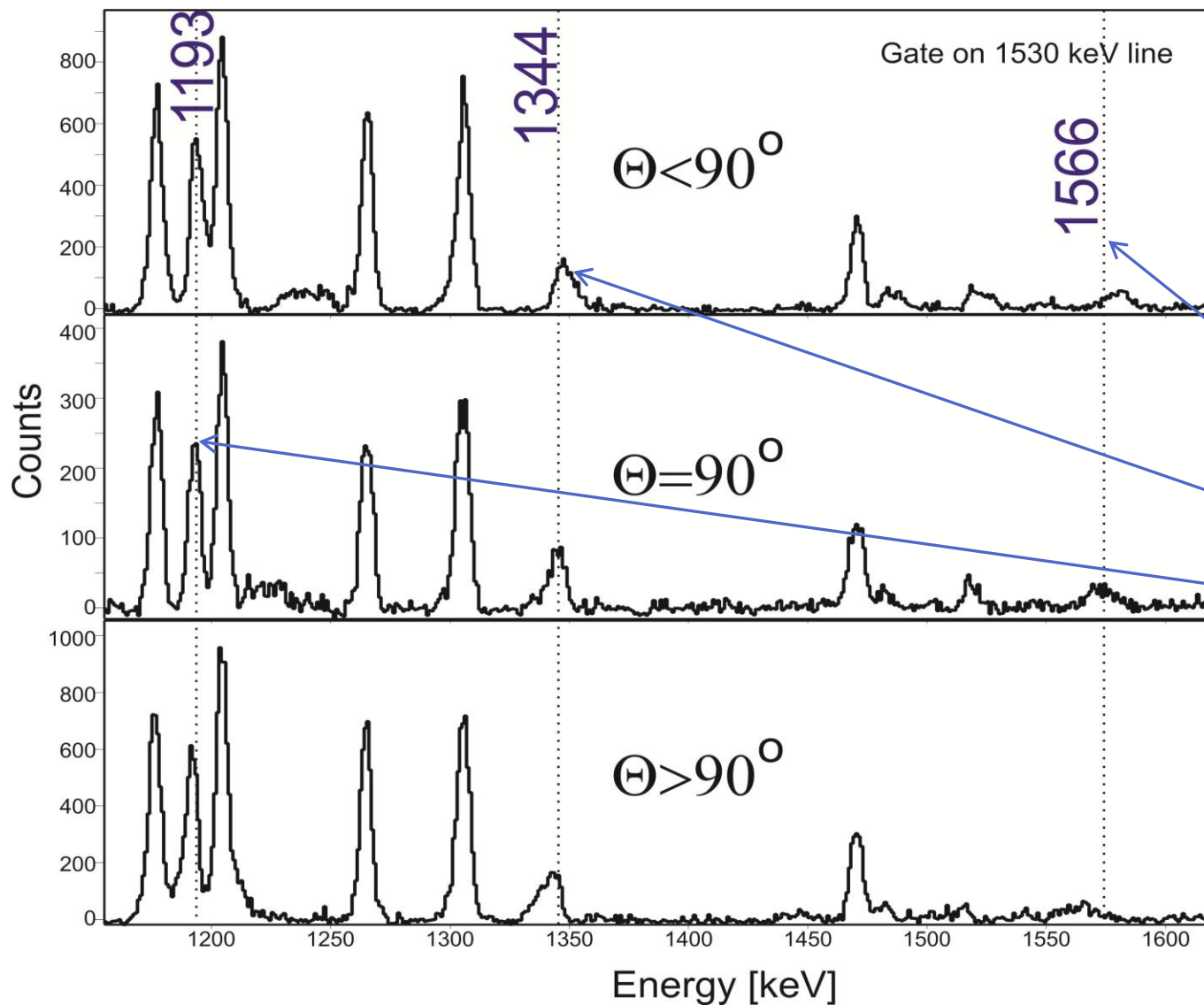


$\beta_2 \approx 0.28, \gamma \approx 30^\circ$ – band „3”



$\beta_2 \approx 0.3, \gamma \approx 15^\circ$ – band „7”

Band „7”



Summary

- This experiment shows that very interesting physical problems can be investigated with that type of setup
- Measurement of very short excited states lifetimes is possible when using Ge array with RFD
- Our results offer unique opportunity for testing various micro- and macroscopic theoretical models that are used to interpret the variety of collective bands known in the ^{69}As nucleus

Collaboration

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