

Photon induced γ - γ coincidence experiments at the γ^3 -setup at HlyS

Date: 21.03.2012

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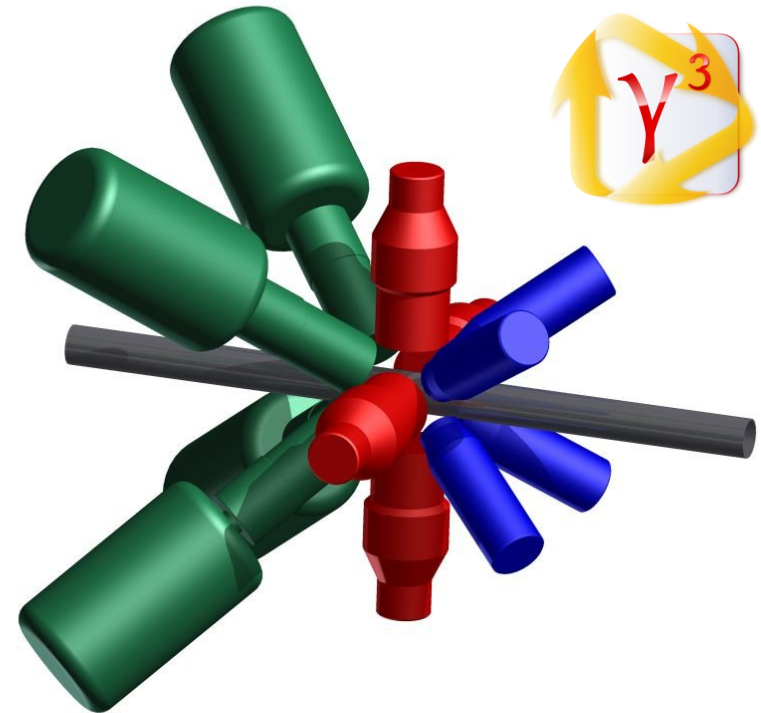
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⁵Institut für Kernphysik, Technische Universität Darmstadt

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Motivation

Date: 21.03.2012

New experimental possibilities at γ^3 to study decay patterns

- Study of the Pygmy Dipole Resonance
- Deeper Investigation of the Scissors Mode
- Two phonon excitations in light and heavy nuclei

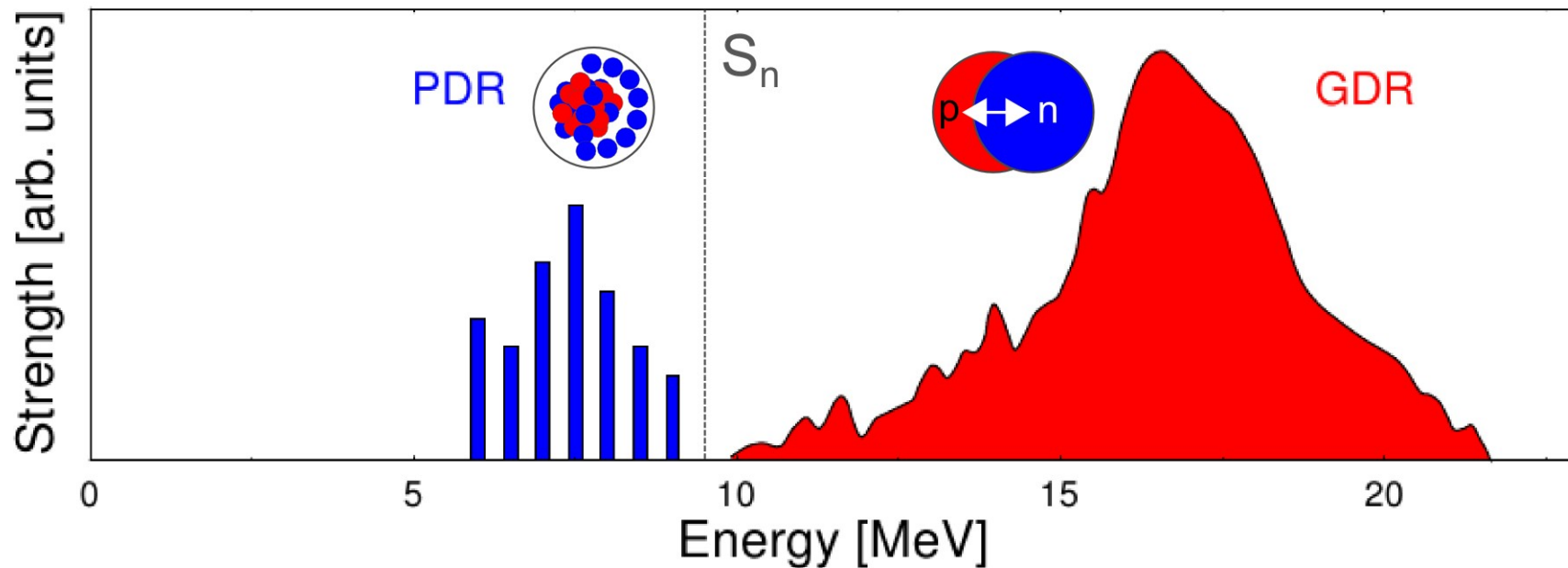


Motivation

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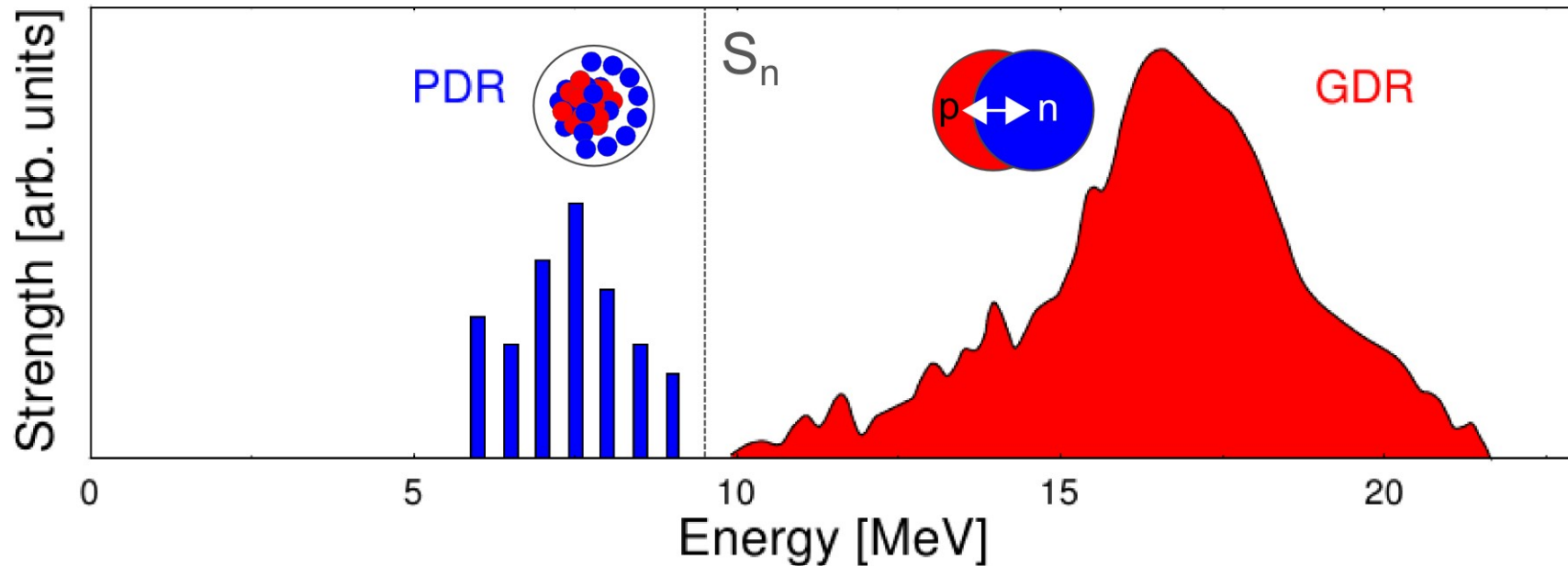
New experimental possibilities at γ^3 to study decay patterns

- Study of the Pygmy Dipole Resonance
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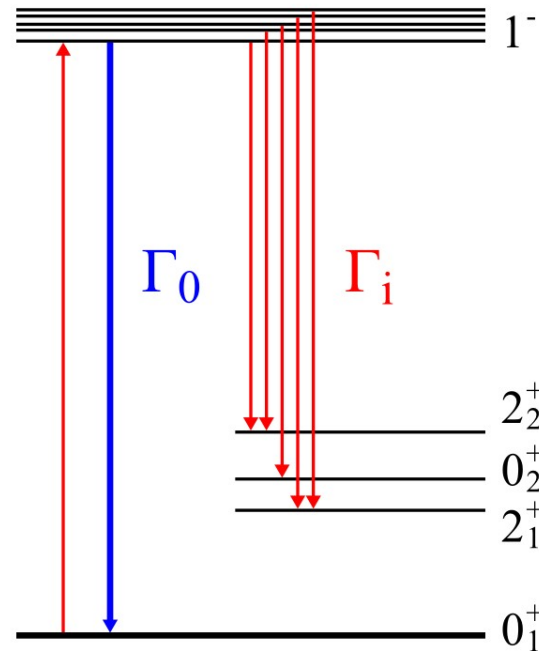
Photoresponse of (spherical) nuclei

- **GDR**: Oscillation of Neutrons vs. Protons
- **PDR**: Oscillation of Neutron skin vs. Core

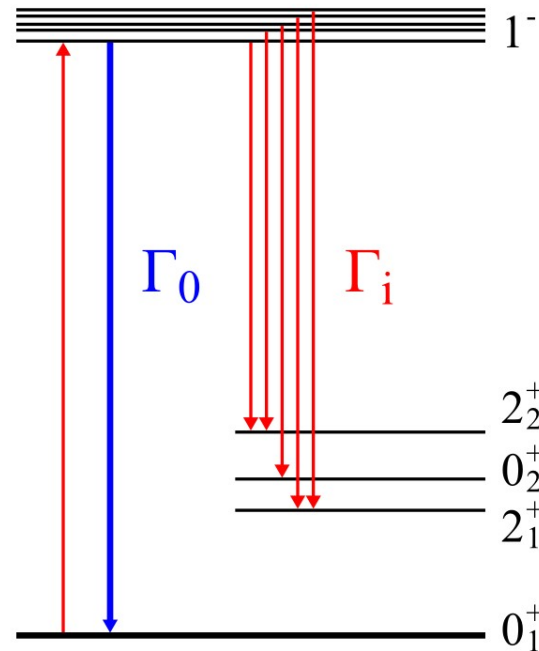


Photoresponse of (spherical) nuclei

- **GDR**: Oscillation of Neutrons vs. Protons
- **PDR**: Oscillation of Neutron skin vs. Core
→ Investigate decay behavior



- Decay „elastic“ (Γ_0) or „inelastic“ (Γ_i)
- Elastic channel dominant: ($\Gamma_0 \gg \Gamma_i$)



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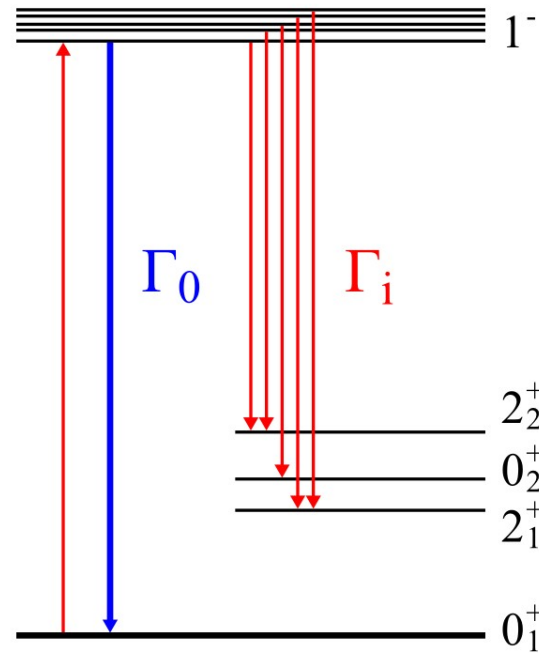
Experimental challenge:

- Observe transitions with small branching ($\approx 1\%$)
→ Dedicated experimental method



Experimental Method

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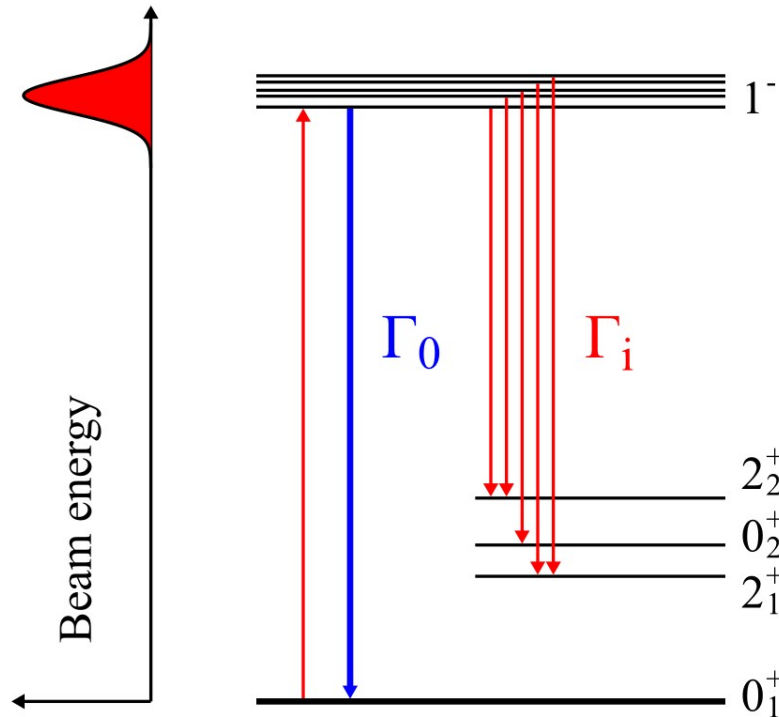
Use:

- **Selectivity** of NRF reaction



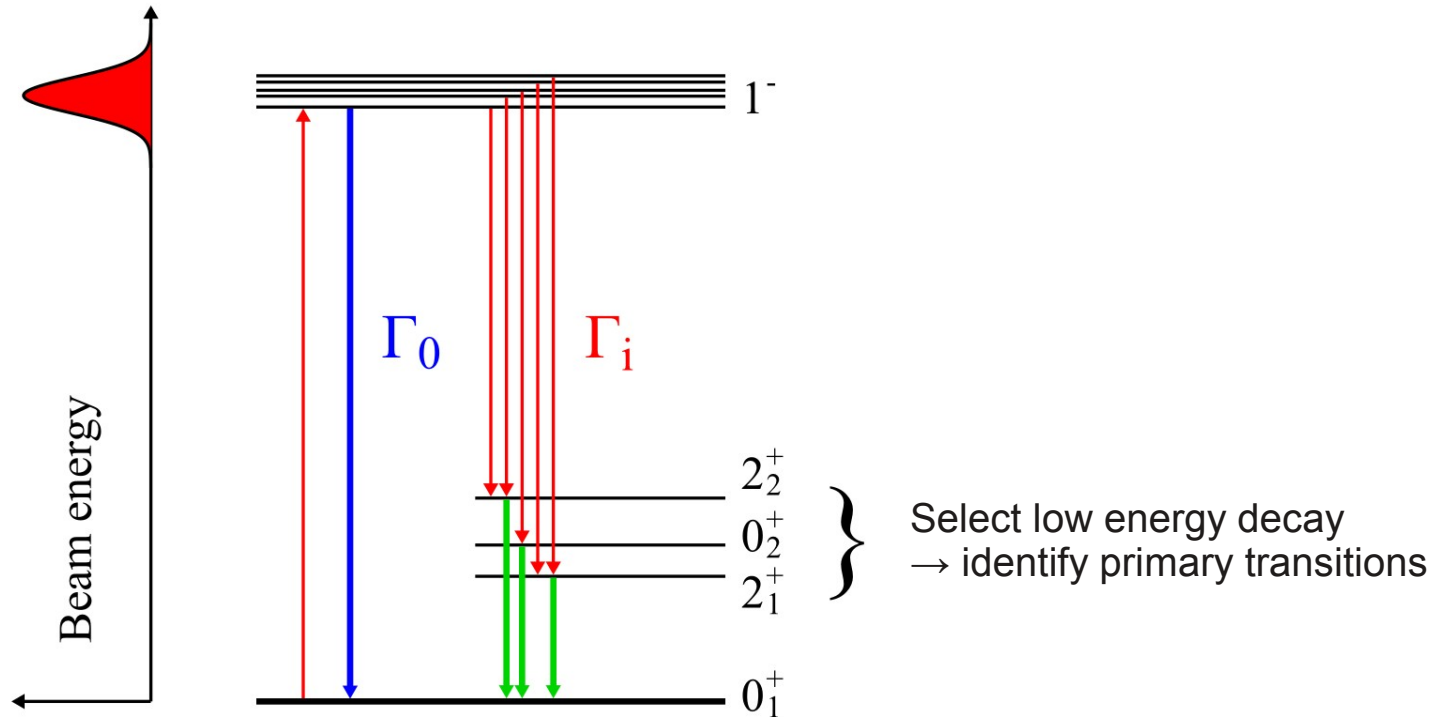
Experimental Method

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Use:

- **Selectivity** of **NRF reaction** and **mono-energetic beam**



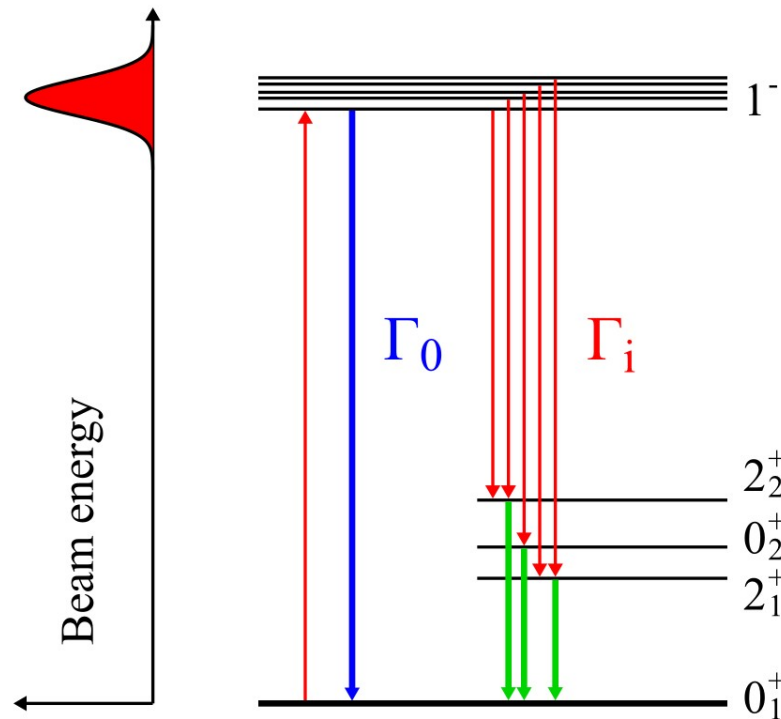
Combine:

- **Selectivity** of NRF reaction and mono-energetic beam
- **Sensitivity** of γ - γ coincidence method



Proposed Setup

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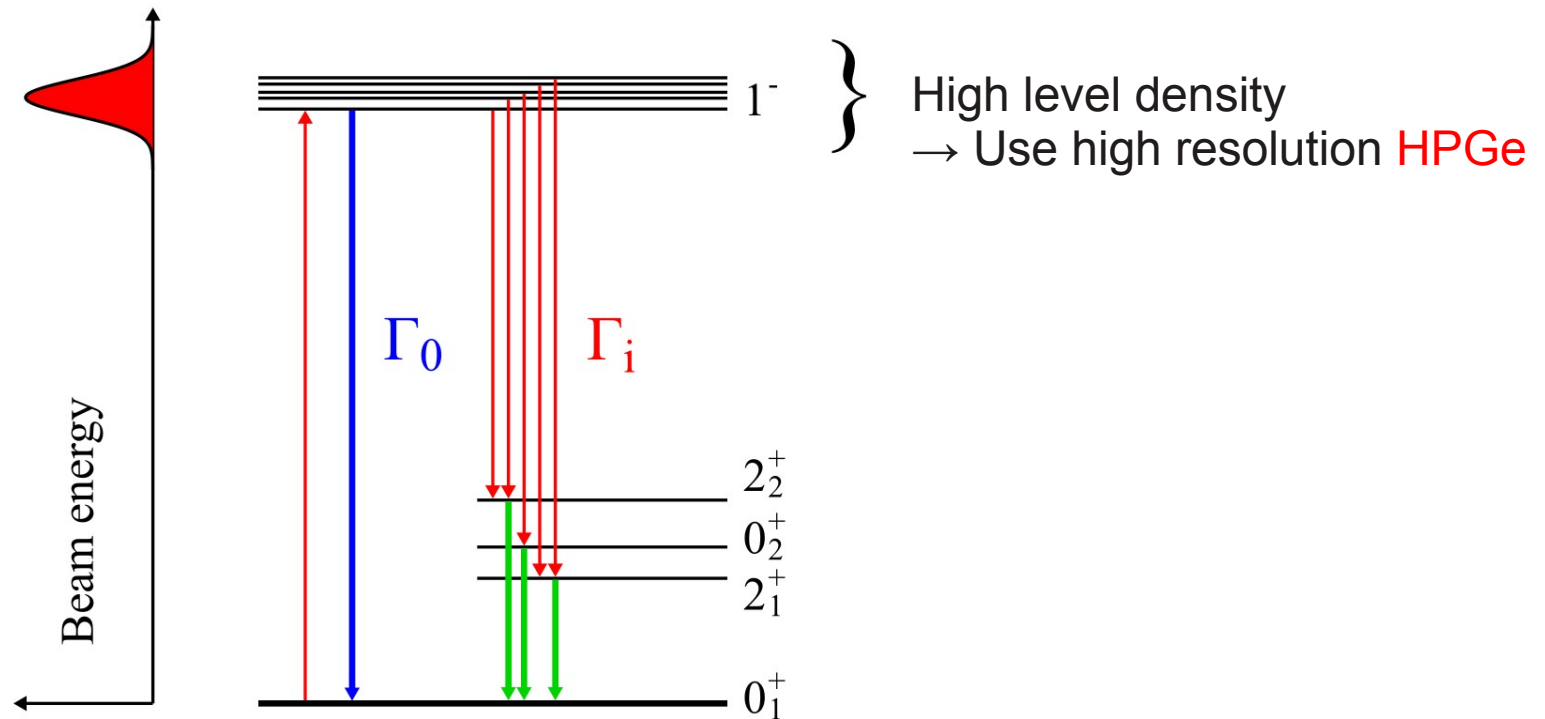


- Detect two photons in coincidence
→ High photo peak efficiency needed



Proposed Setup

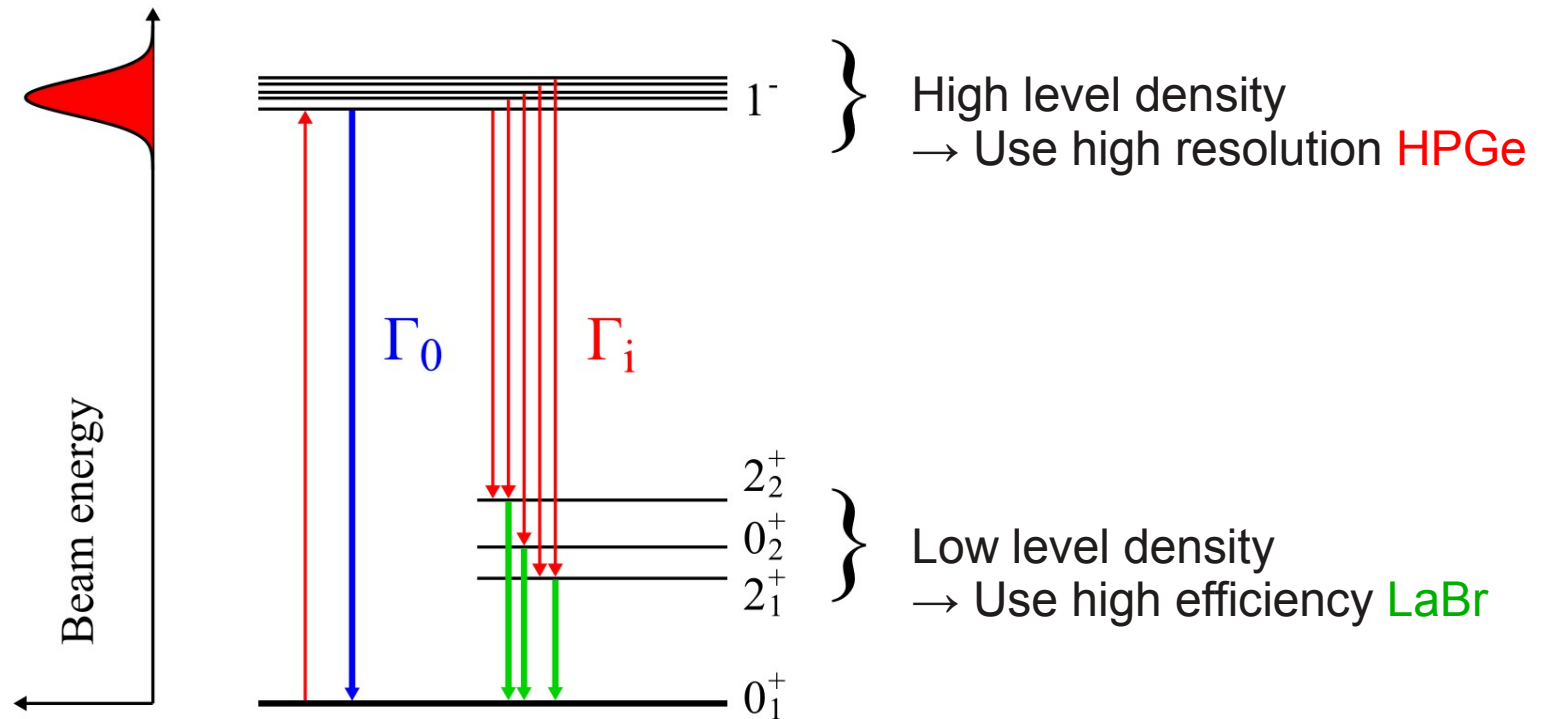
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Proposed Setup

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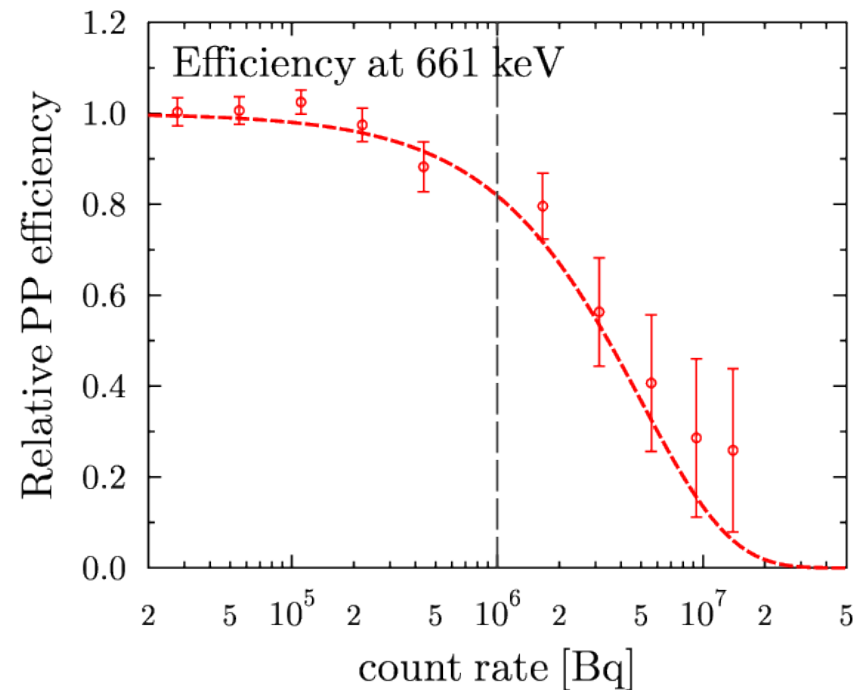
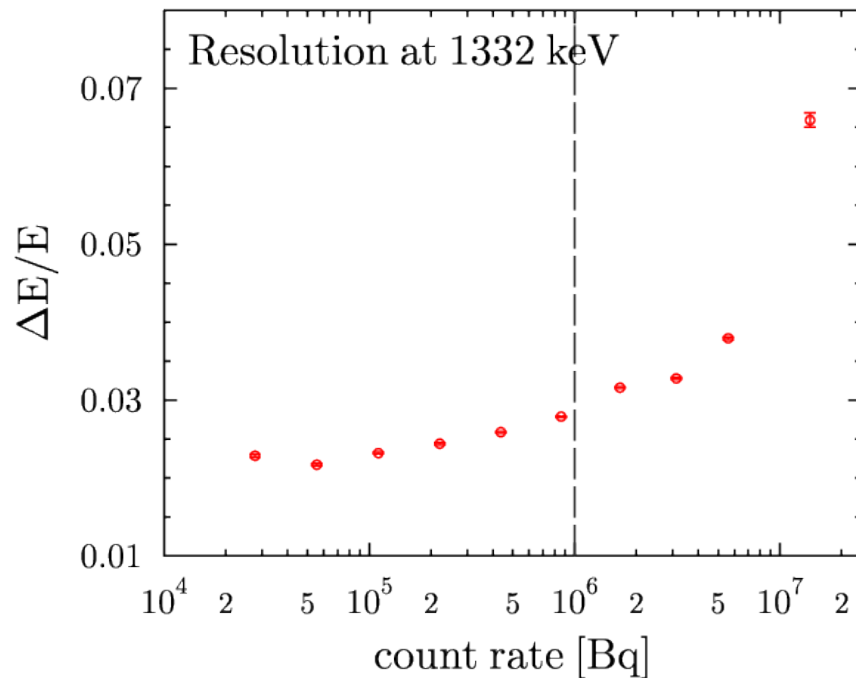


- Detect two photons in coincidence
→ High photo peak efficiency needed
- **Combine HPGe with LaBr detectors**



High Count Rate Spectroscopy with LaBr

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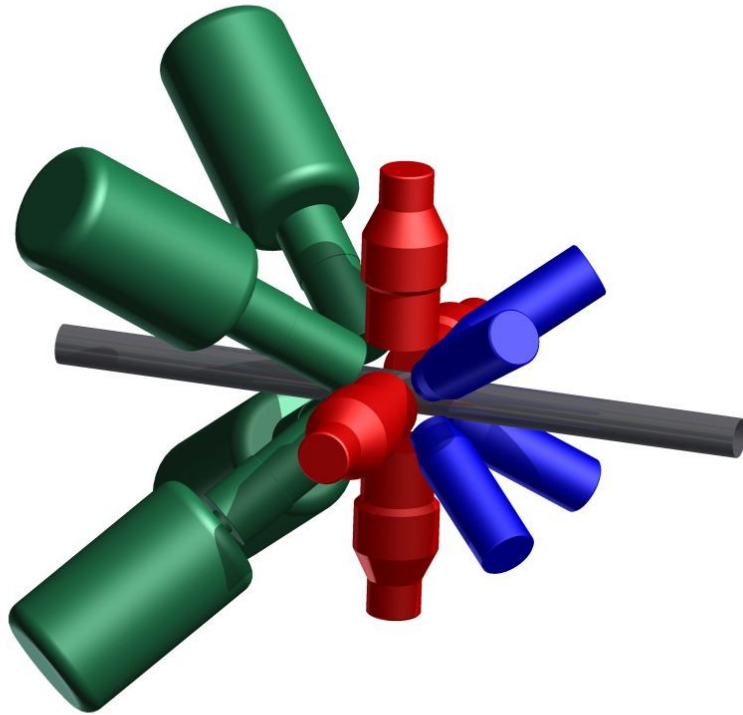


- Beam Intensity $\approx 10^8$ $\gamma/s \rightarrow$ 100-500 kHz in LaBr
- Energy resolution and photo peak efficiency stable up to 1 MHz



The γ^3 setup

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New detector array at High Intensity γ -ray Source

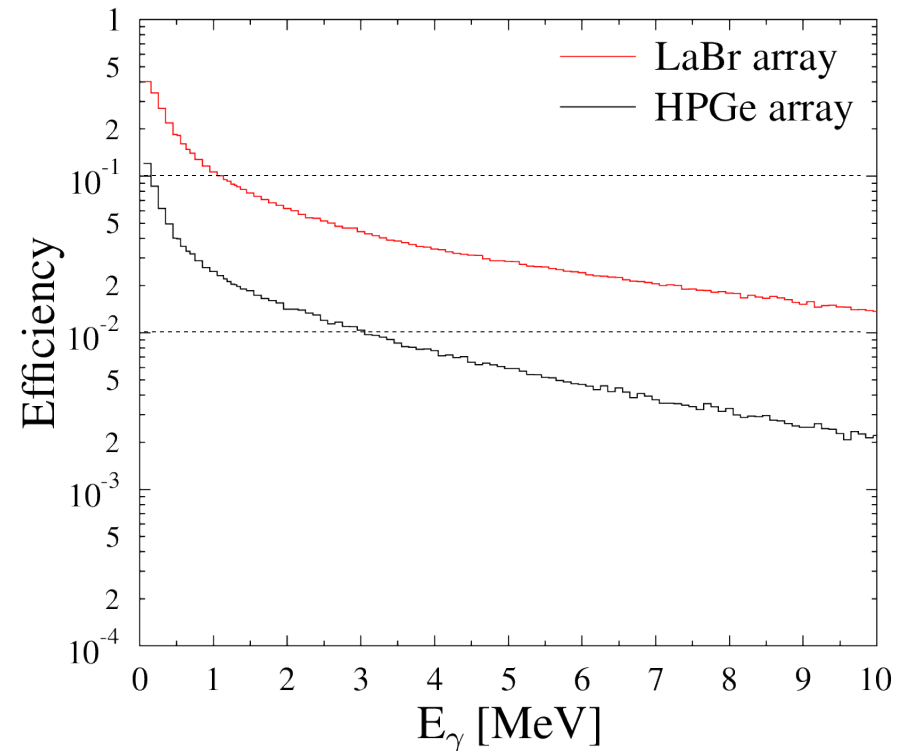
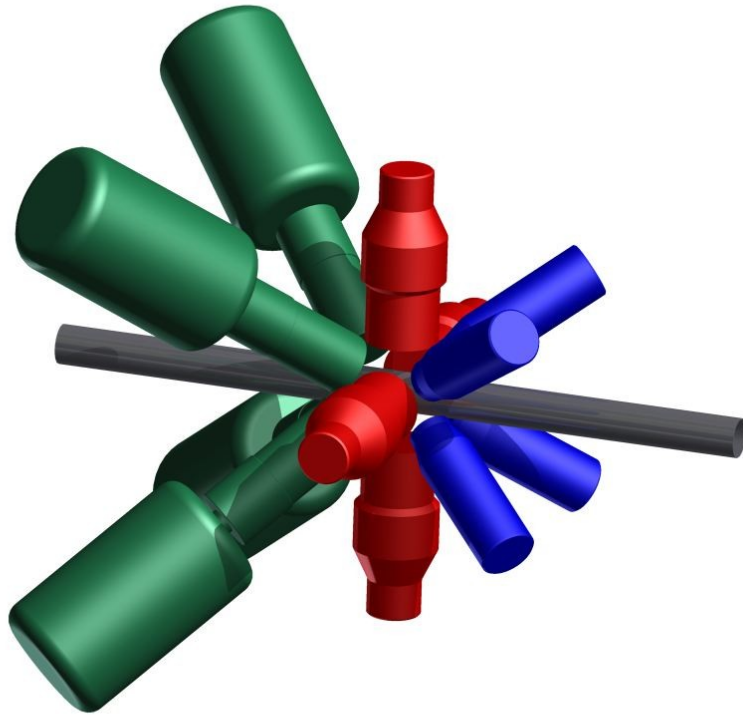
- 4 high resolution HPGGe detectors
- 8 high efficiency LaBr detectors





The γ^3 setup

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New detector array at High Intensity γ -ray Source

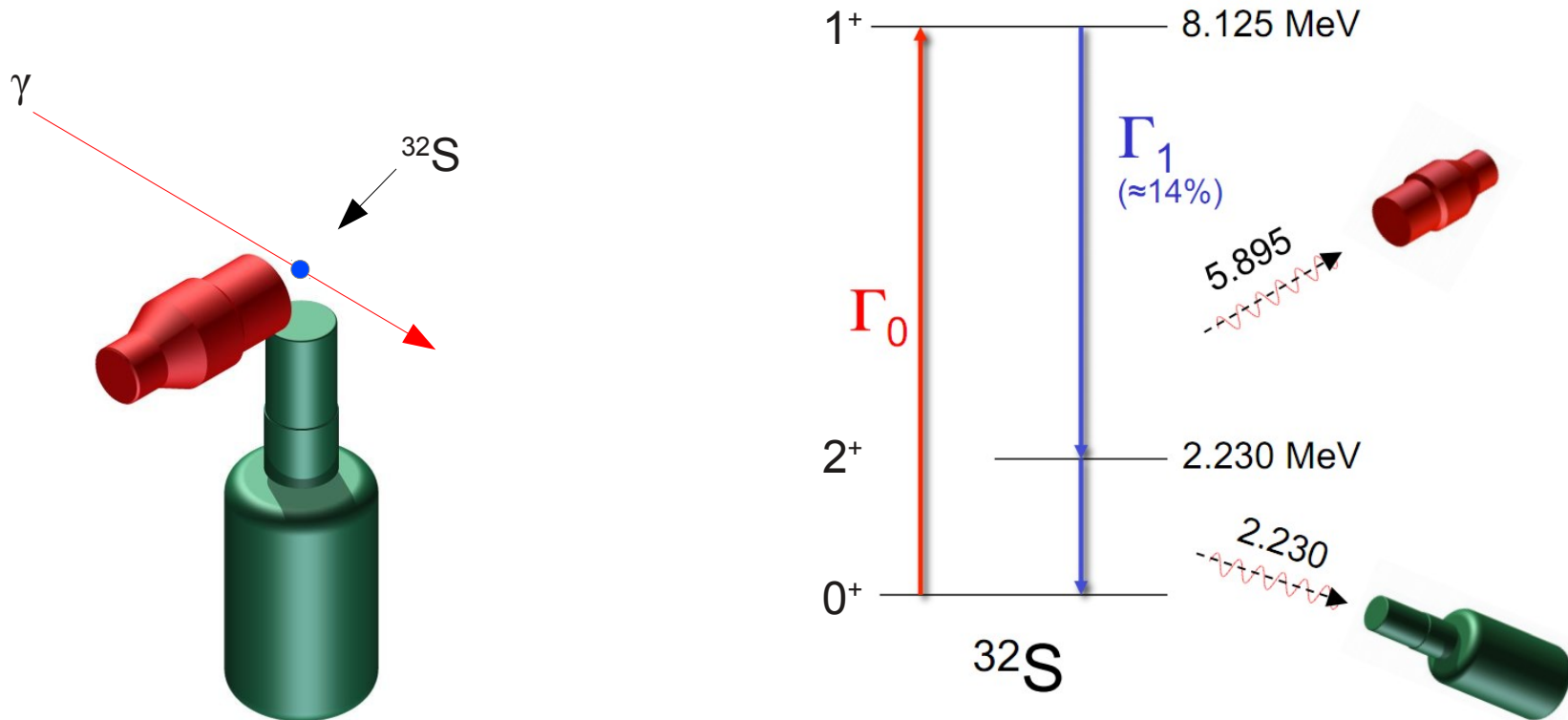
- 4 **high resolution** HPGe detectors
- 8 **high efficiency** LaBr detectors
- Total efficiency: **4-12%**





Feasibility Test

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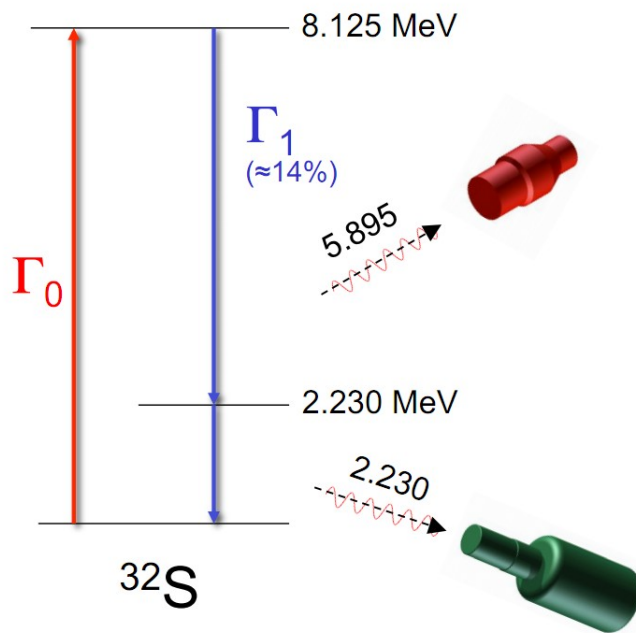
Test setup with HPGe (60%) + 3"x3" LaBr

- Target: ^{32}S @ 8.51 MeV beam energy
- Duration: 5 h



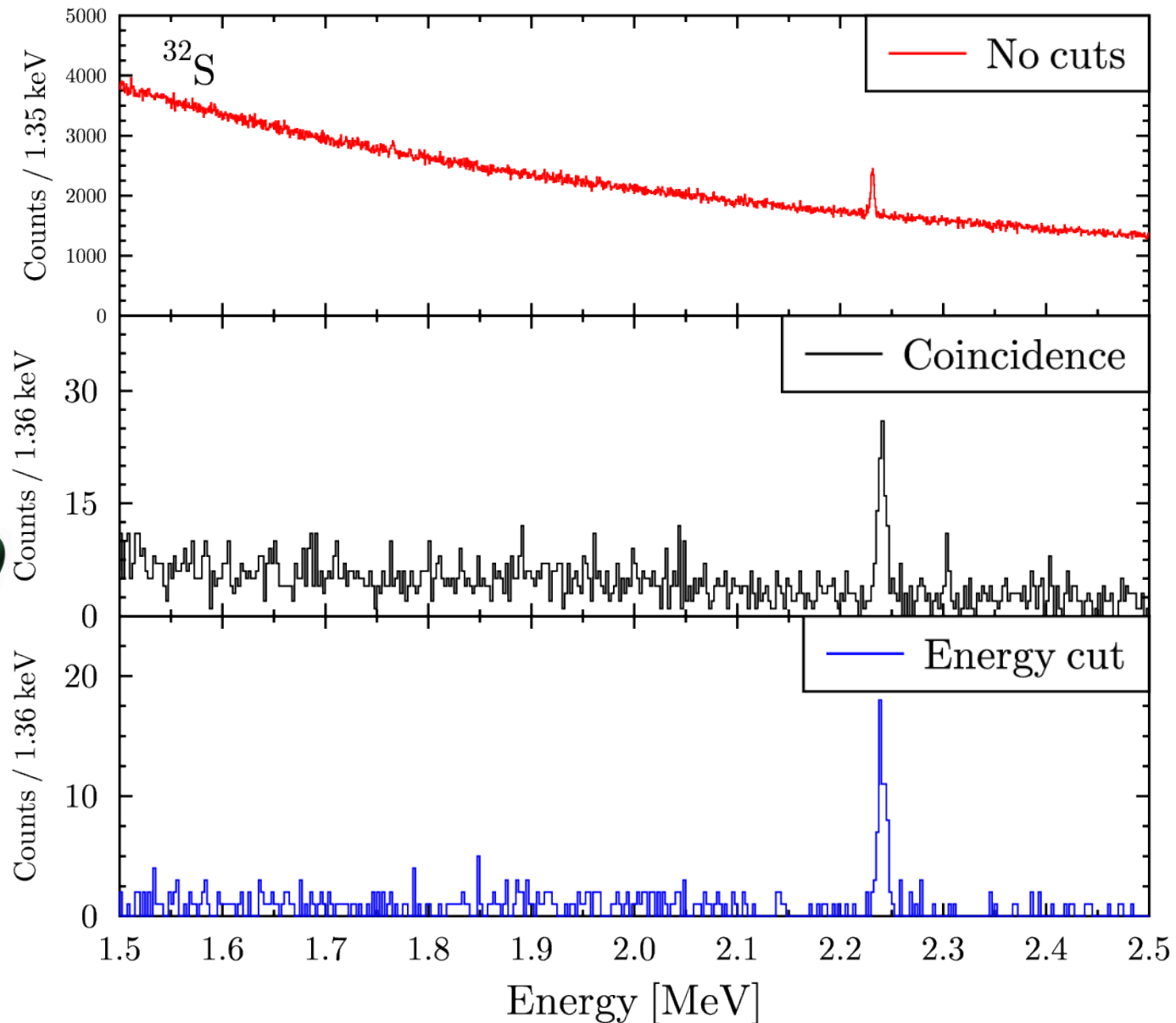
Feasibility Test

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Peak to Background:

- Only HPGe: 0.15(3)
- Concidence: 3.9(9)
- Energy Cut: 14.5(31)

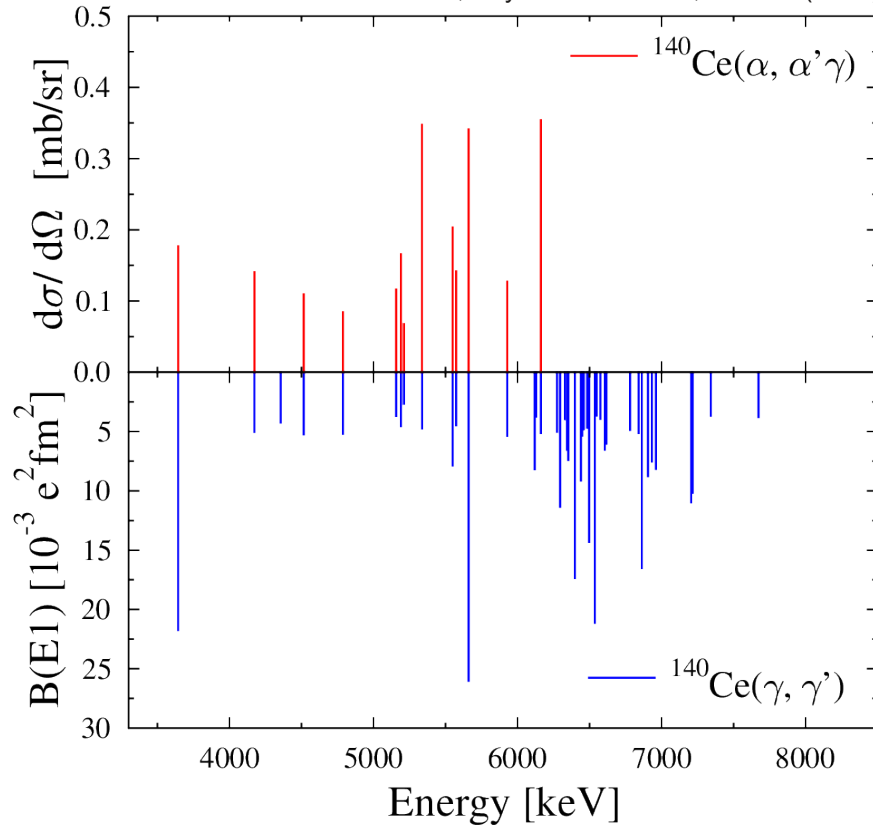




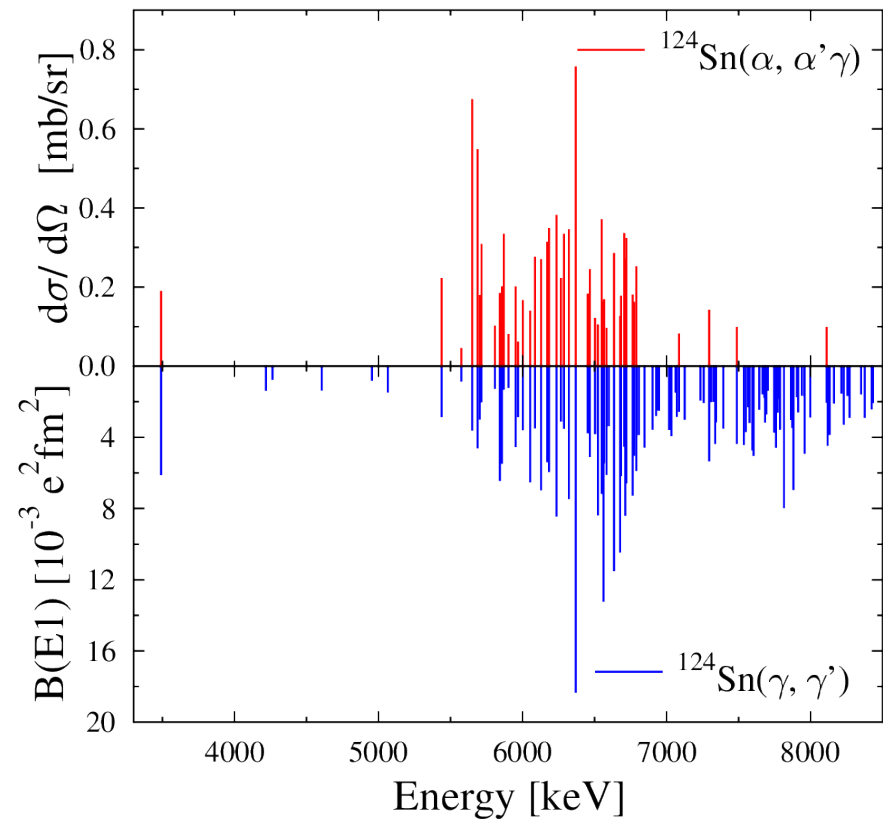
Planned Experiments

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D. Savran *et al.*, Phys. Rev. Lett. **97**, 172502 (2006)



J. Endres *et al.*, Phys. Rev. Lett. **105**, 212503 (2010)

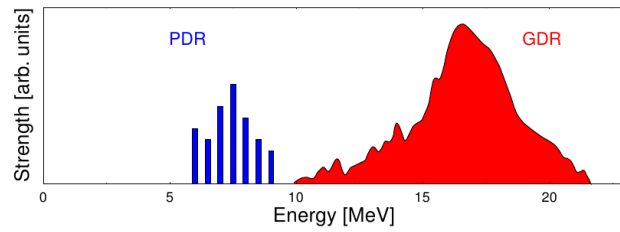


- Substructure identified in $(\alpha, \alpha'\gamma)$ experiments
(\rightarrow Poster by [J.Endres](#), HK 47.5 on Thursday)
- Investigate ^{140}Ce , ^{124}Sn at γ^3 setup



Summary

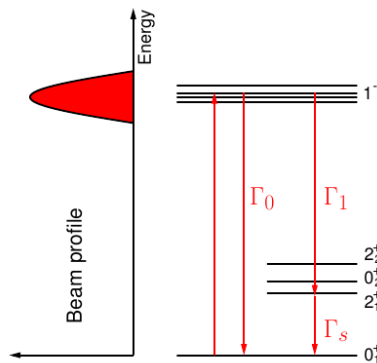
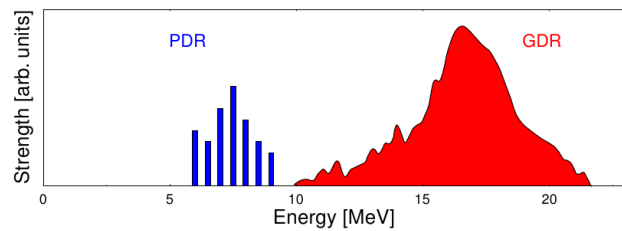
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Summary

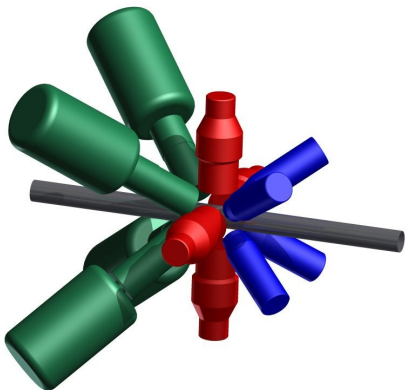
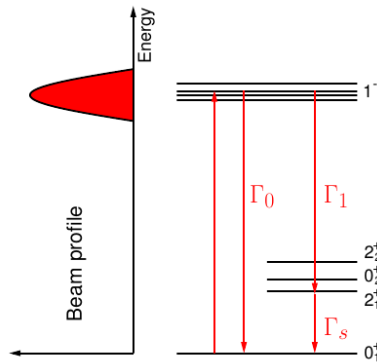
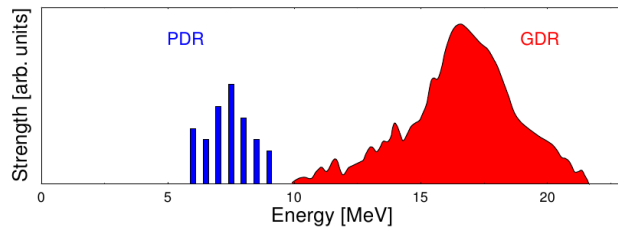
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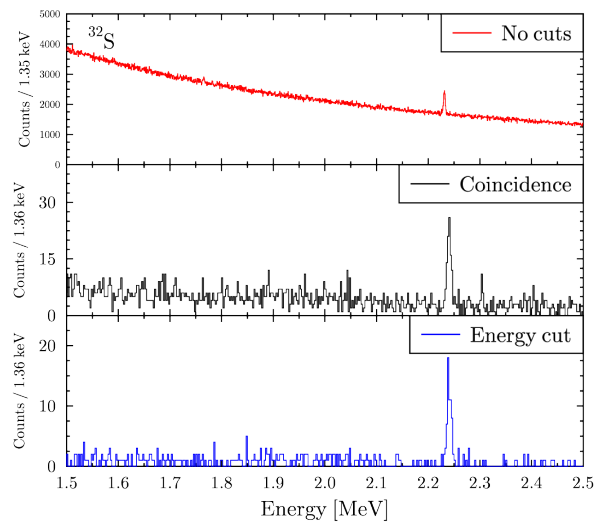
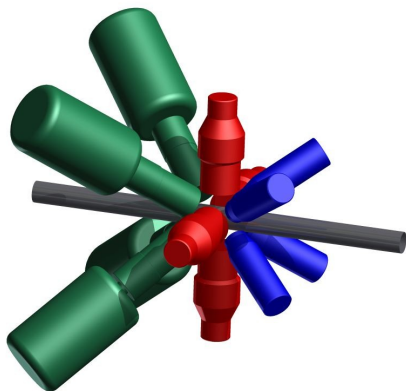
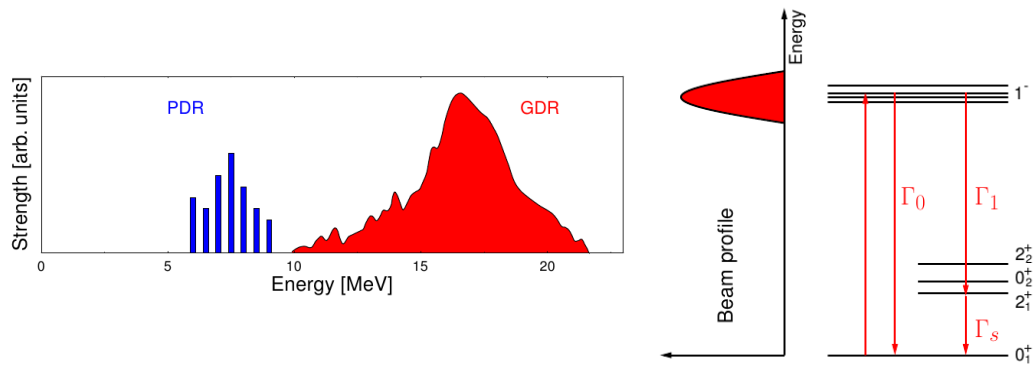
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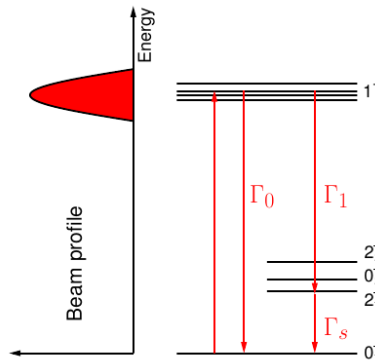
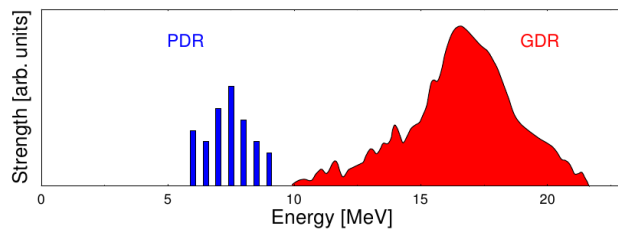
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Collaboration

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- **EMMI/GSI**
 - B. Löher, E. Fiori, D. Savran
- **TU Darmstadt**
 - T. Aumann, N. Pietralla
- **Universität zu Köln (Cologne)**
 - V. Derya, J. Endres, A. Zilges
- **HIγS (Duke University)**
 - J. Kelley, R. Raut, G. Rusev, A. Tonchev, W. Tornow
- **Yale University**
 - N. Cooper, V. Werner

