
Gamma Spectroscopy and Lifetime Measurement Techniques at the Bucharest TANDEM

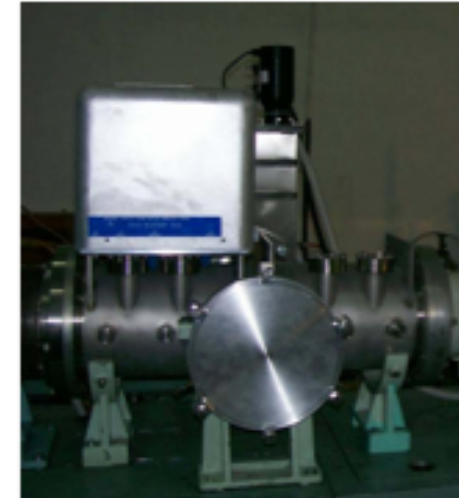
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TANDEM Accelerator at IFIN-HH

- ◆ 9 MV TANDEM accelerator, completely modernized
- ◆ Duoplasmatron alpha particles source (Li-exchange)
- ◆ Sputtering source
- ◆ “Fast” (nanoseconds) pulsing system
- ◆ “Slow” (>millisecond) pulsing system
- ◆ Very good transmission (>98%)

Ions from protons to Si can be accelerated at energies above the Coulomb barrier



Detection systems

Present infrastructure:

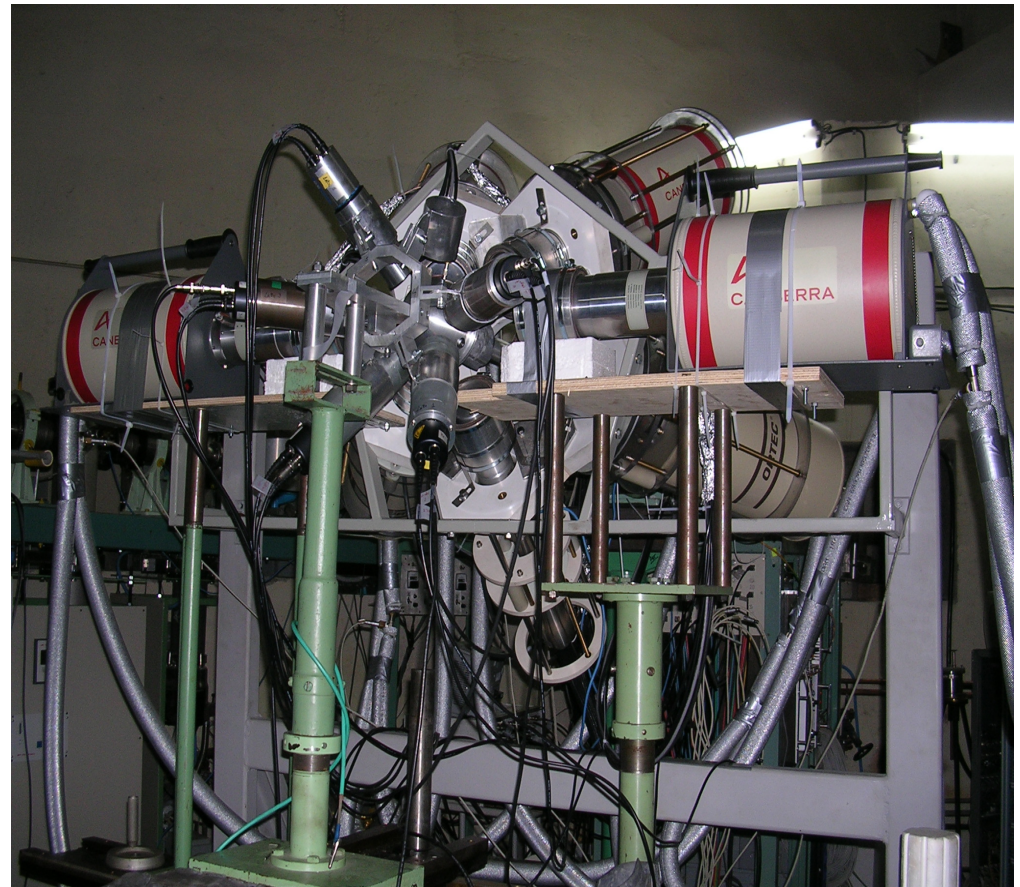
- 18 HPGe detectors with 55% efficiency
- two clover detectors
- scintillation detectors: 8 $\text{LaBr}_3:\text{Ce}$,
 - 3 : 2"x2"
 - 3 : 1.5"x1.5"
 - 2 : 1.5" conical
- charged-particle detectors
- neutron detectors

Permanent gamma detection array

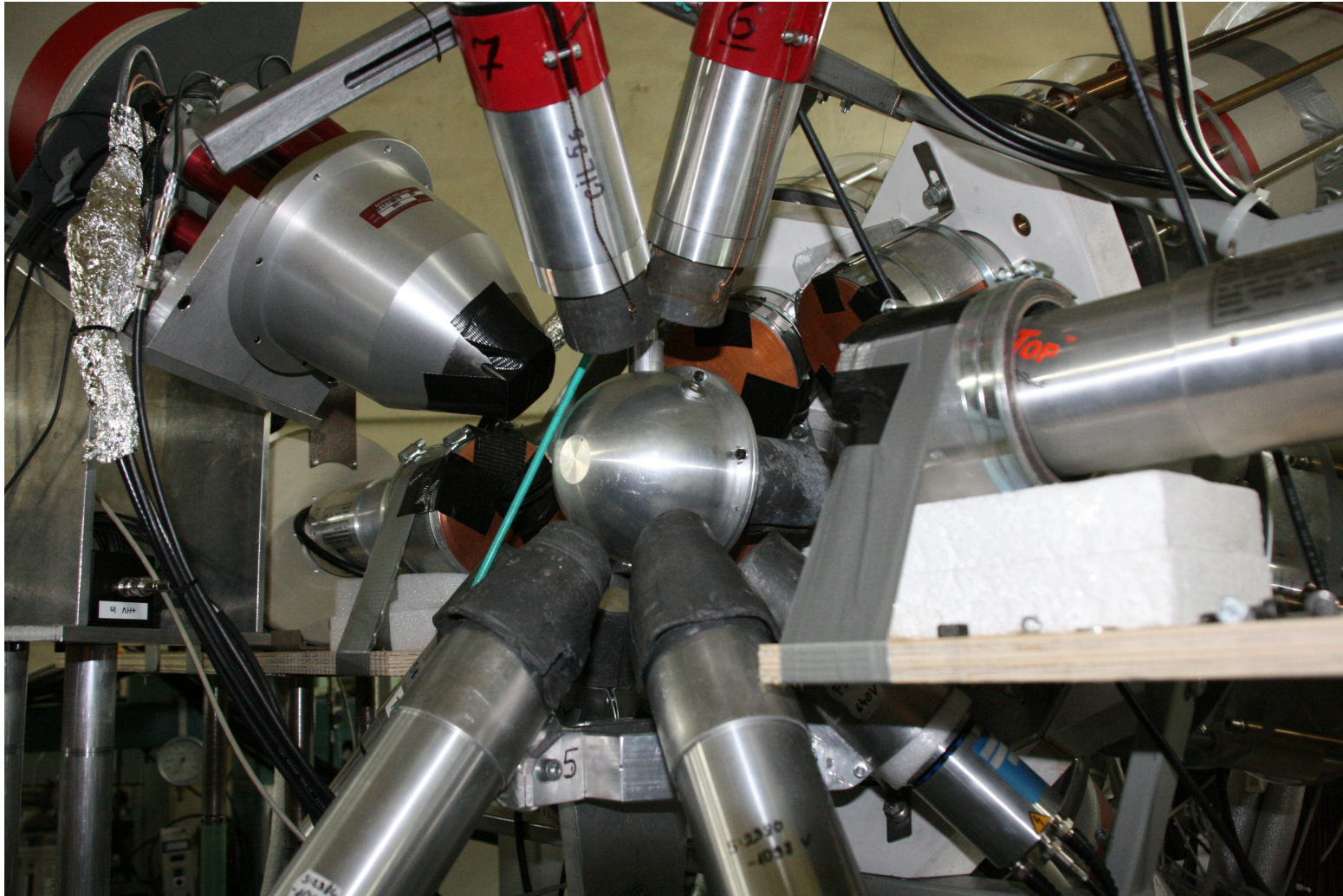
7-8 55% HPGe detectors

8 $\text{LaBr}_3:\text{Ce}$ detectors

+ 4 new 1.5" conical detectors ordered in Dec. 2010

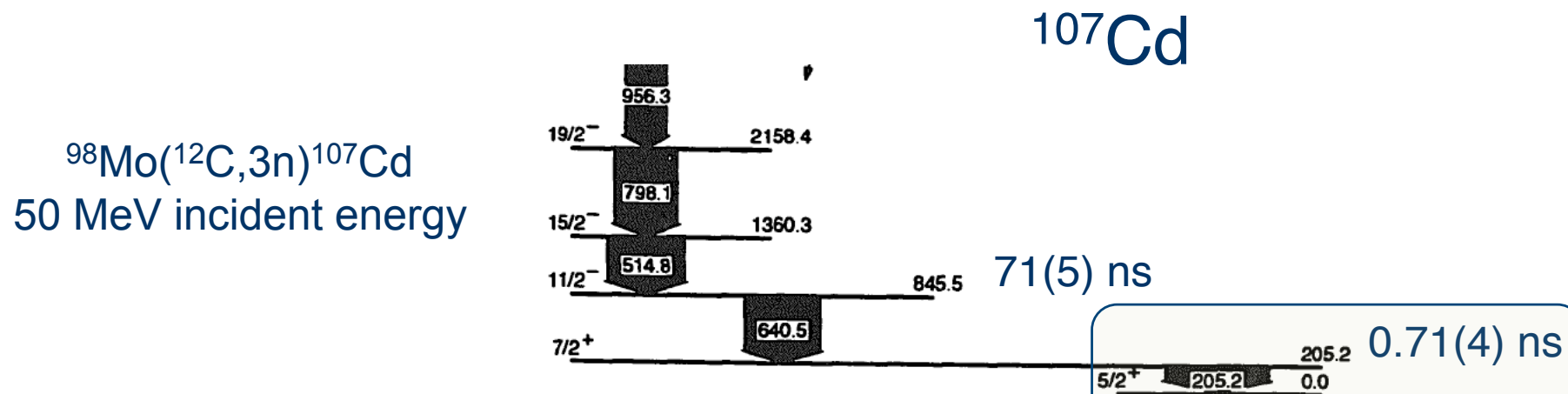


Present “in-beam fast timing” setup



In-beam Fast-Timing : test experiment

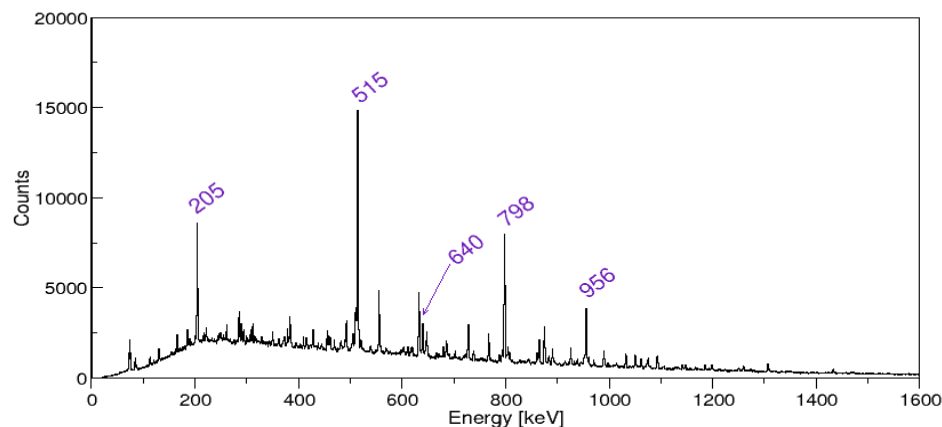
Experiment proposed by D. Balabaski (INRNE-BAS Sofia)



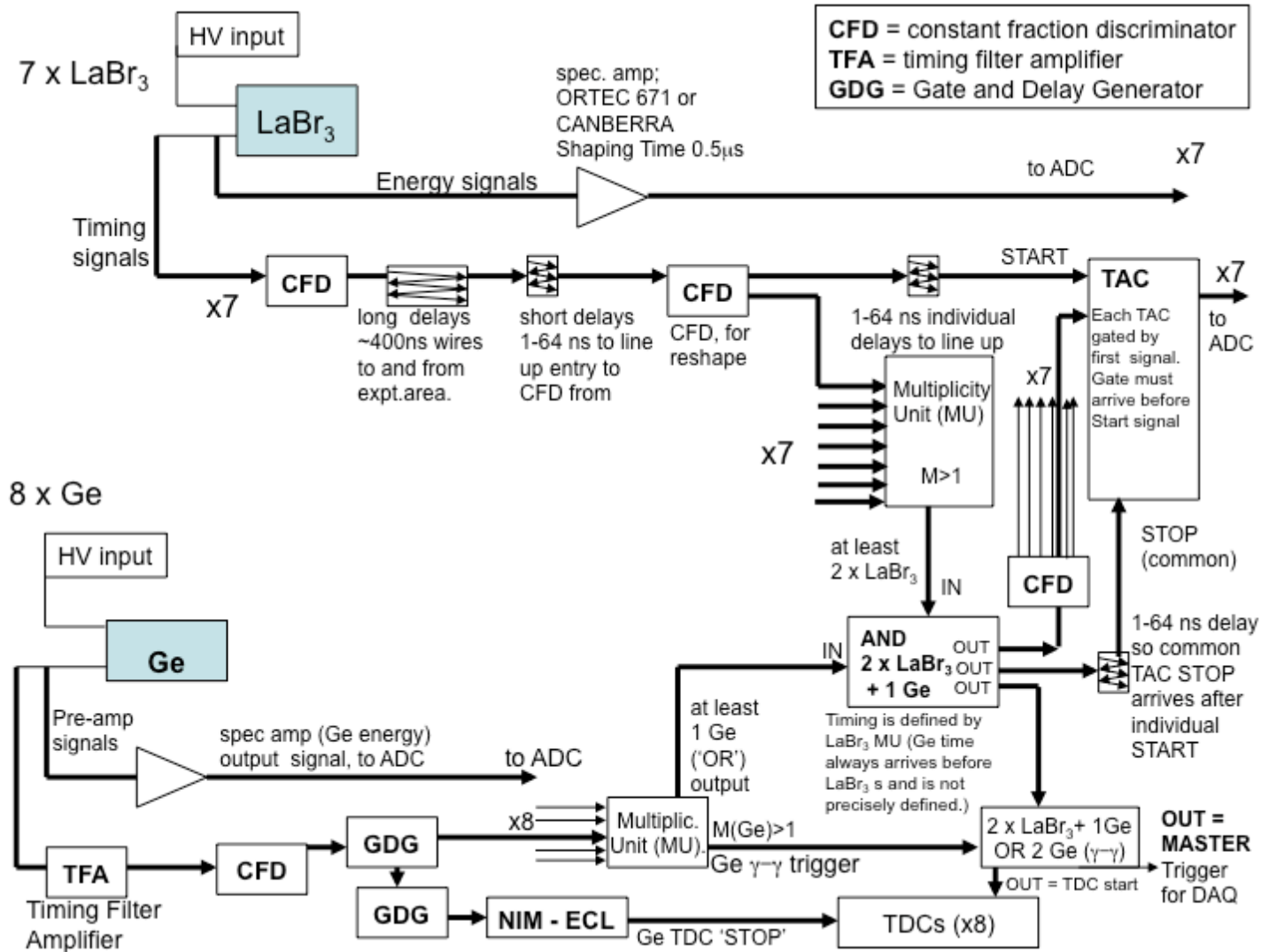
- 5 LaBr₃:Ce detectors (Sofia, Orsay)
- 7 HPGe detectors (Bucharest)

72 hours experiment, January 2009

Trigger condition
Ge \geq 1 AND LaBr₃:Ce \geq 2



In-Beam Fast Timing Electronic Diagram



CFD walk correction

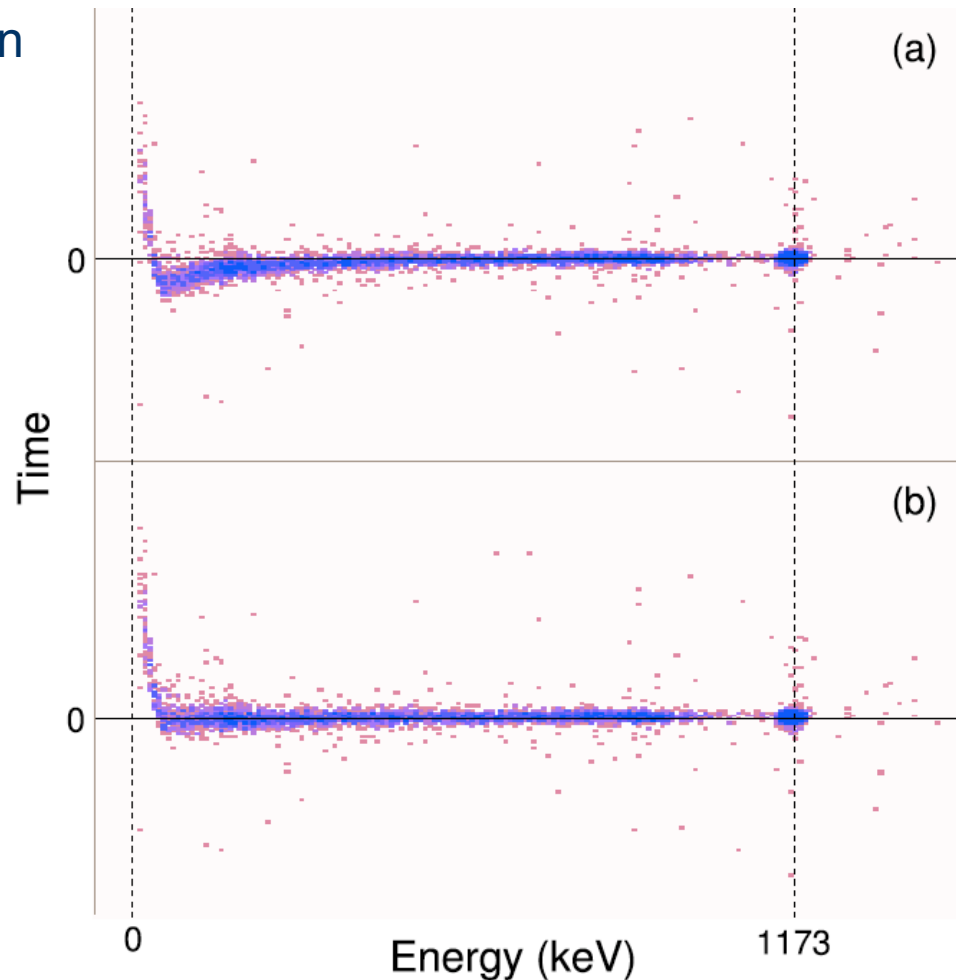
- ^{60}Co source placed in target position

- One $\text{LaBr}_3:\text{Ce}$ detector taken as time reference

Voltage close to the linear regime for energy

- 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

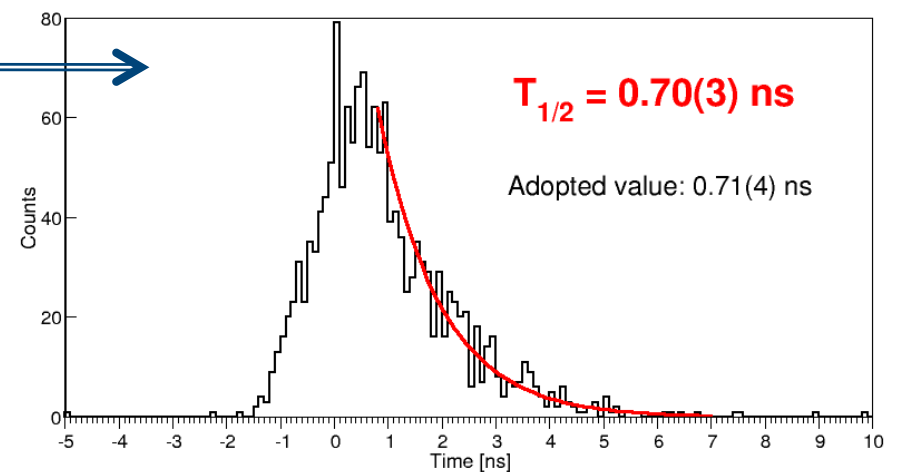
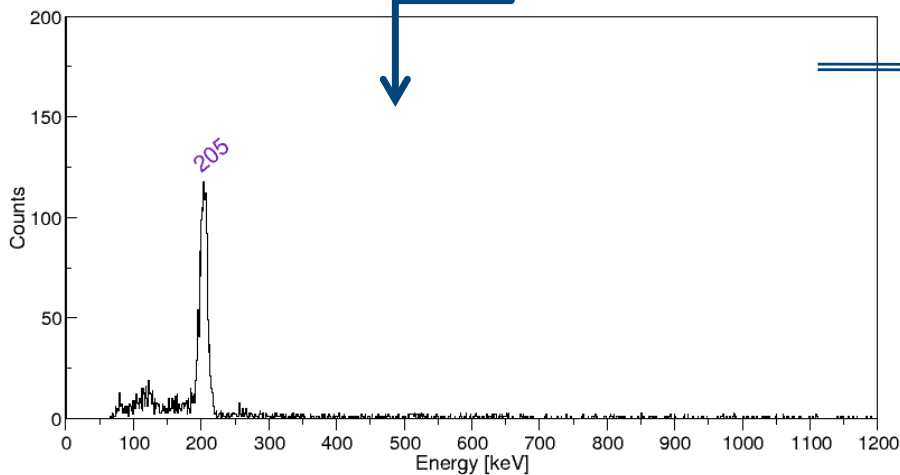
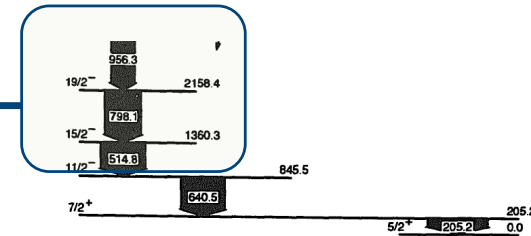
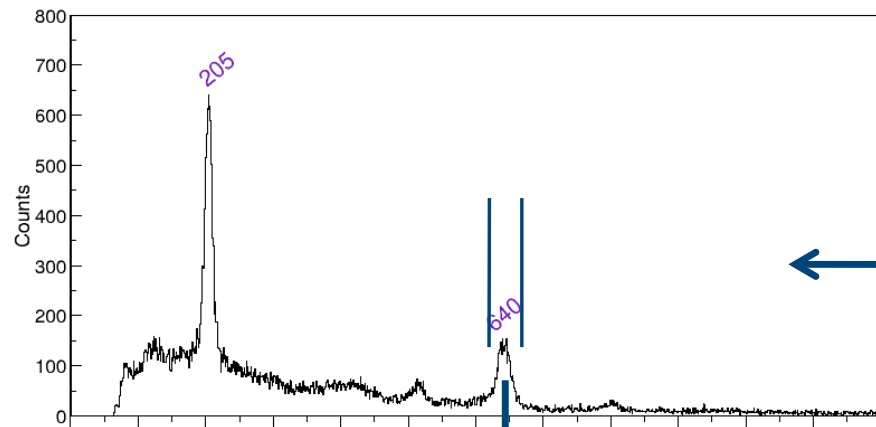


In-beam Fast-Timing : ^{107}Cd test case

640-205 coincidence in $\text{LaBr}_3:\text{Ce}$ detectors

selected gating with HPGe detectors

on yrast transitions of ^{107}Cd



In-beam Fast-Timing : ^{107}Cd test case

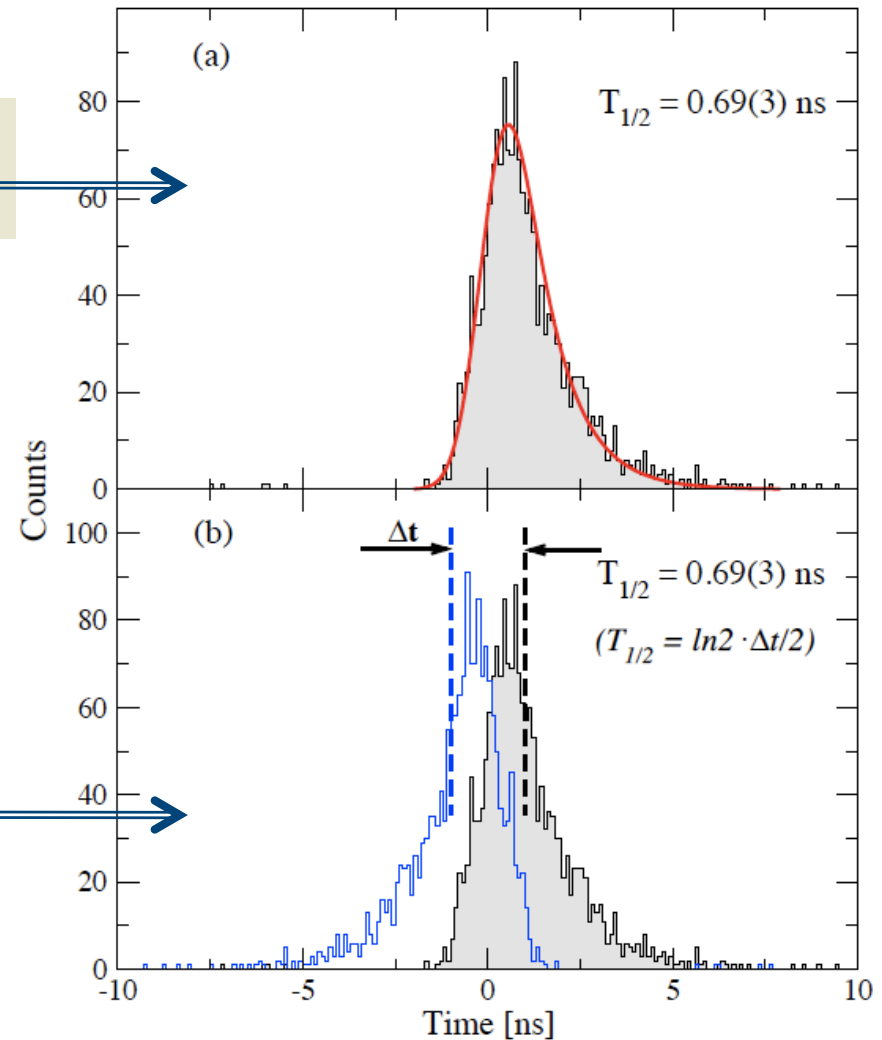
Fit of the decay curve convoluted with effective detector response



Consistent result using both methods



Centroid shift method

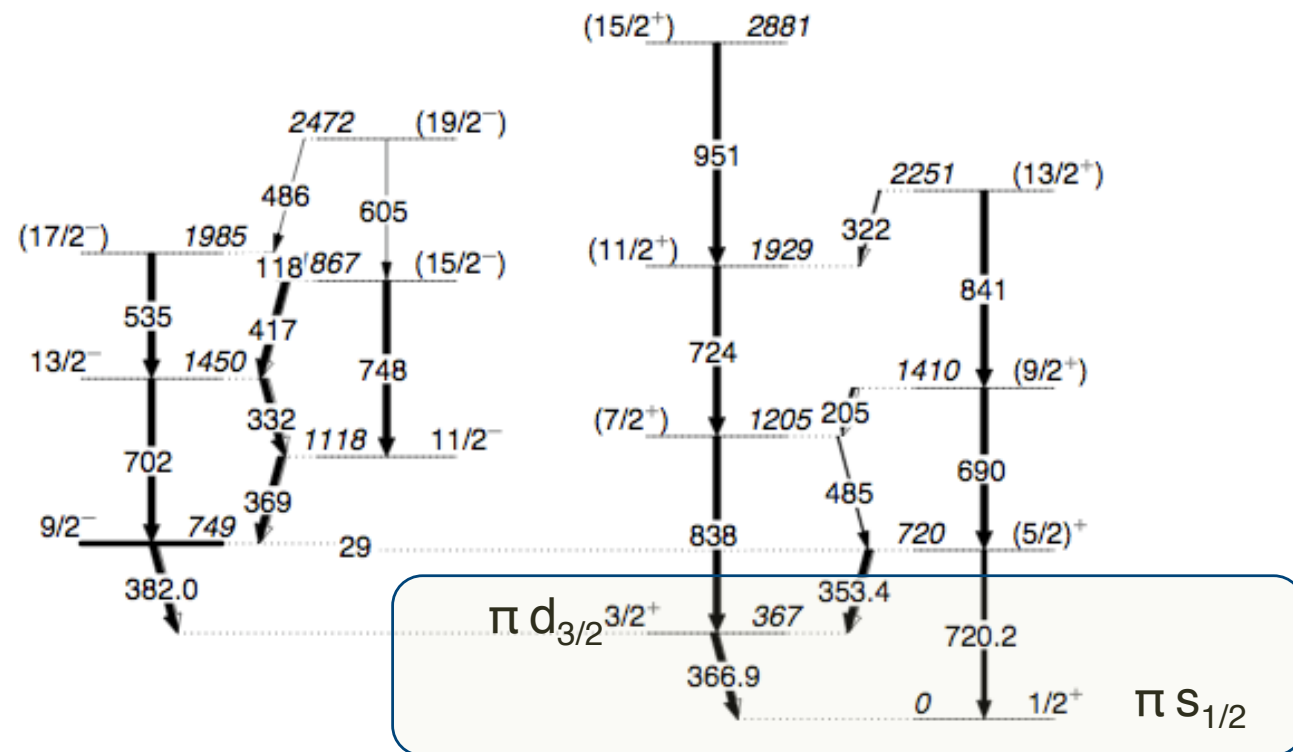


Spectroscopy of ^{199}Tl

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

8 HPGe and 5 LaBr₃:Ce detectors

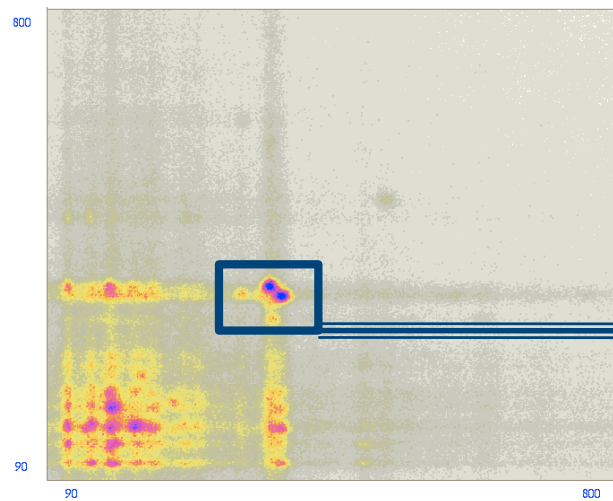
$T_{1/2} = 28.4(2)$ ms



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

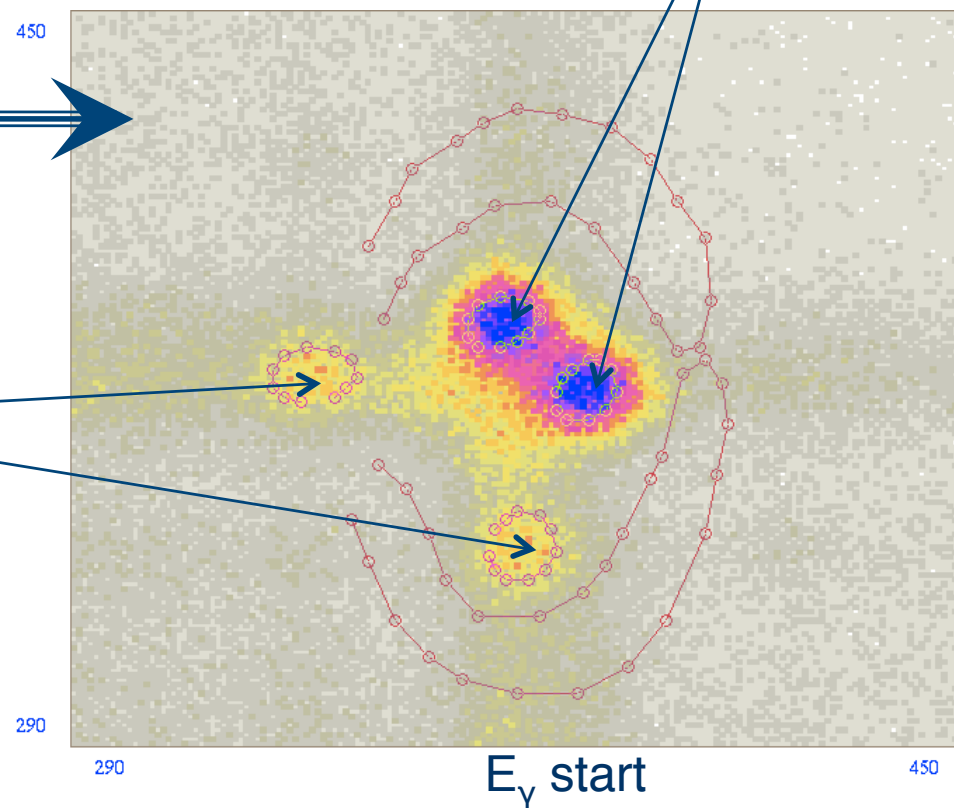
Lifetime of the 367 keV level

γ - γ - Δt cube with LaBr₃:Ce detectors



332 keV – 369 keV
coincidence

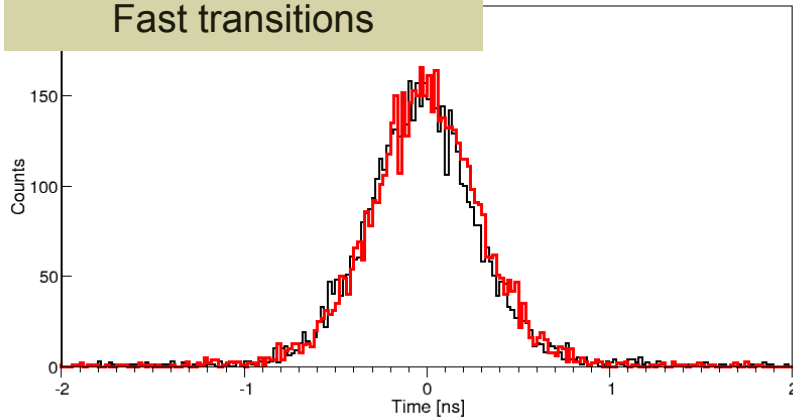
381 keV – 367 keV
coincidence



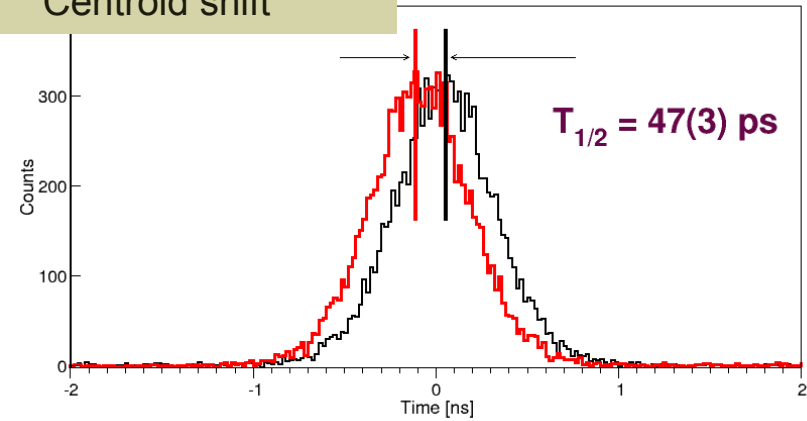
E_γ stop

Lifetime of the 367 keV level

332-369 keV coincidence
Fast transitions



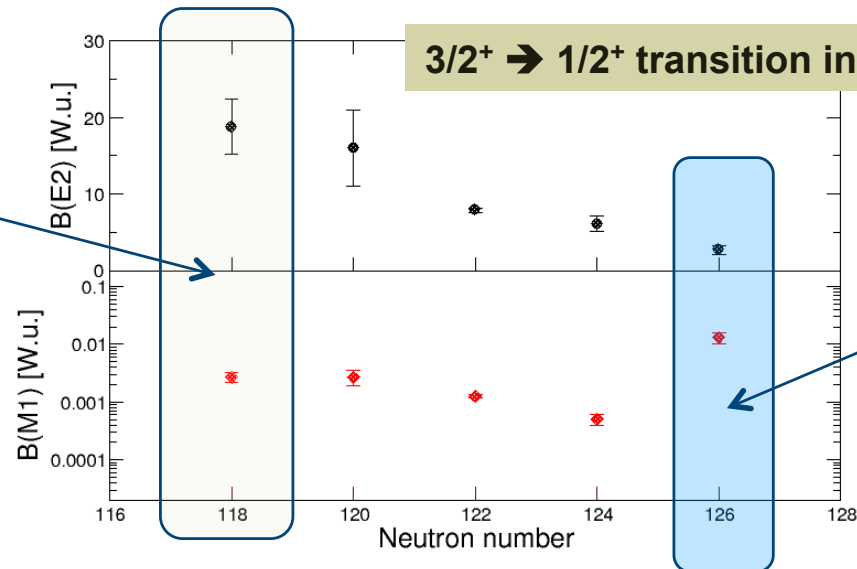
367-381 keV coincidence
Centroid shift



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

Present data

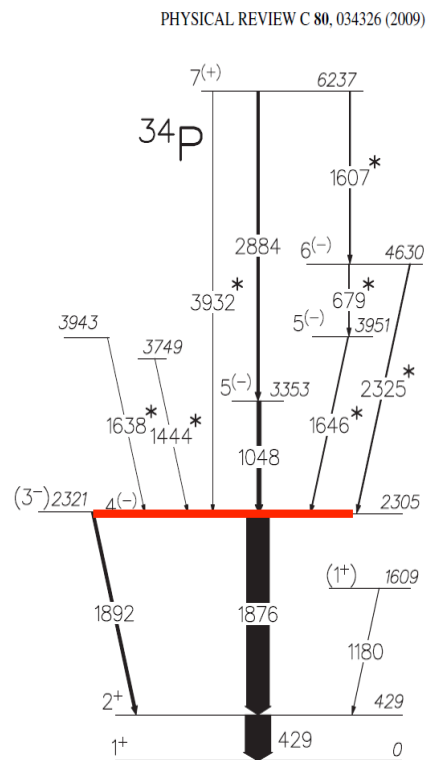
Increased collectivity
of the two states



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

“In-beam fast timing” for ^{34}P

Univ. Surrey, IFIN-HH, Univ. Brighton, Univ. Notre Dame,
Florida State, Sofia, Istanbul, Kolkata, KACST(Saudi Arabia)



$^{18}\text{O}(36 \text{ MeV}) + ^{18}\text{O}$

8 HPGe
7 $\text{LaBr}_3:\text{Ce}$

