
γ -ray Spectroscopy Studies in Bucharest

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γ spectroscopy setup

Unique mixed gamma detection array

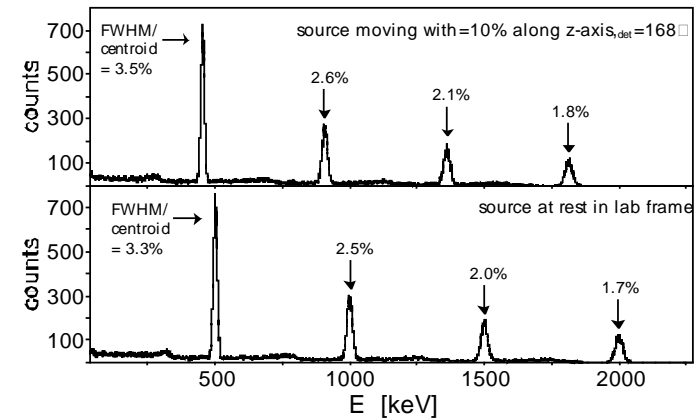
7-8 55% HPGe detectors

5-8 LaBr₃:Ce detectors

The mechanics and the reaction chambers allow flexibility in the configuration of the detectors for various experiments

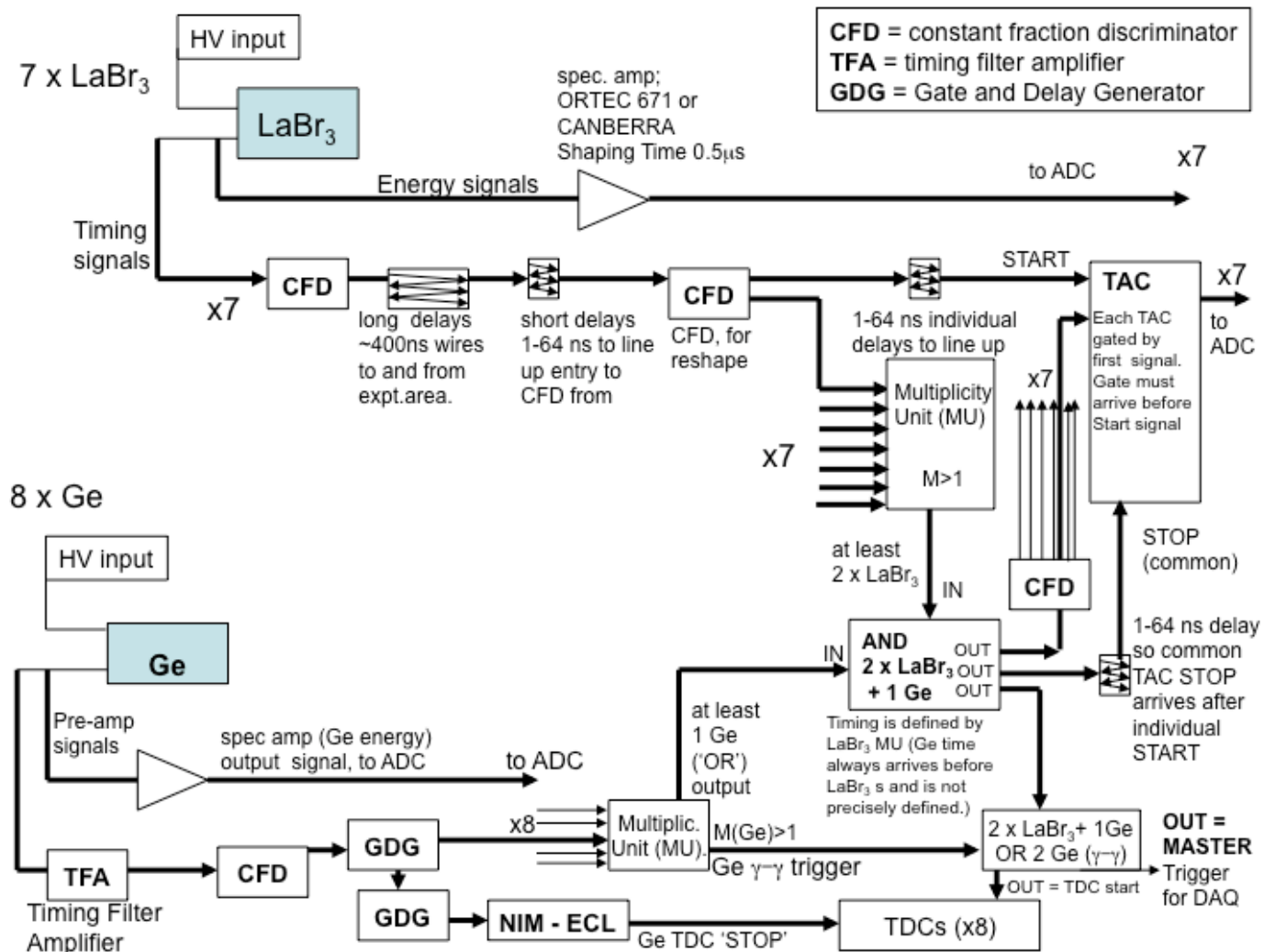


LaBr₃:Ce detectors



- ◆ Best energy resolution achievable with scintillators
- ◆ Timing comparable with BaF₂ : 100-300 ps depending on crystal size
- ◆ 3 2"x2" , 3 1.5"x1.5" , 2 conical shaped 1"x1.5"x1.5" (total 8 LaBr₃:Ce detectors)
- ◆ Might be used to measure lifetimes in the 50ps – few ns range

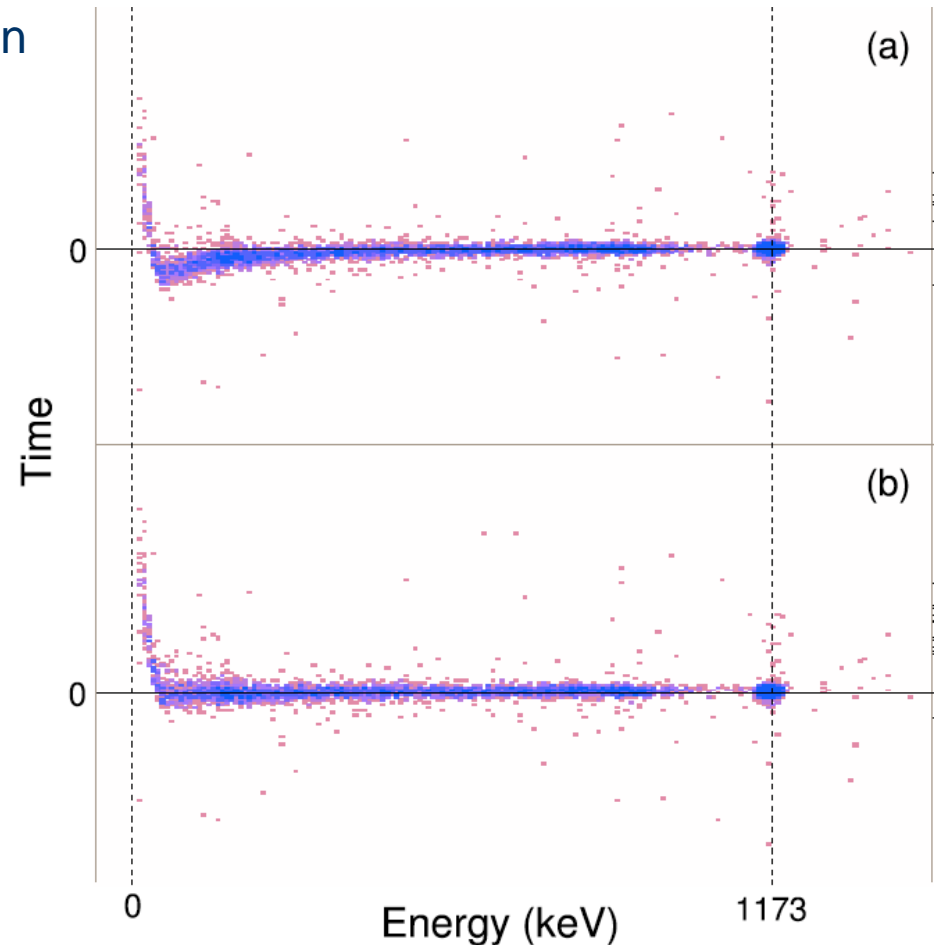
In-Beam Fast Timing Electronic Diagram



CFD walk correction

- ^{60}Co source placed in target position
- One $\text{LaBr}_3:\text{Ce}$ detector taken as time reference
- Time reference detector gated on the 1332 keV full-energy peak

The CFD walk dependence on amplitude is removed using offline corrections, in order to insure similar time response for all elements of the detection system

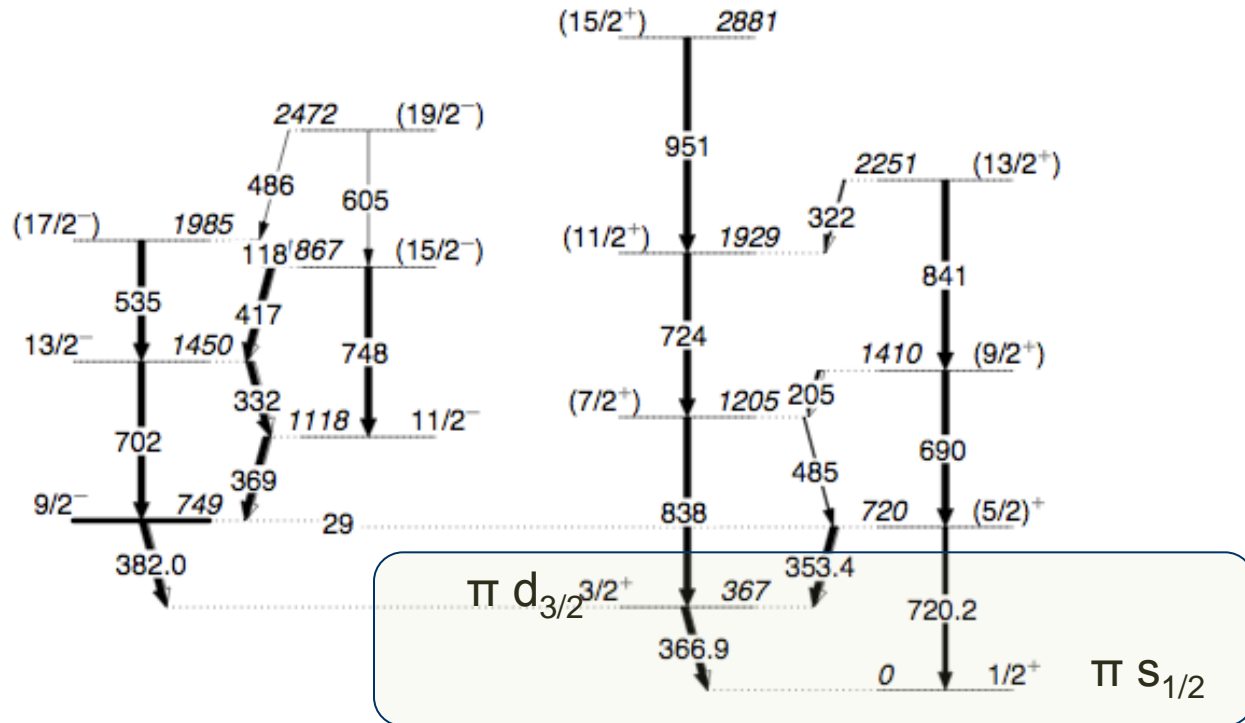


Fast-timing test case: ^{199}Tl

- $^{197}\text{Au}(\alpha,2n)^{199}\text{Tl}$ at 24 MeV beam energy

8 HPGe and 5 LaBr₃:Ce detectors

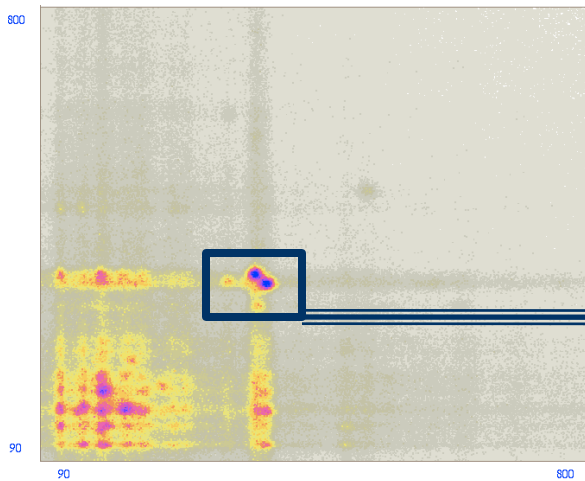
$T_{1/2} = 28.4(2)$ ms



If these states have pure single-particle configurations, one expects lifetime of several hundreds of picoseconds for the 367 keV level

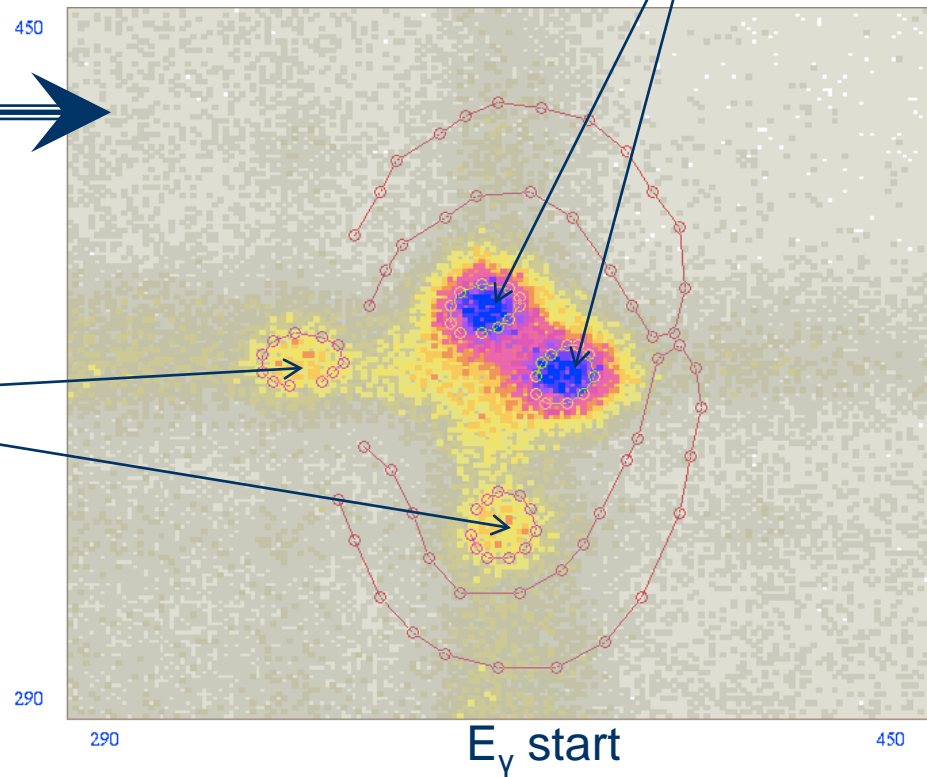
Lifetime of the 367 keV level

γ - γ - Δt cube with LaBr₃:Ce detectors



381 keV – 367 keV
coincidence

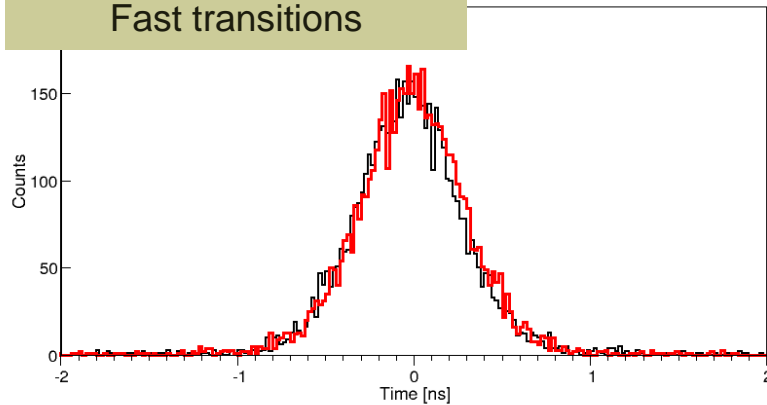
332 keV – 369 keV
coincidence



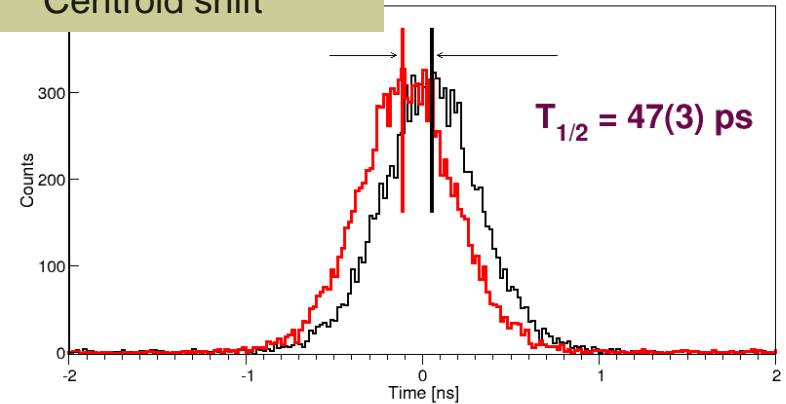
E_γ stop

Lifetime of the 367 keV level

332-369 keV coincidence
Fast transitions



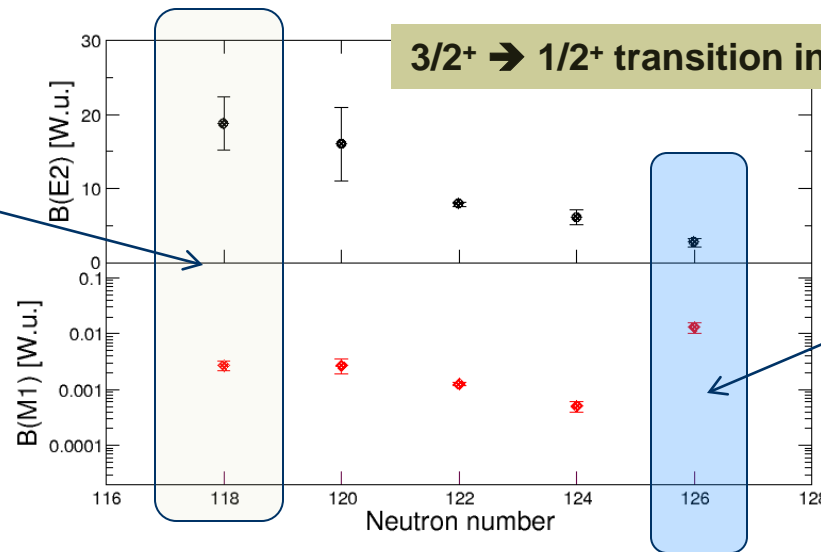
367-381 keV coincidence
Centroid shift



$3/2^+ \rightarrow 1/2^+$ transition in odd-A Tl isotopes

Present data

Increased collectivity
of the two states



One hole in doubly-magic ^{208}Pb
Single-particle states

EPJ A 46 ,329-
336, (2010)

“Low-recoil” DSAM in (α,n) reactions

Advantages:

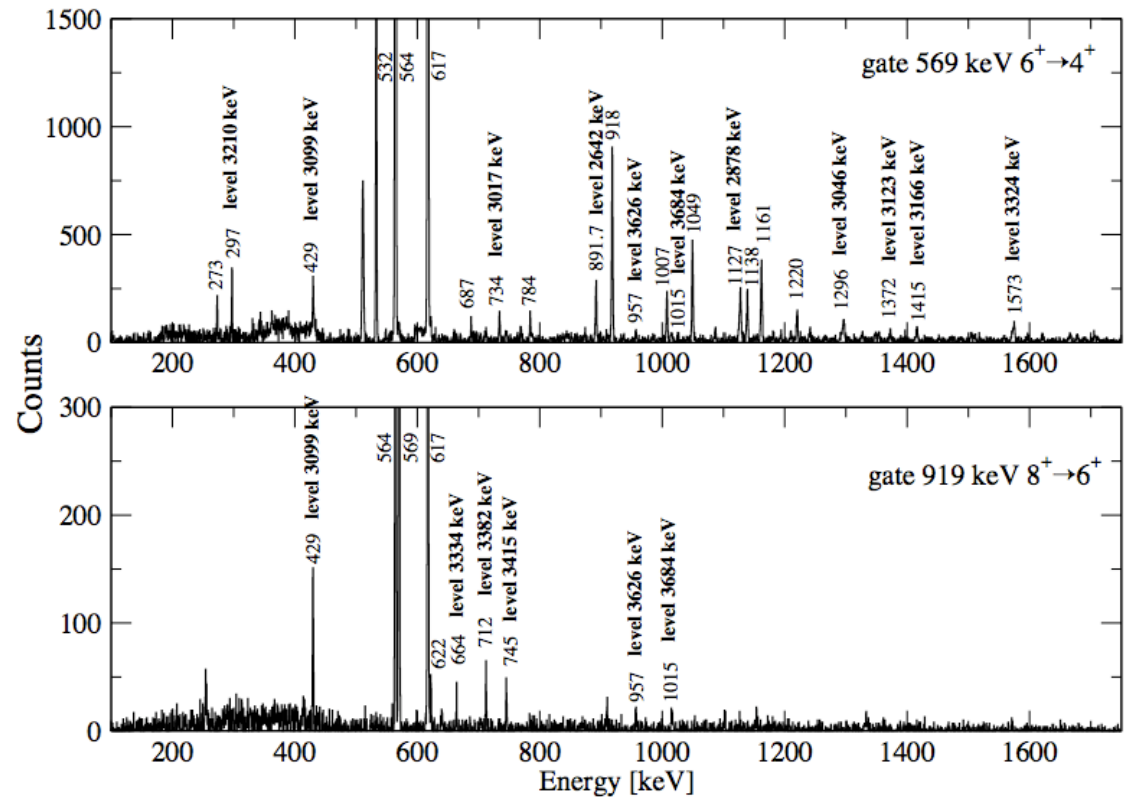
- clean spectra
- large cross-sections
- non-yrast states are reasonably well populated

Difficulties:

- low recoil velocity $v/c \sim 0.3\%$
- nuclear stopping power becomes important
- short cascades, feeding should be parameterized

$$^{119}\text{Sn}(\alpha,n)^{122}\text{Te} \quad E_{\alpha} = 15 \text{ MeV}$$

C. Mihai, A.A. Pasternak et al, Phys. Rev. C 81 034314(2010)



Side-feeding estimate

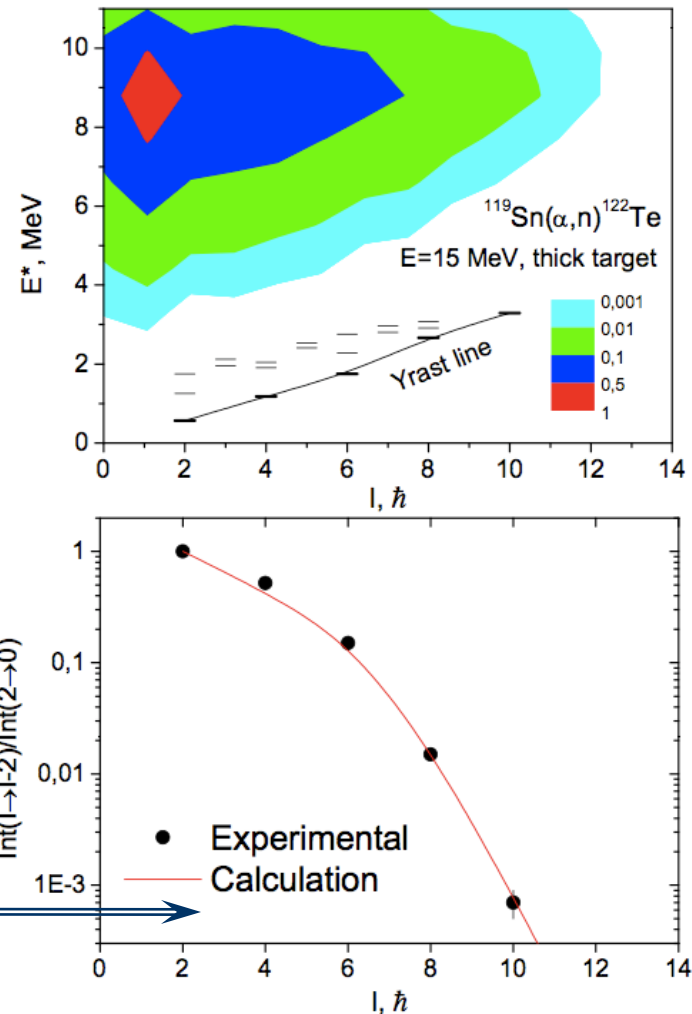
Side-feeding model :

E. Grodner, A.A. Pasternak et al.
 Eur. Phys J. A27 (2006) 325

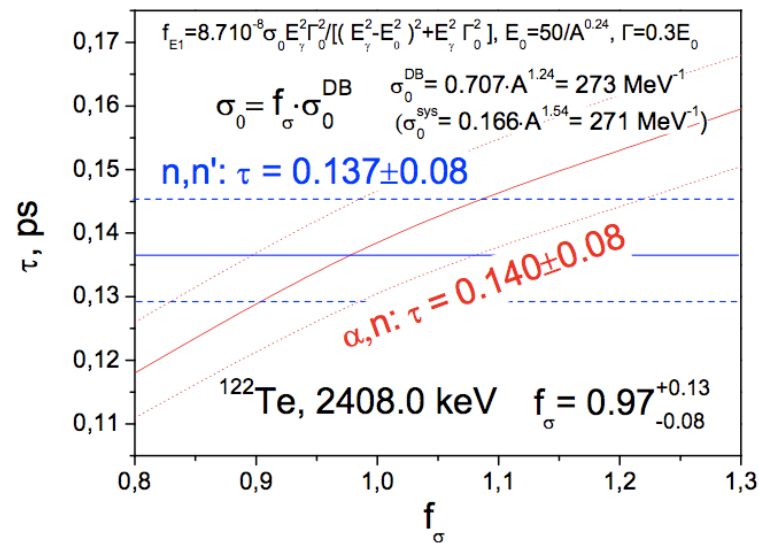
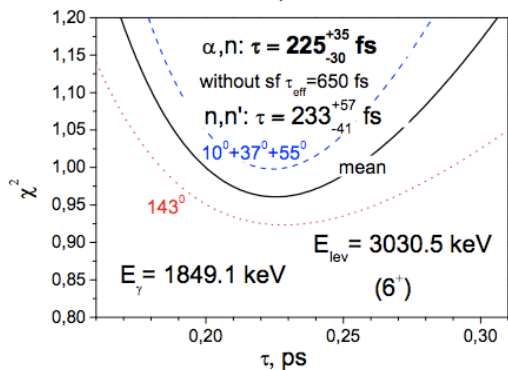
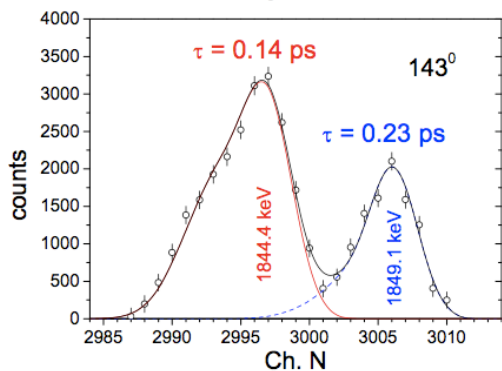
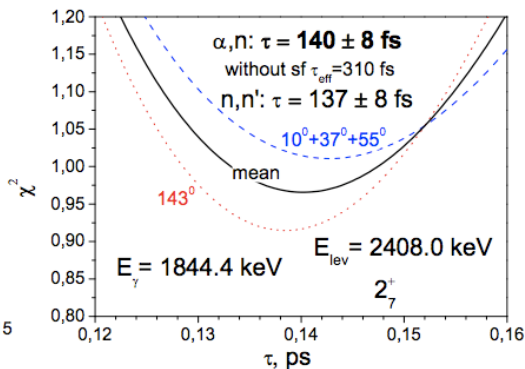
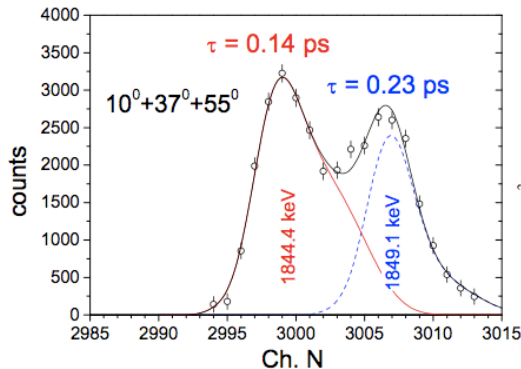
The population of discrete levels from the entry point proceeds mainly through fast E1 transitions

$$f_{E1} = 8.7 \cdot 10^{-8} \sigma_0 E_\gamma^2 \Gamma_0^2 / [(E_\gamma^2 - E_0^2)^2 + E_\gamma^2 \Gamma_0^2]$$

Population of the yrast cascade

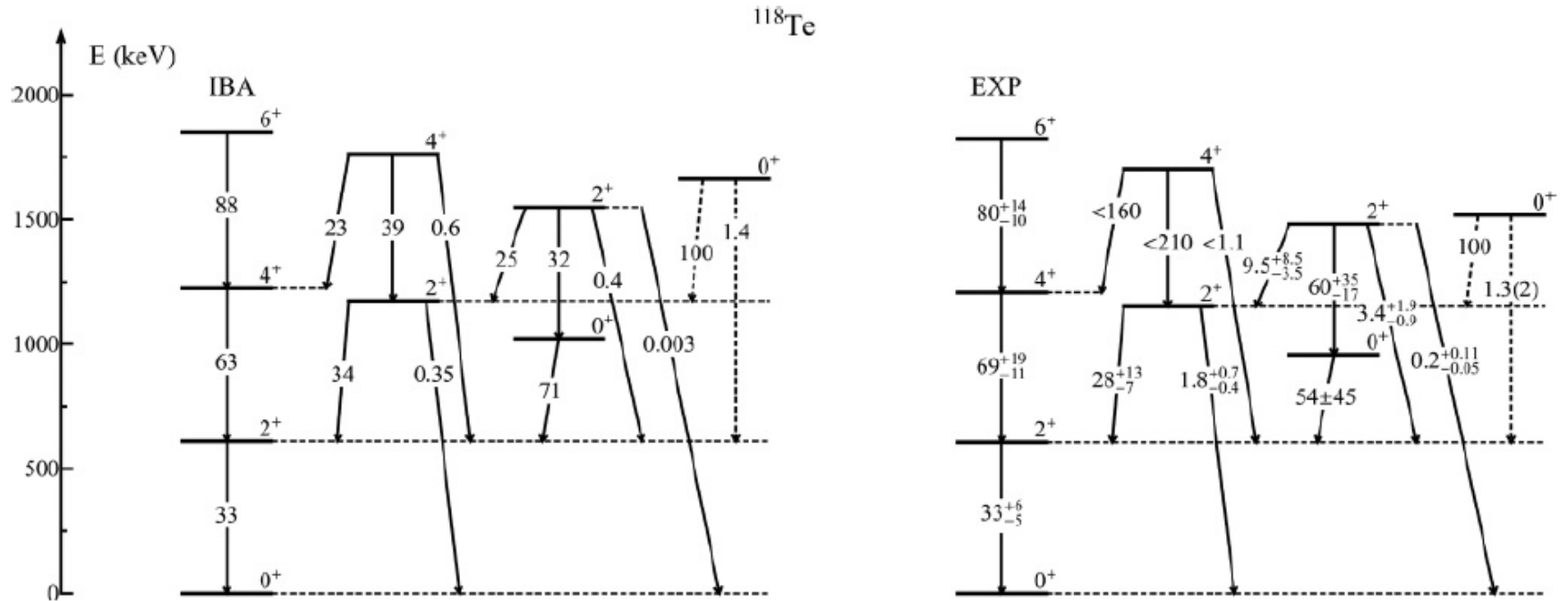


Lineshape fit, consistency checks



Consistency checks were done using lifetimes measured in an (n,n') reaction, where the feeding is negligible

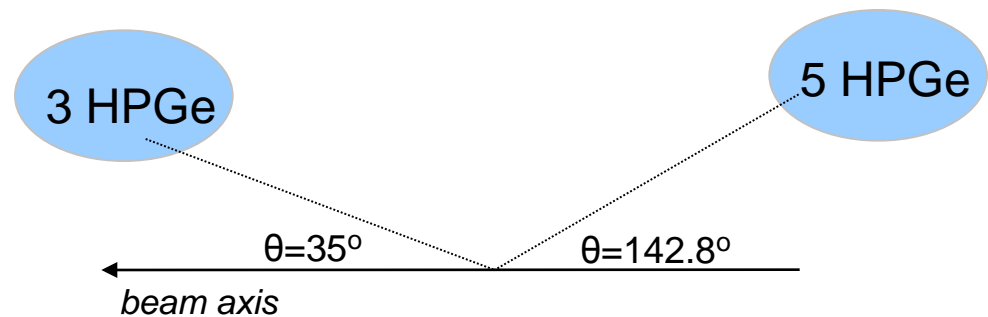
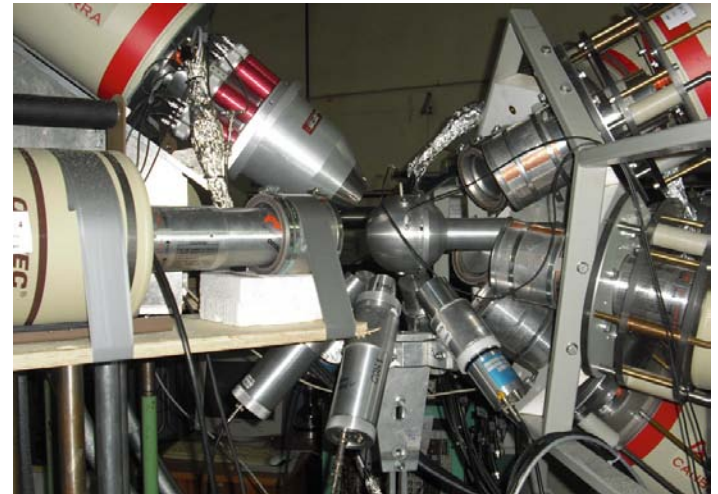
^{118}Te results



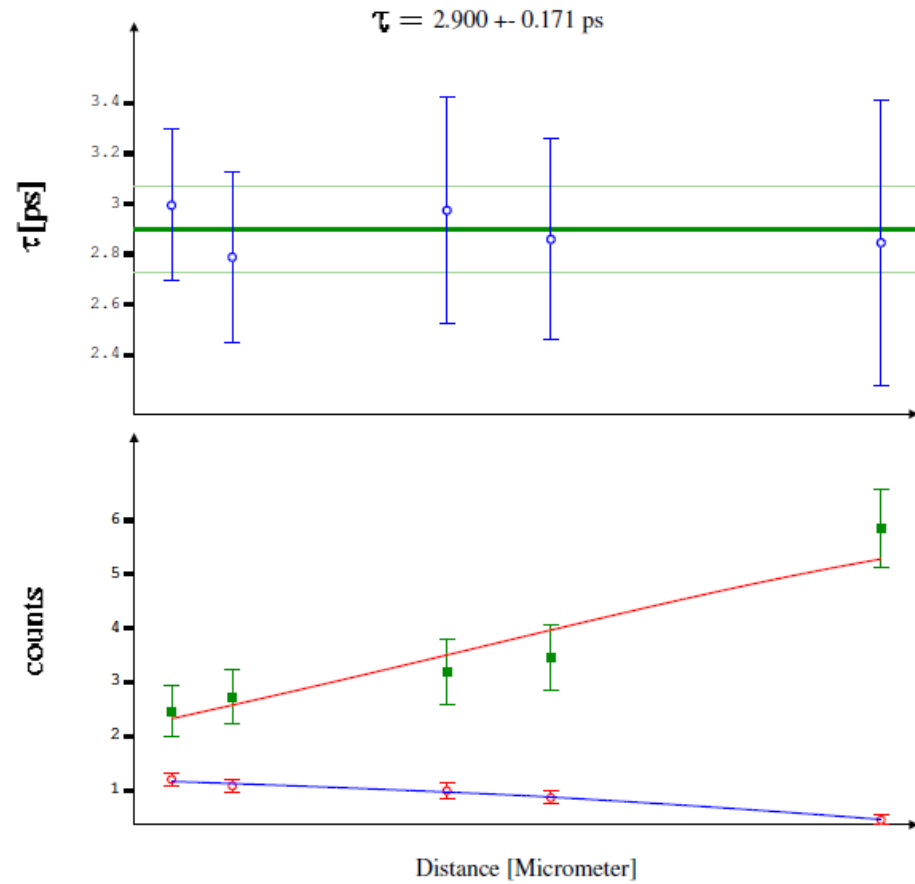
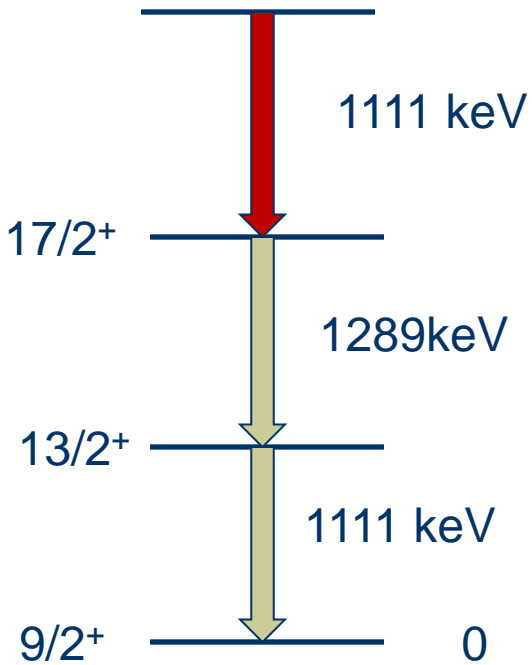
Plunger experiments

Plunger device was constructed in collaboration
with IKP Köln

$^{76}\text{Ge}(^{13}\text{C},4n)^{85}\text{Sr}$ @56 MeV
0.4 mg/cm² $^{76}\text{GeO}_2$ on
1mg/cm² Ta



Plunger experiments



The end

Thank you for your attention