Study of low-lying dipole strength in $(\vec{\gamma}, \gamma'\gamma'')$ reactions using the γ^3 setup

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International Workshop on

„Neutrino Nuclear Responses for Double Beta Decays and Astro-Neutrino Interactions“

Osaka, September 29-30, 2016

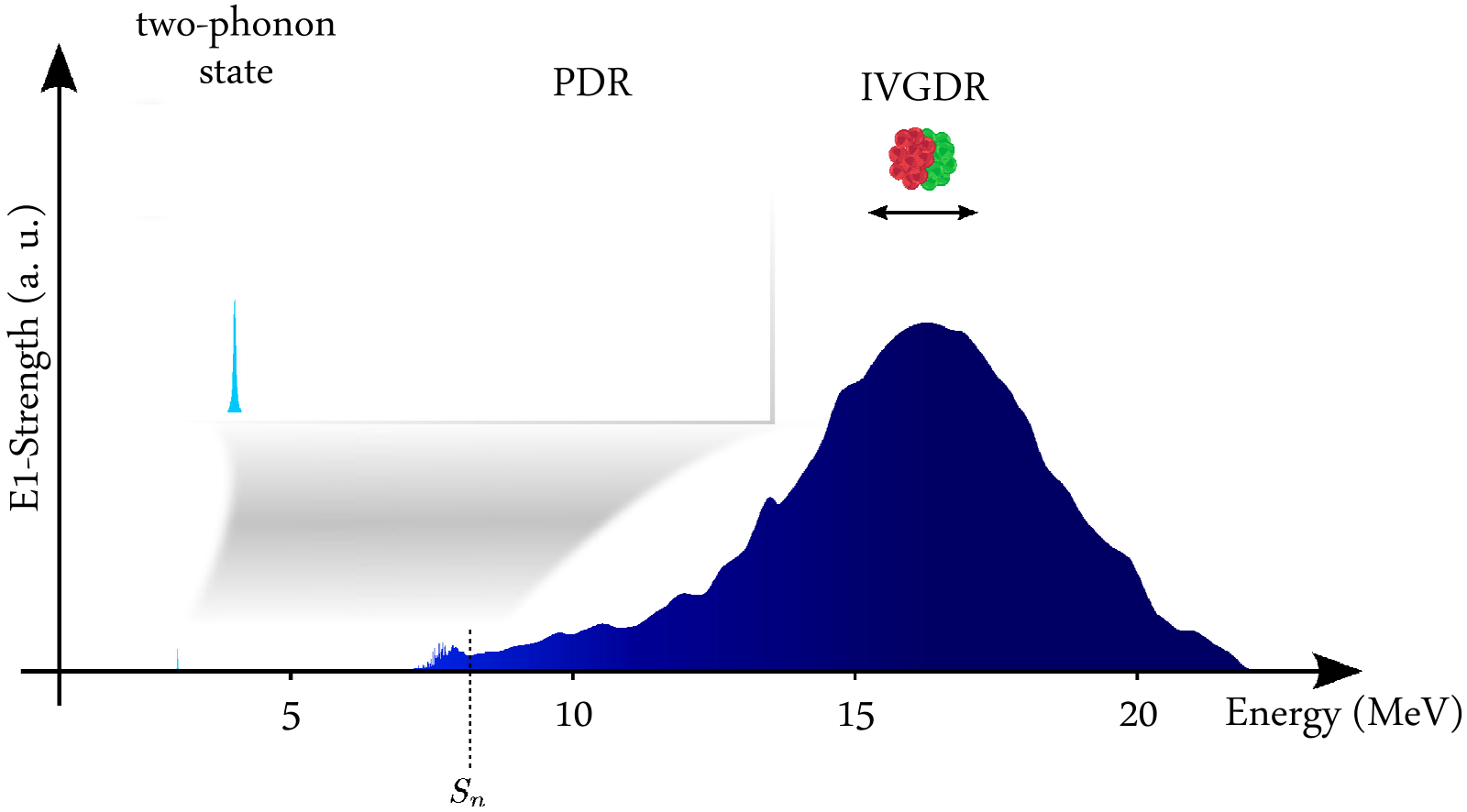
FIAS Frankfurt Institute for Advanced Studies

EMMI

γ^3

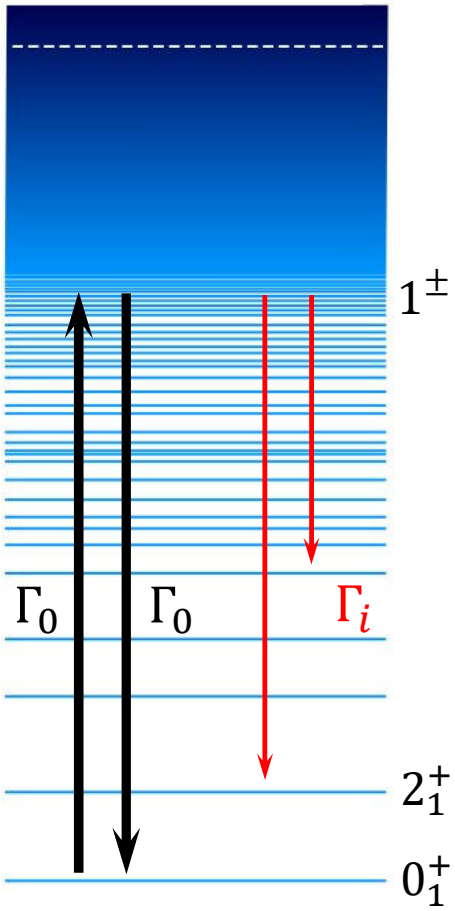
GSI

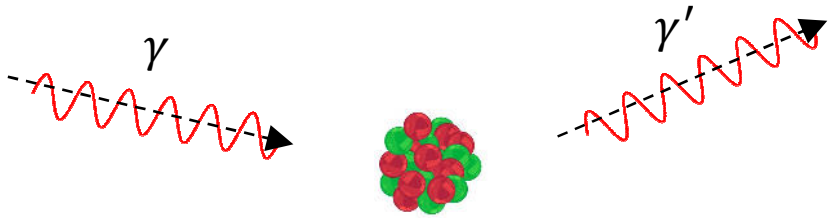
Electric dipole excitations



Nuclear Resonance Fluorescence (NRF)

photon scattering

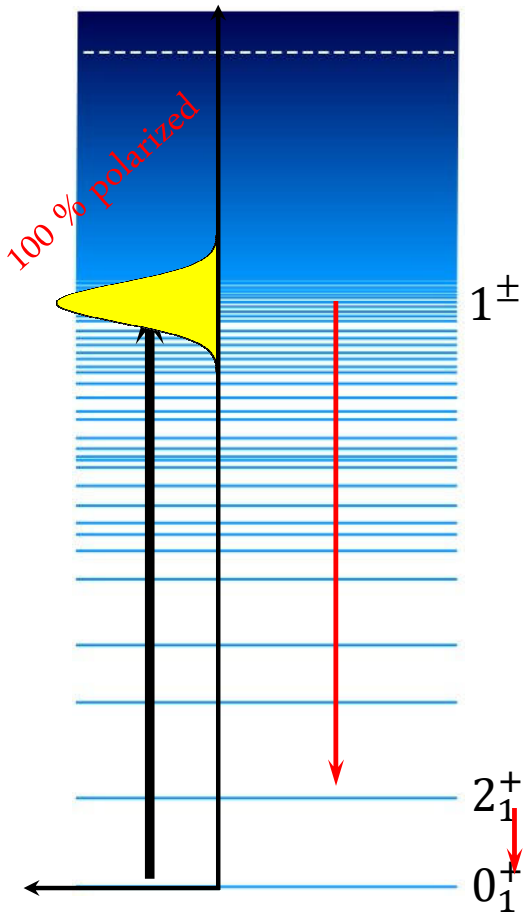


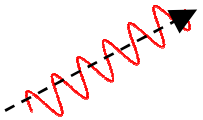


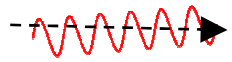
- selective to J=1 states
- model-independent determination of
  - ... spin
  - ... parity
  - ... transition strength
- low sensitivity for weak transitions

γ-γ coincidence

$(\vec{\gamma}, \gamma'\gamma'')$



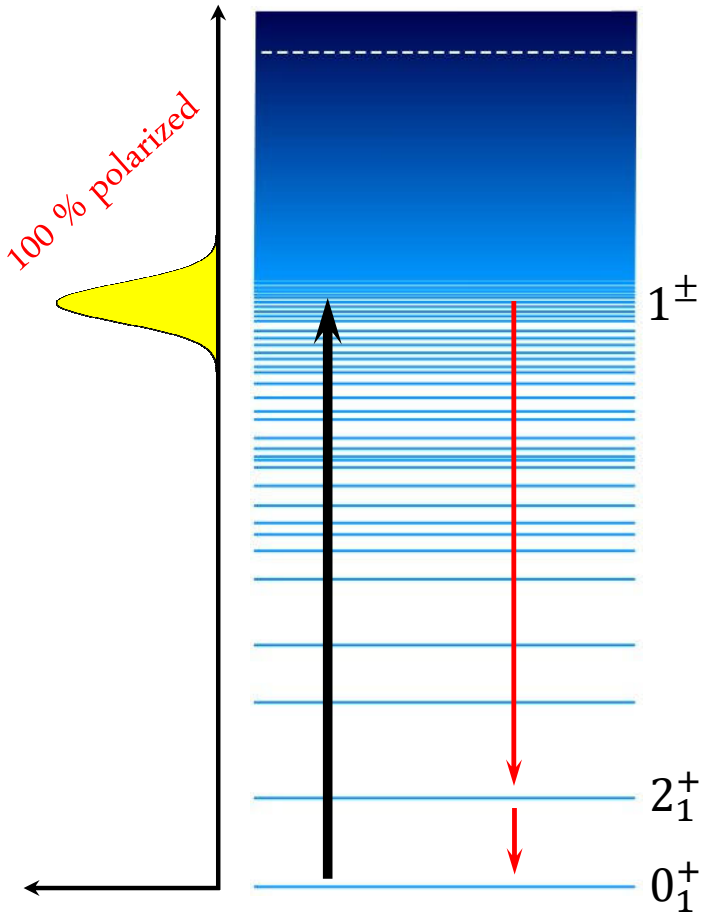




coincident measurement

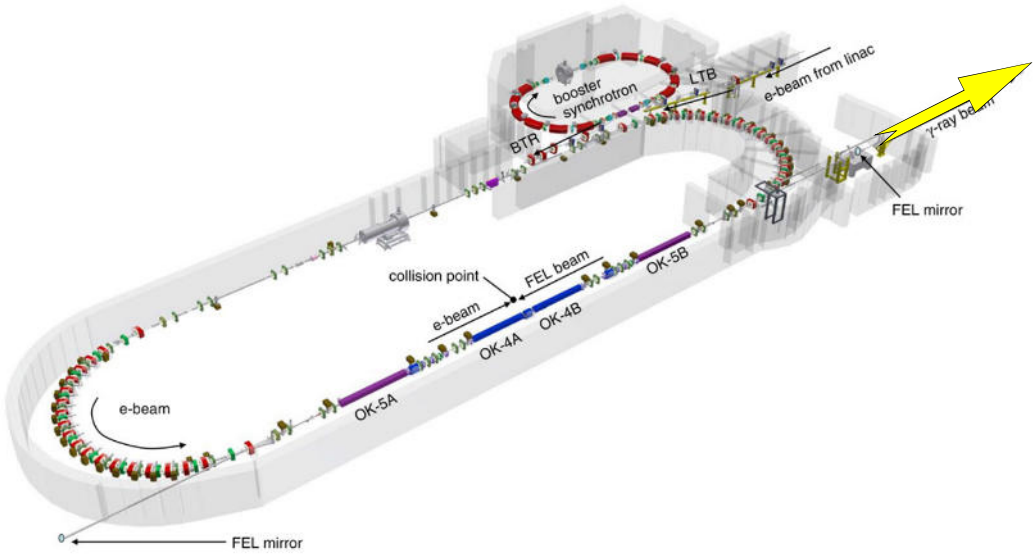
γ-γ coincidence

... with Compton-backscattering



High Intensity γ-Ray Source

(HIγS)



~ eV »»»» ~ MeV

H.R. Weller *et al.*, Prog. Part. Nucl. Phys. **62** (2009) 257

γ-γ coincidence

High Intensity γ-Ray Source

(HIγS)

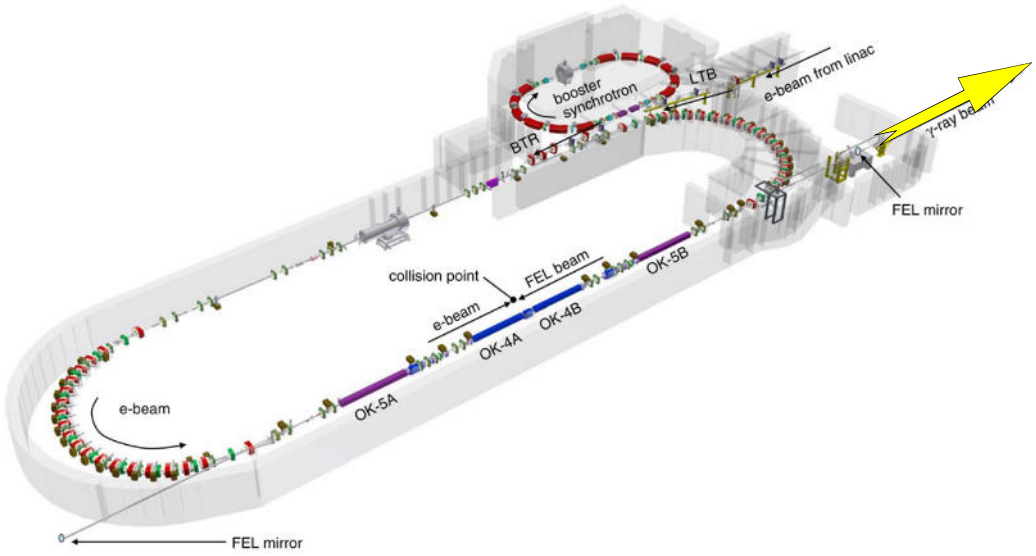
- quasi-monochromatic

  $\frac{\Delta E}{E} \sim 3\ \%$

- linearly polarized

- high beam intensity

  $\sim 10^7\ \gamma/s$

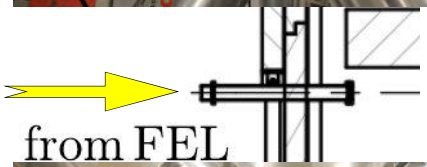


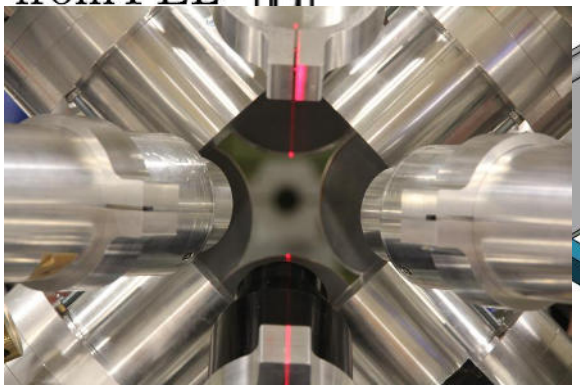
$\sim$ eV »»»» $\sim$ MeV

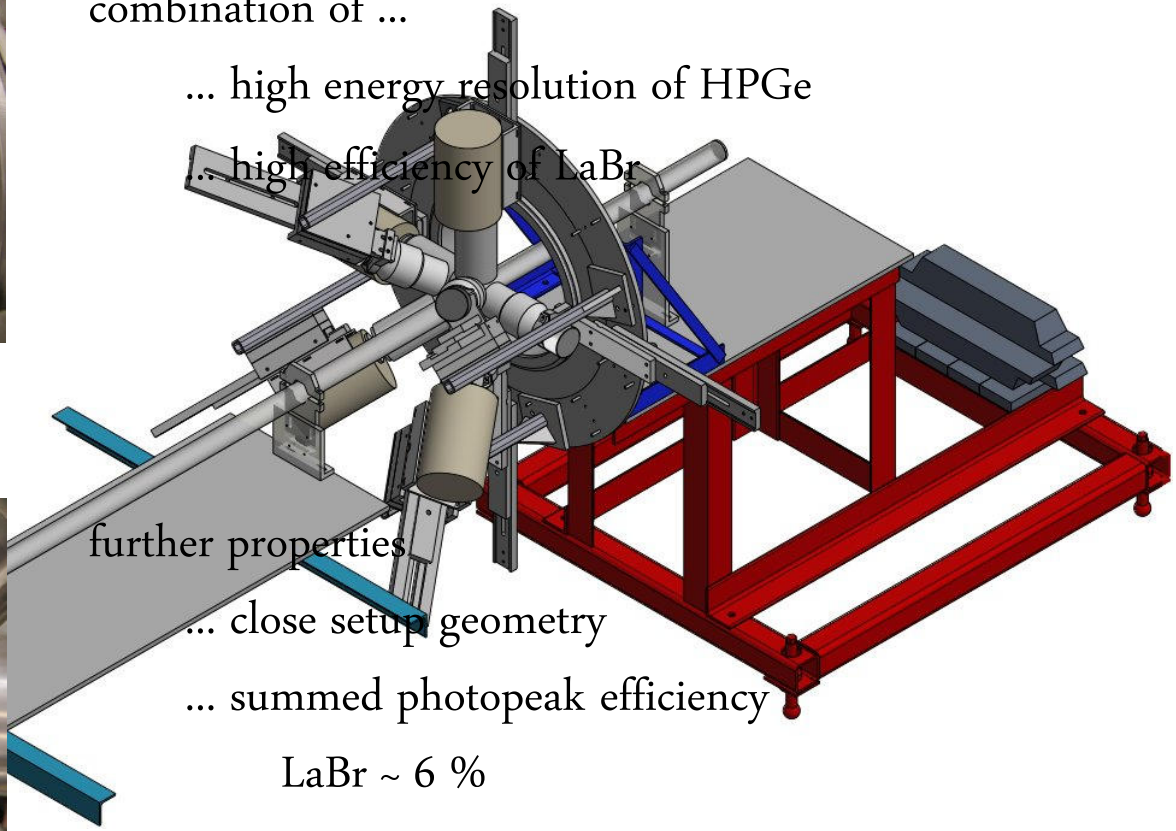
H.R. Weller *et al.*, Prog. Part. Nucl. Phys. **62** (2009) 257

γ^3- setup

B. Löher *et al.*, NIMA **723** (2013) 136







combination of ...

... high energy resolution of HPGe

... high efficiency of LaBr

further properties

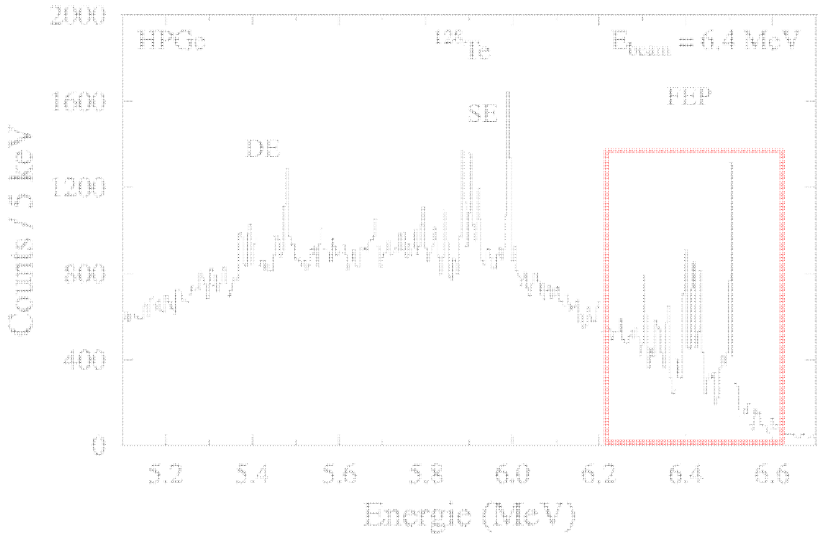
... close setup geometry

... summed photopeak efficiency

LaBr ~ 6 %

HPGe ~ 1.5 %

Single γ-ray spectroscopy

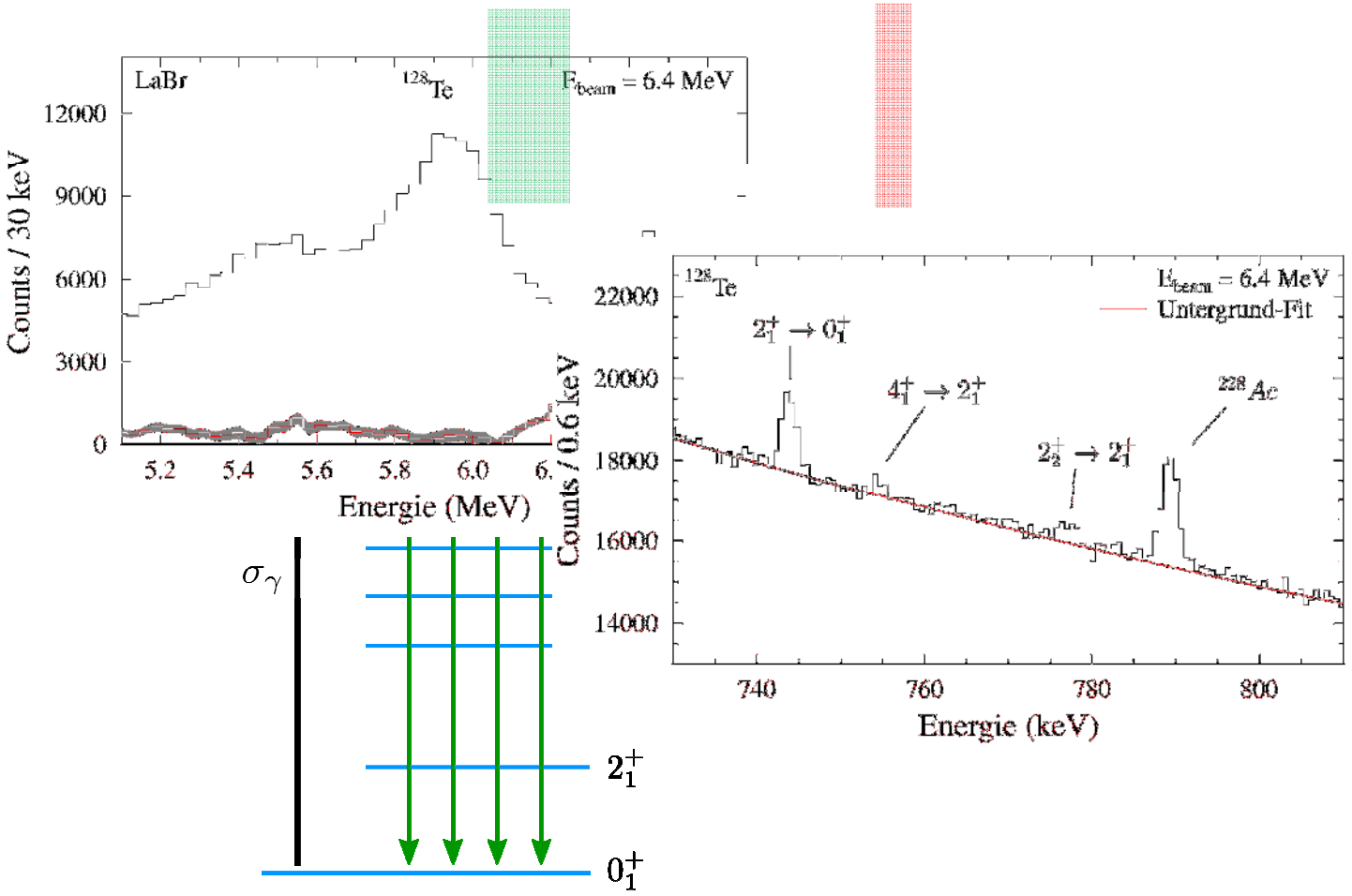


→ individual excited states

→ averaged quantities

Single γ-ray spectroscopy

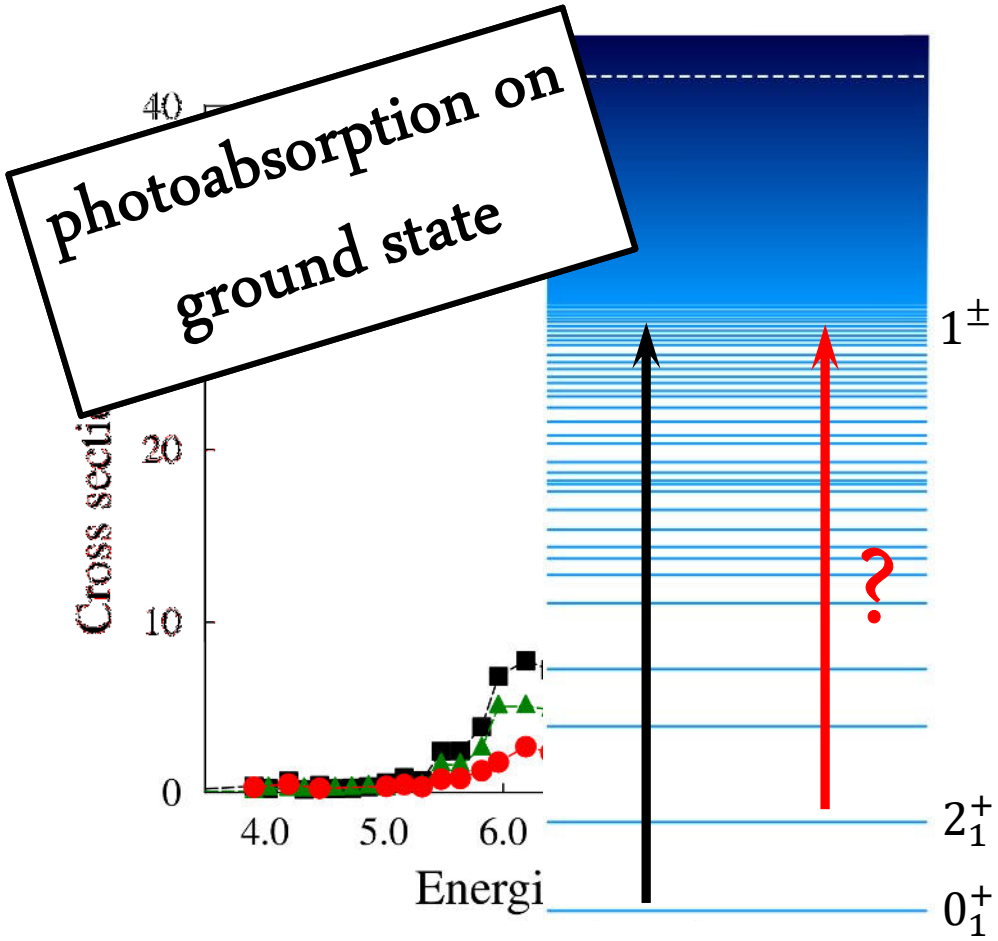
photoabsorption cross section: $\sigma_\gamma = \sigma_{\gamma\gamma} + \sigma_{\gamma\gamma'}$



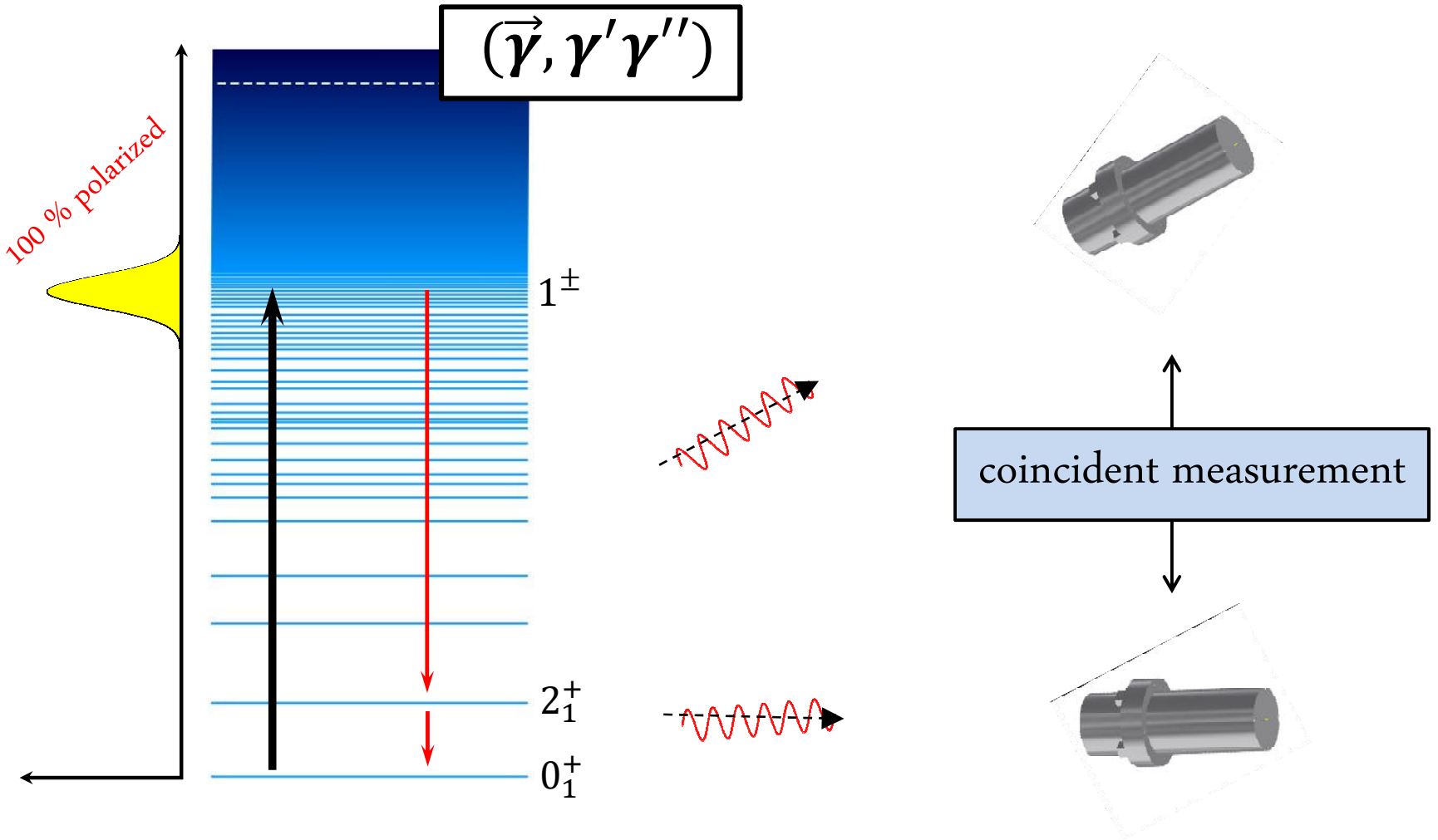
A.P. Tonchev *et al.*, PRL **104** (2010) 072501

Single γ-ray spectroscopy

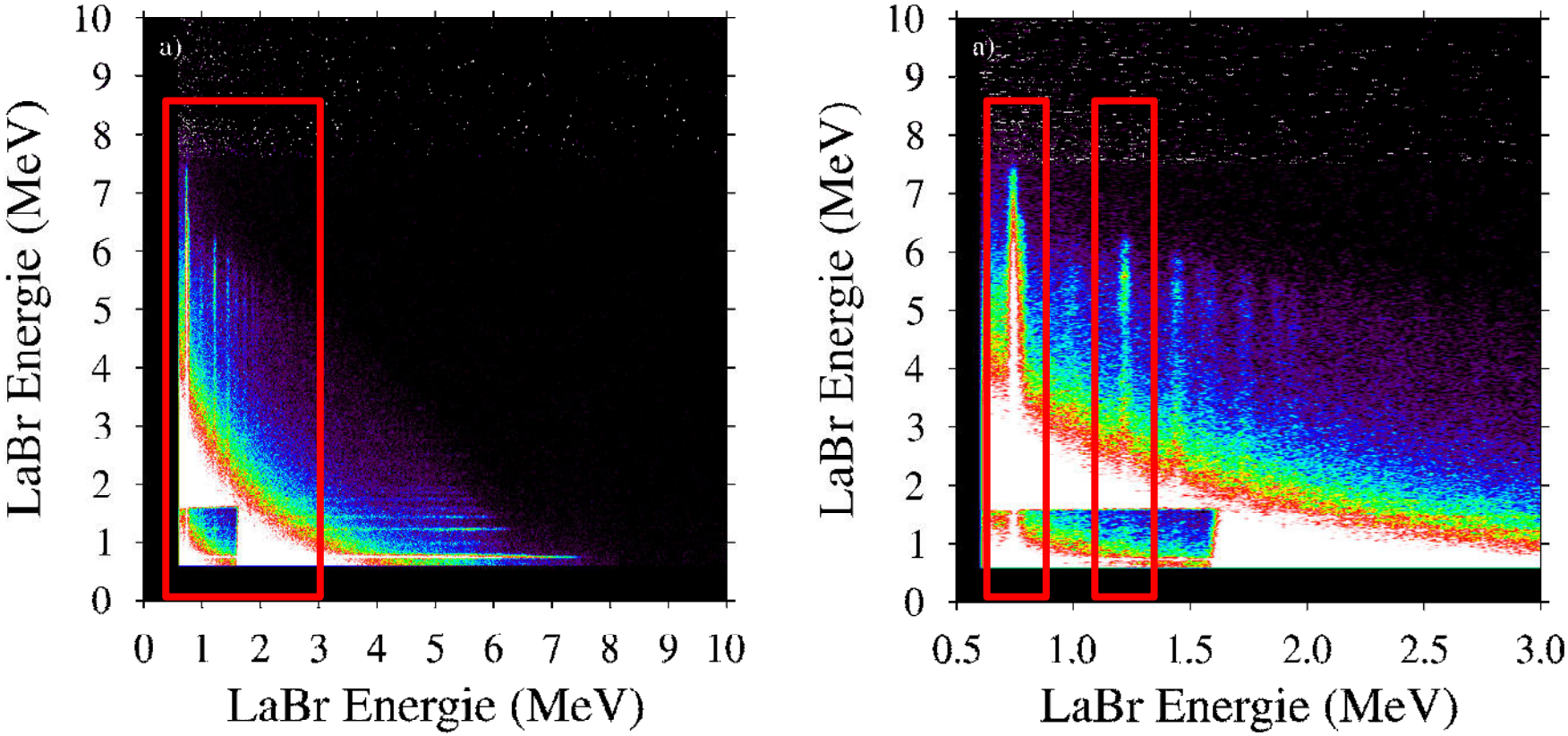
- photoabsorption cross section: $\sigma_\gamma = \sigma_{\gamma\gamma} + \sigma_{\gamma\gamma'}$



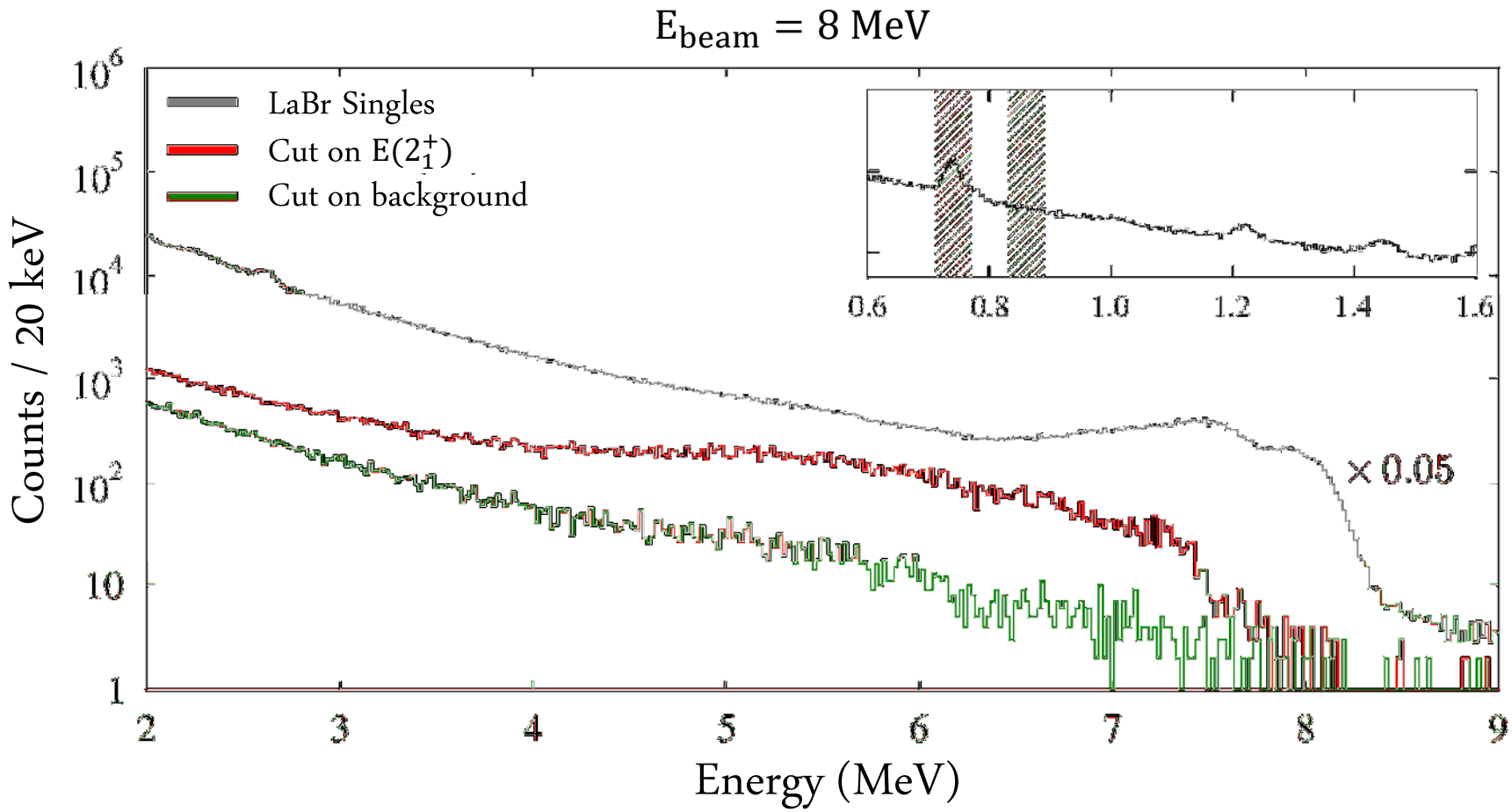
Reminder


$(\vec{\gamma}, \gamma'\gamma'')$
100 % polarized
$1^{\pm}$
2_1^+
0_1^+
coincident measurement

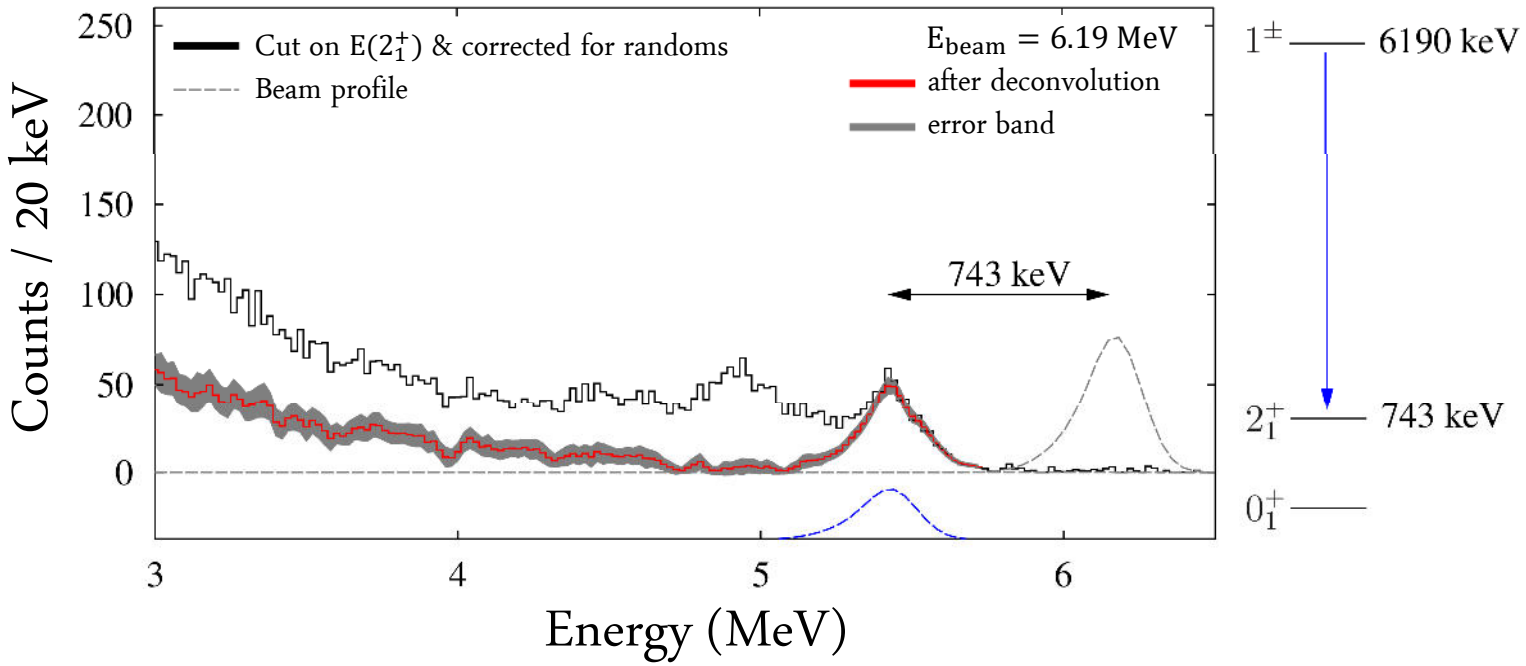
γ-γ coincidence



γ-γ coincidence

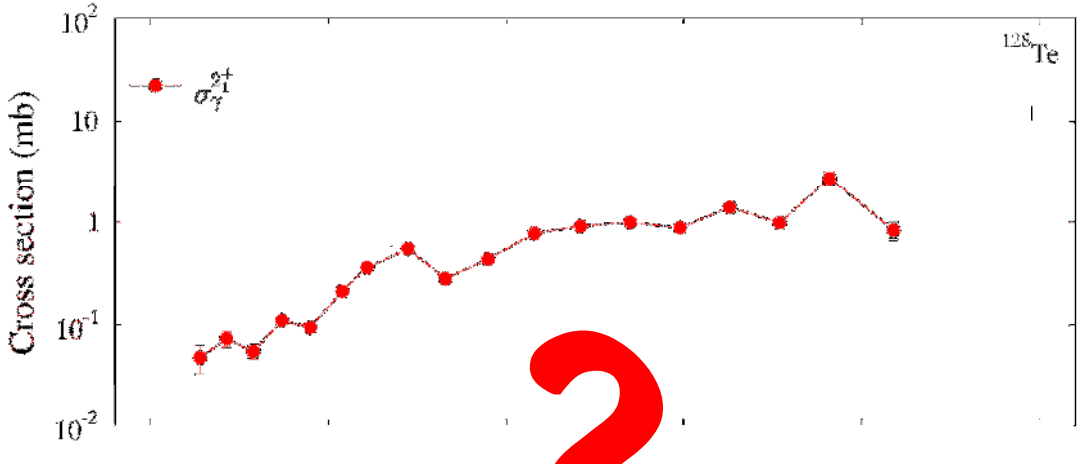


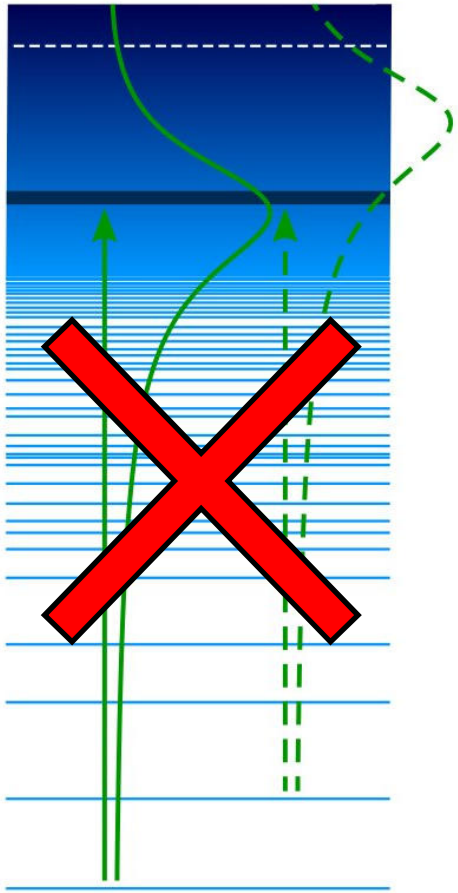
γ-γ coincidence



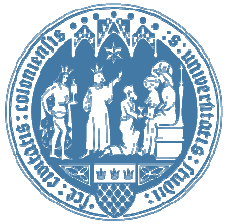
γ-γ coincidence

- photoabsorption on 0_1^+ and 2_1^+





Thank you!



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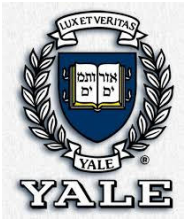

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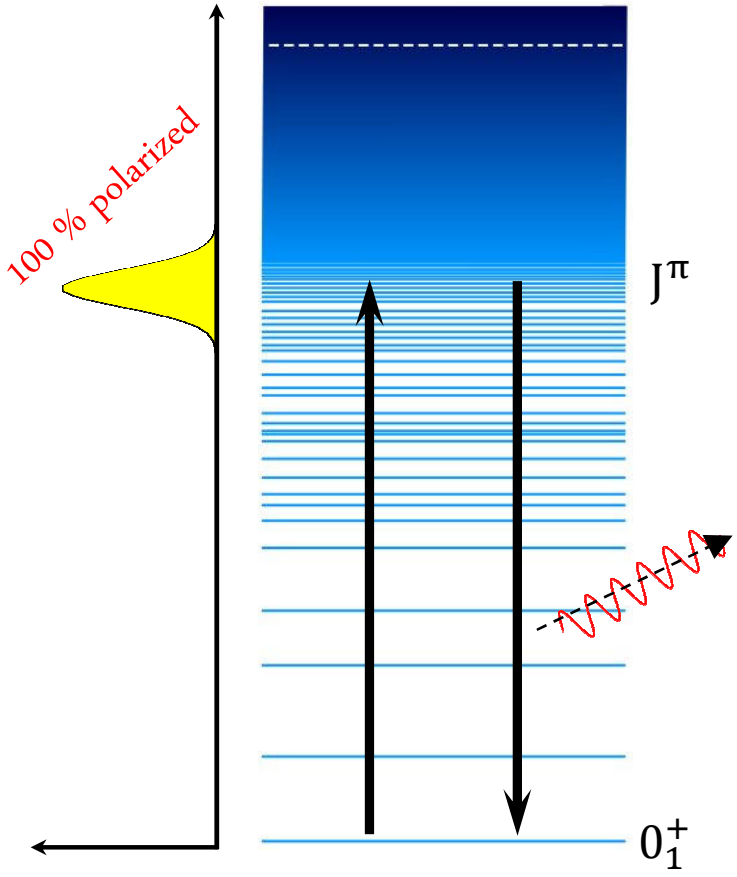
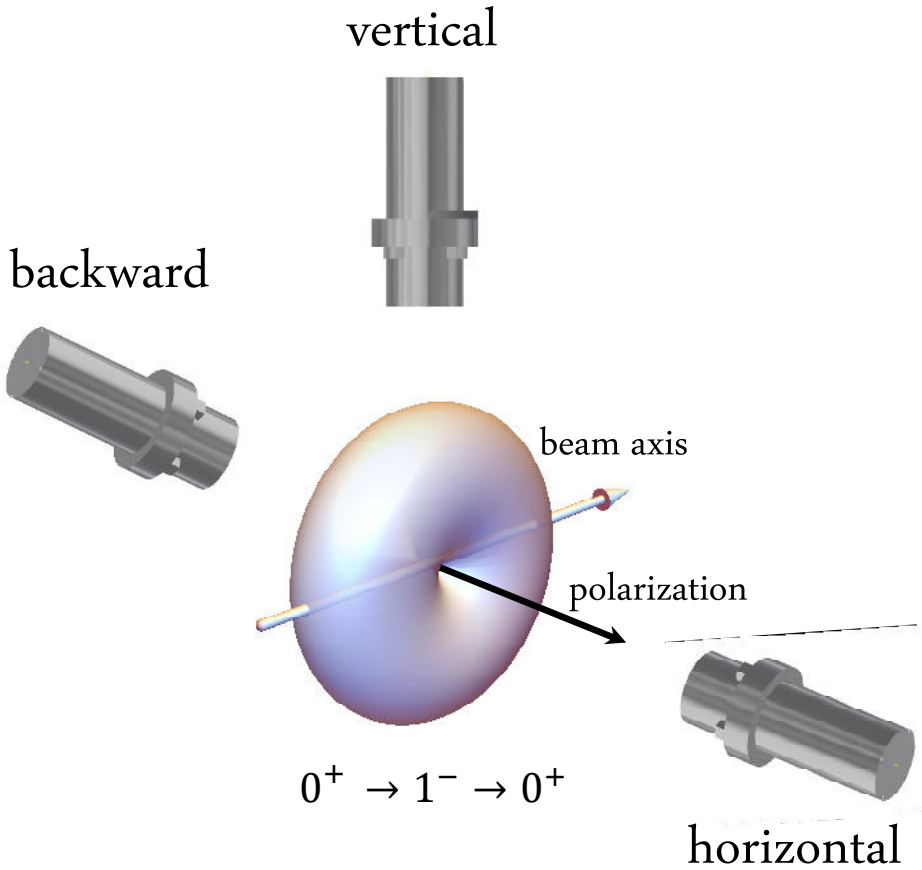
(HA216/EMMI) and by the Deutsche Forschungsgemeinschaft (SFB 634 and ZI 510/4-2)

γ- spectroscopy

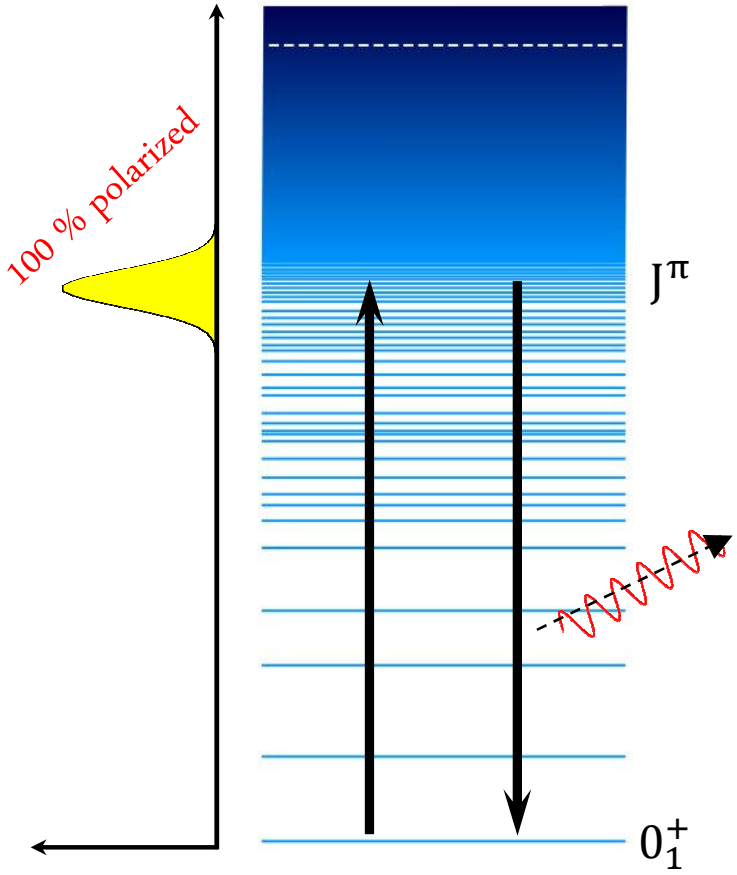
transition character

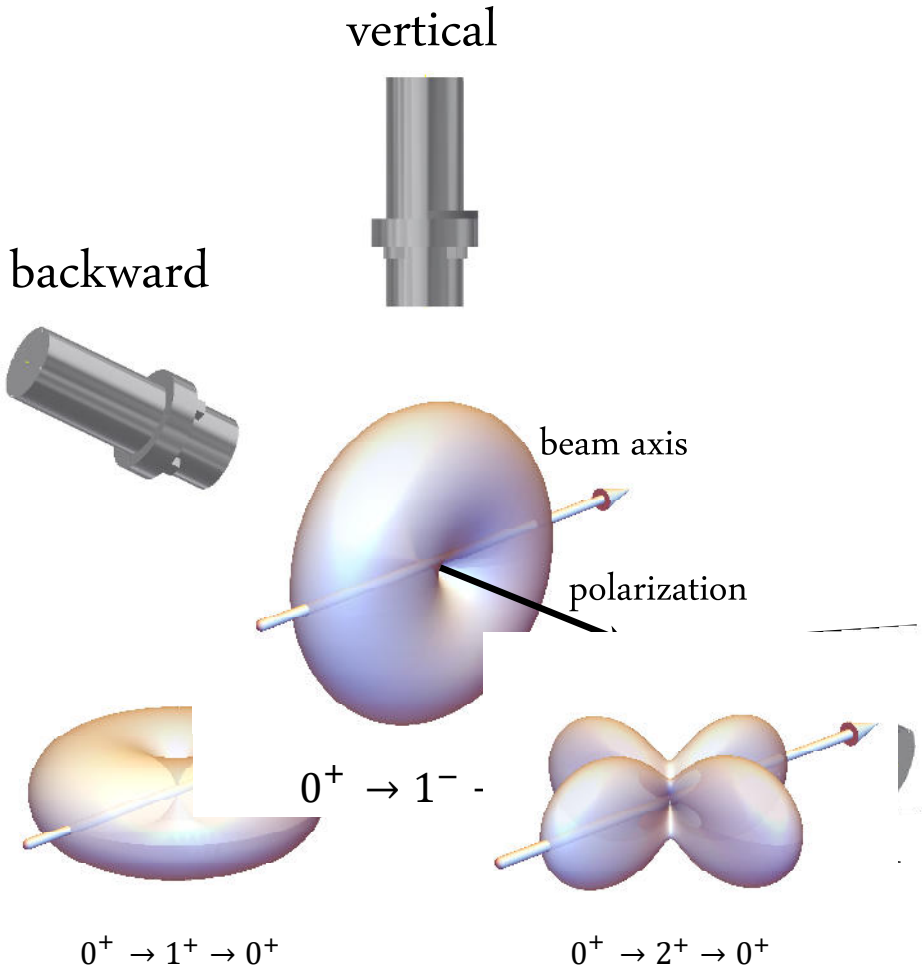




γ- spectroscopy

transition character





γ- spectroscopy

- transition character: M1/E1 ratio