Complete dipole response in ^{120}Sn from polarized proton scattering

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- Motivation
- Proton scattering experiment at RCNP
- Spectra
- Separation of M1/E1 strength
- Outlook

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Motivation

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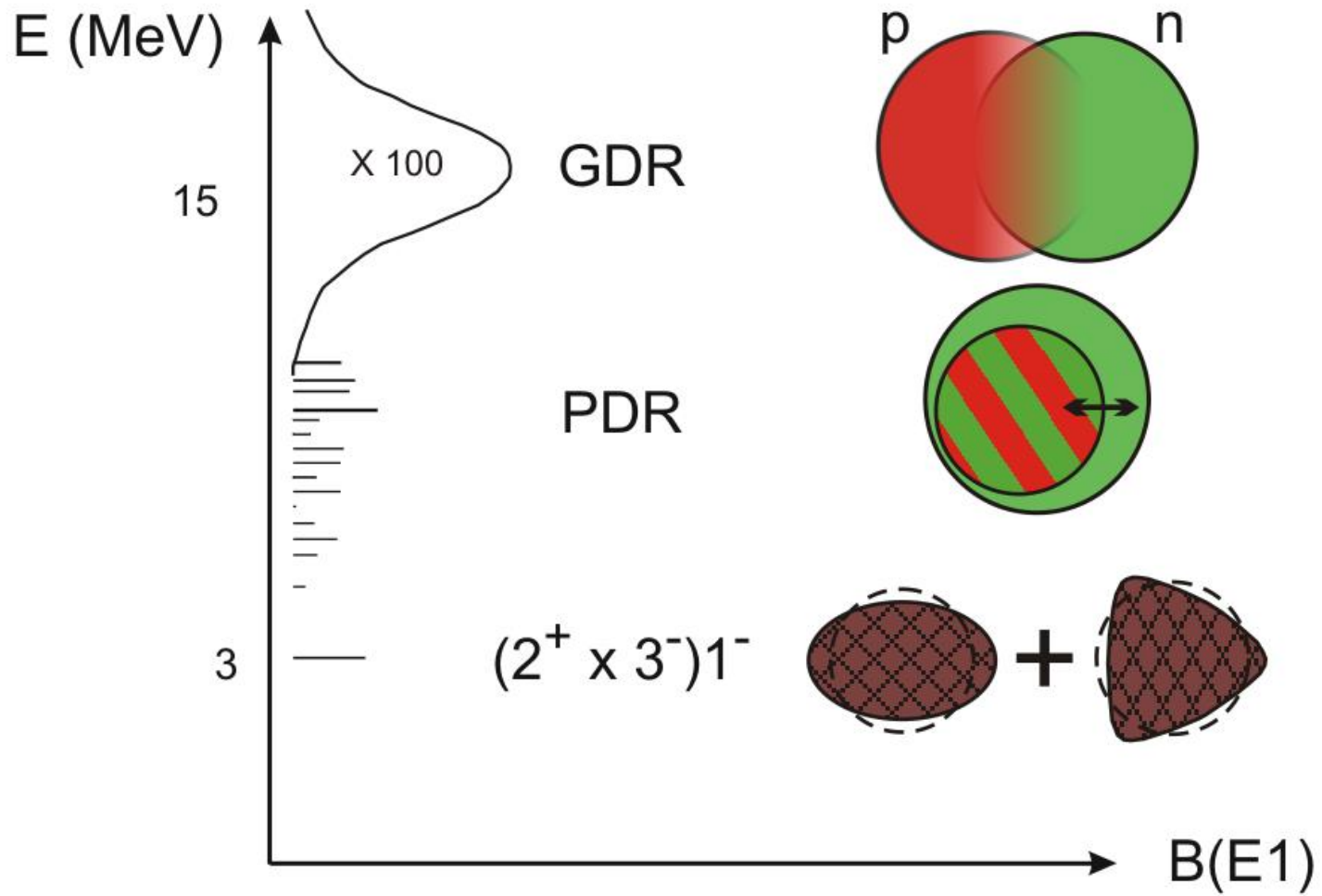

Electric pygmy dipole resonance (PDR)

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- PDR: resonance-like structure, typically close to neutron threshold
- Strength related to neutron excess
  - measure of neutron skin
  - measure of the density dependence of the asymmetry energy
- Strength distribution around neutron threshold relevant for nucleosynthesis (r-process, p-process)

Classical Method: Nuclear Resonance Fluorescence

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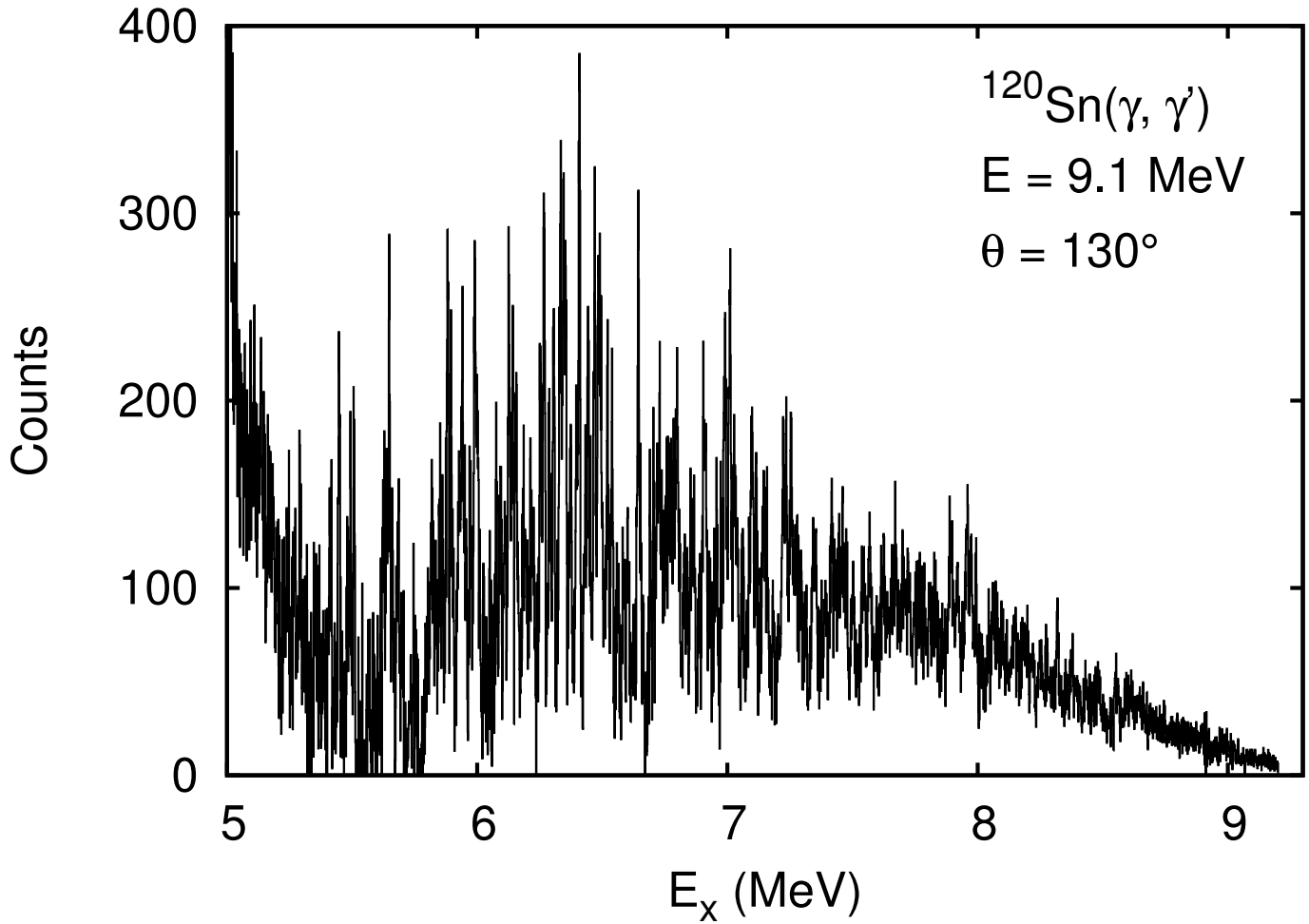

B. Özel et al., Nucl.Phys. A 788 (2007) 385.

Experimental problems

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- **Missing strength**
  - (γ, γ') reaction measures strength (roughly) up to threshold only
  - Experimental quantity $\Gamma_0 \cdot \frac{\Gamma_0}{\Gamma}$
  - assumption in most analyses: $\frac{\Gamma_0}{\Gamma} = 1 \rightarrow$ **lower limit**
  - alternatively correction with statistical model calculation $\rightarrow$ **upper limit**
- Motivation for new experiment

New experimental access by $(\vec{p}, \vec{p'})$ at 0°

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- Complete B(E1) strength from Coulomb excitation
- high resolution (30 keV @ 300 MeV)
- Spin-isospin excitations
  $\rightarrow$ at 0° selectivity on ΔL=0 transitions (spinflip M1)
- Effective separation of E1 and M1 cross sections
  $\rightarrow$ two independent methods
  - analysis of the angular distribution
  - polarization transfer observables (D_{LL} and D_{SS})

Separation of E1/M1 strength

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Two independent methods

- Multipole decomposition of angular distributions
  - depends on DWBA model
  - using wave functions from QPM calculation
  - measurements at different angles up to 4°

- Separation by polarization transfer observables
  - distinguishes spinflip and non-spinflip
  - model independent
  - measurement with polarized beam with two setups necessary
  - → **Talk by Johannes Simonis (HK 36.6)**

RCNP facility

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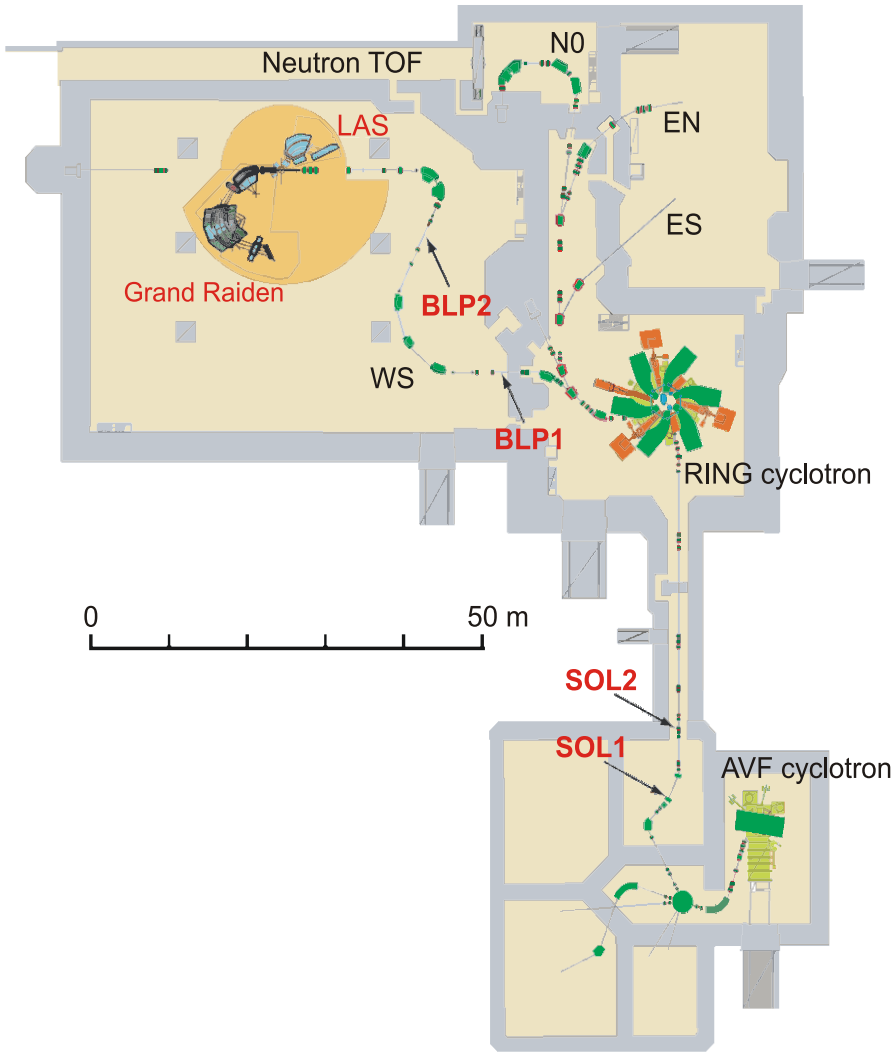

- 295 MeV
- beam intensity 2-3 nA
- high resolution
- degree of polarization: 70%

Spectrometer at RCNP facility longitudinal polarization setup

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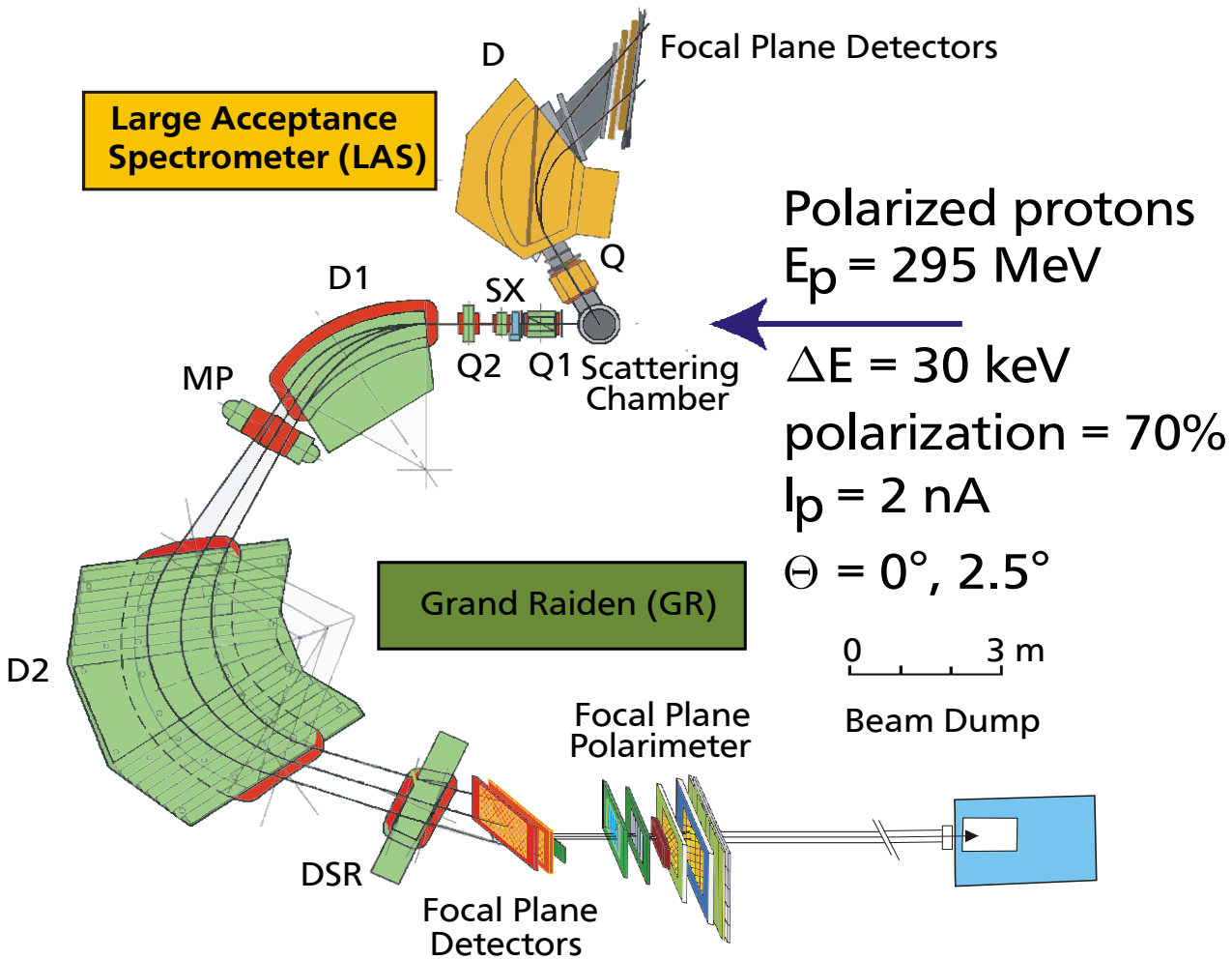
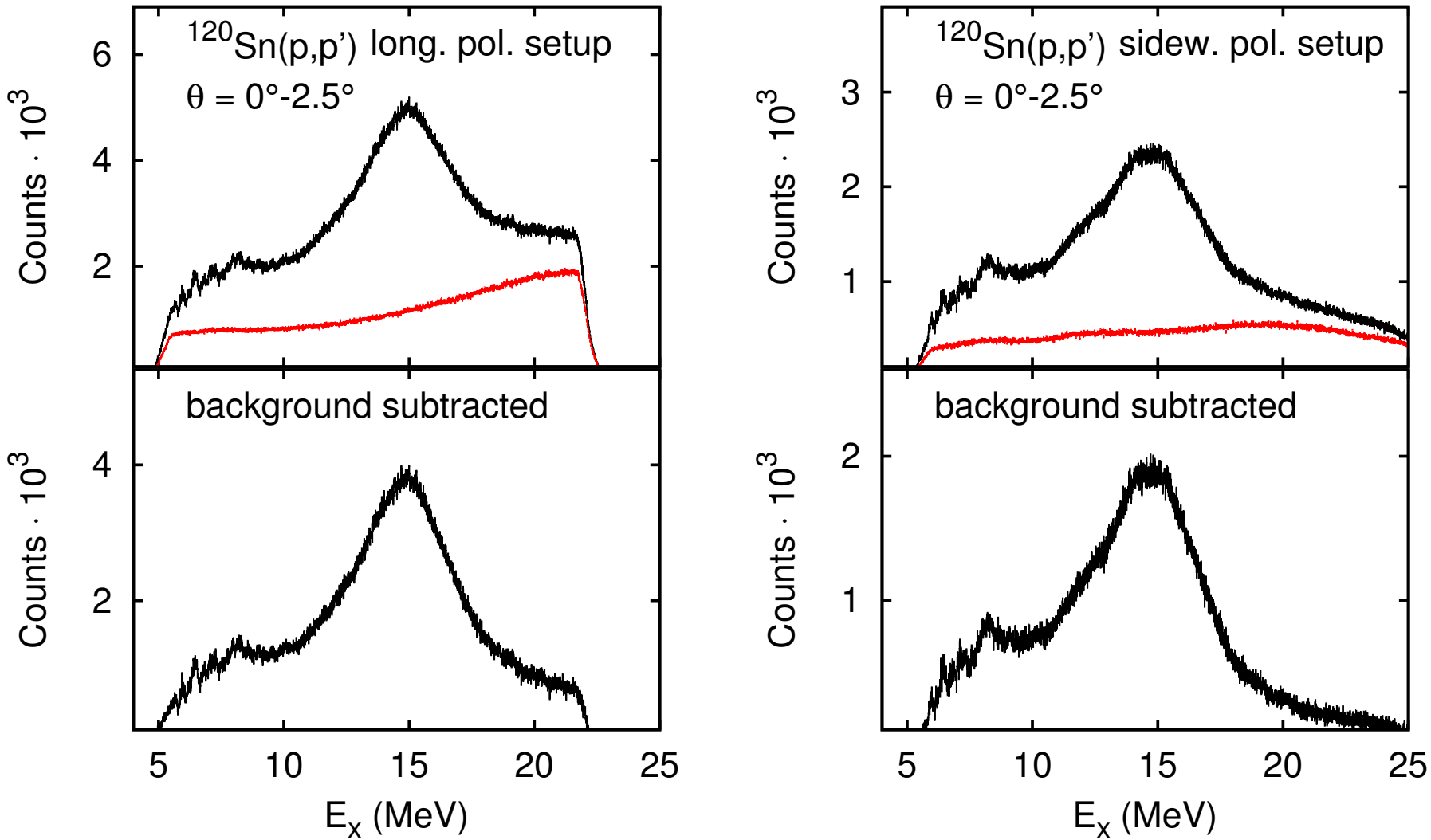


Spectra of ^{120}Sn(p,p')



Spectra of ^{120}Sn(p,p')

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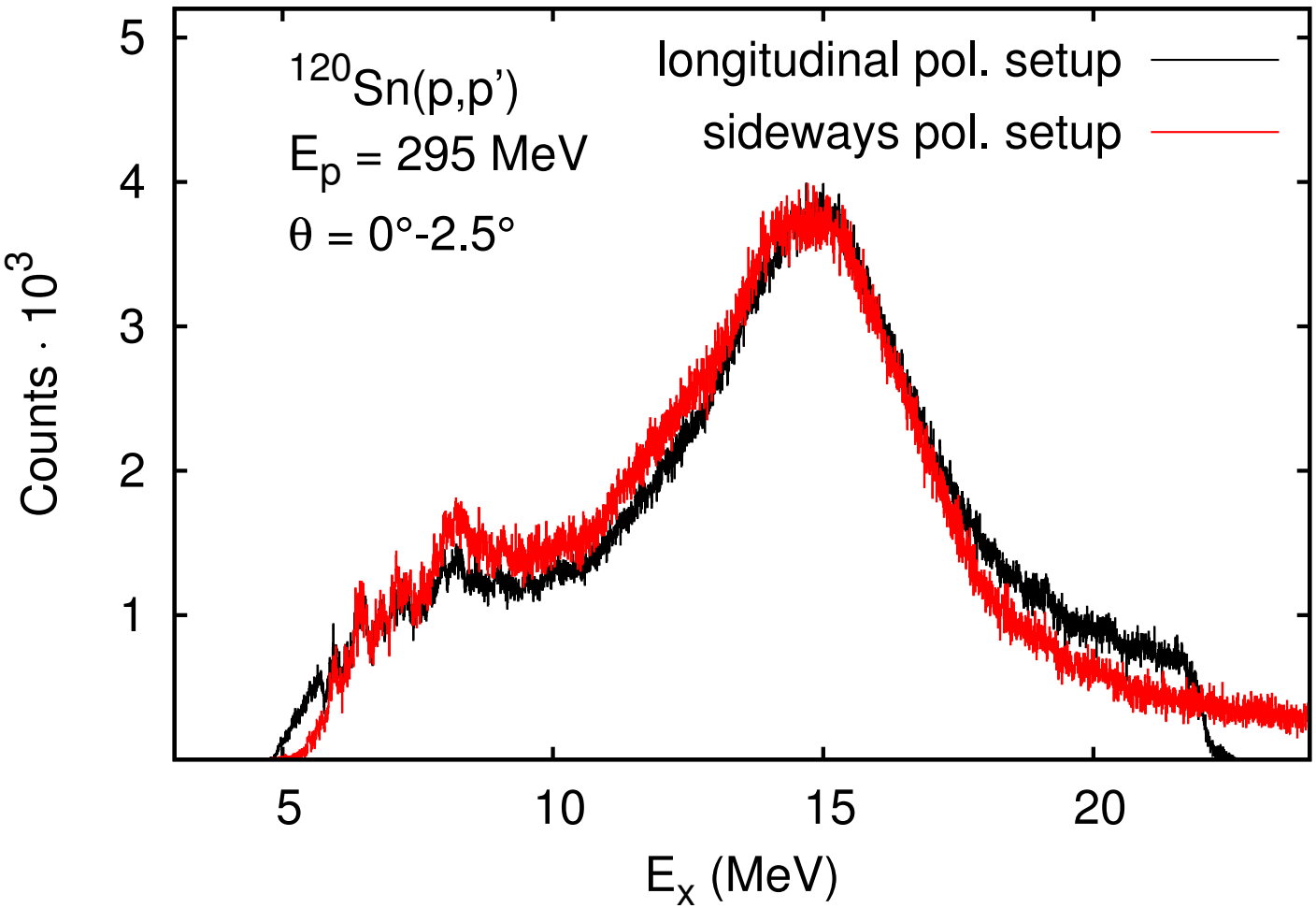

Comparison with γ,γ' experiment

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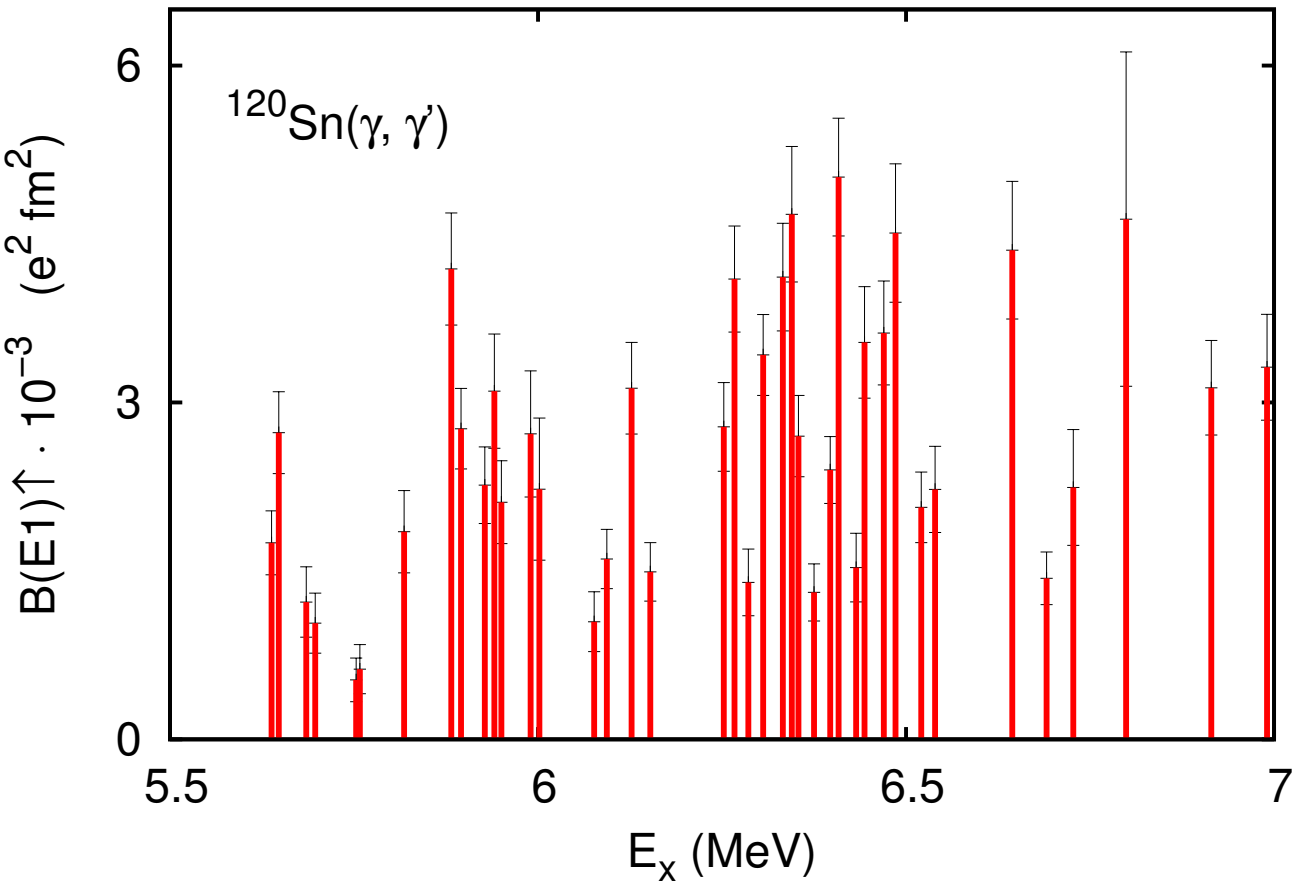
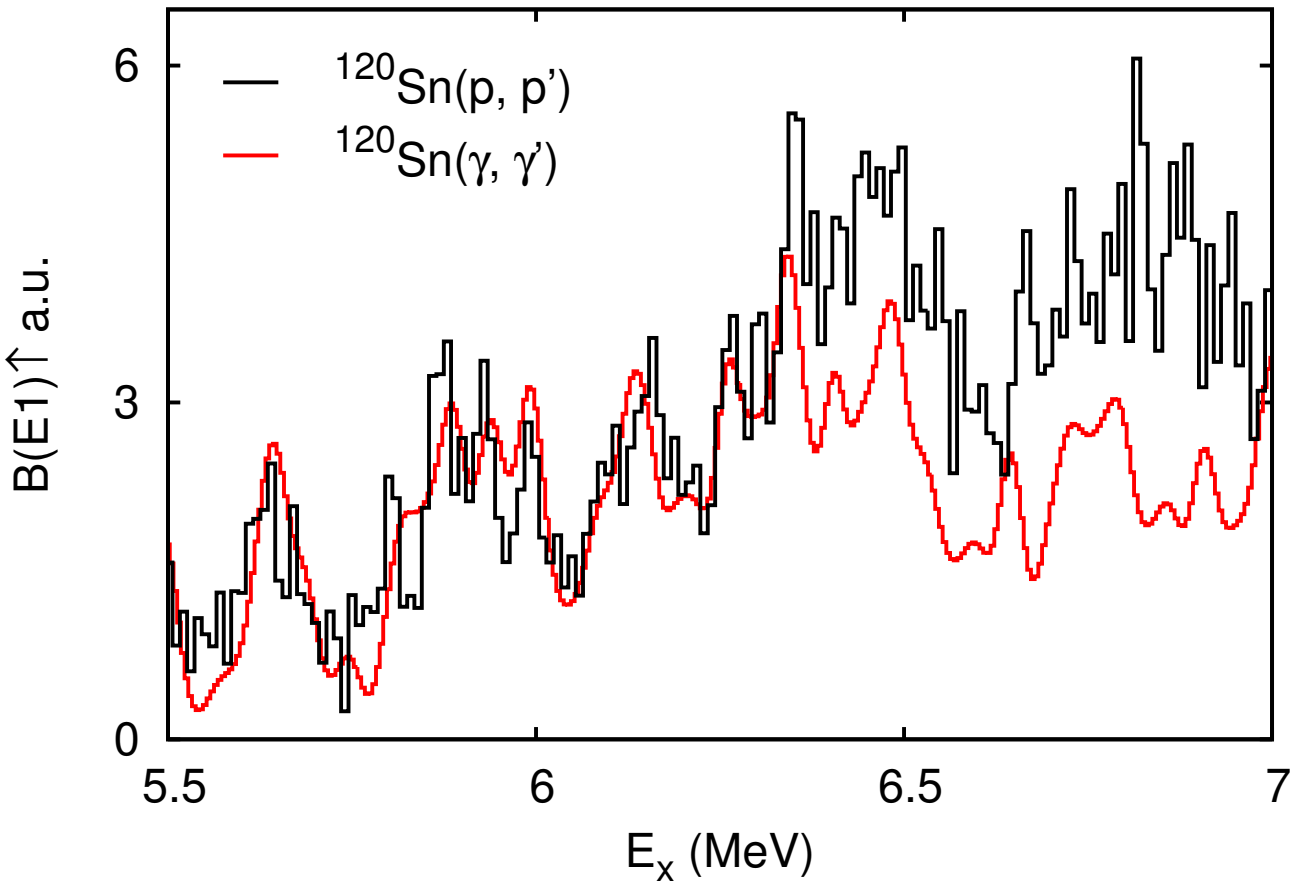


- ^{120}Sn(γ,γ') data from B. Özel

Comparison with γ,γ' experiment



- ^{120}Sn(γ,γ') data folded with ΔE= 30 keV

Multipole Decomposition of Angular Distributions

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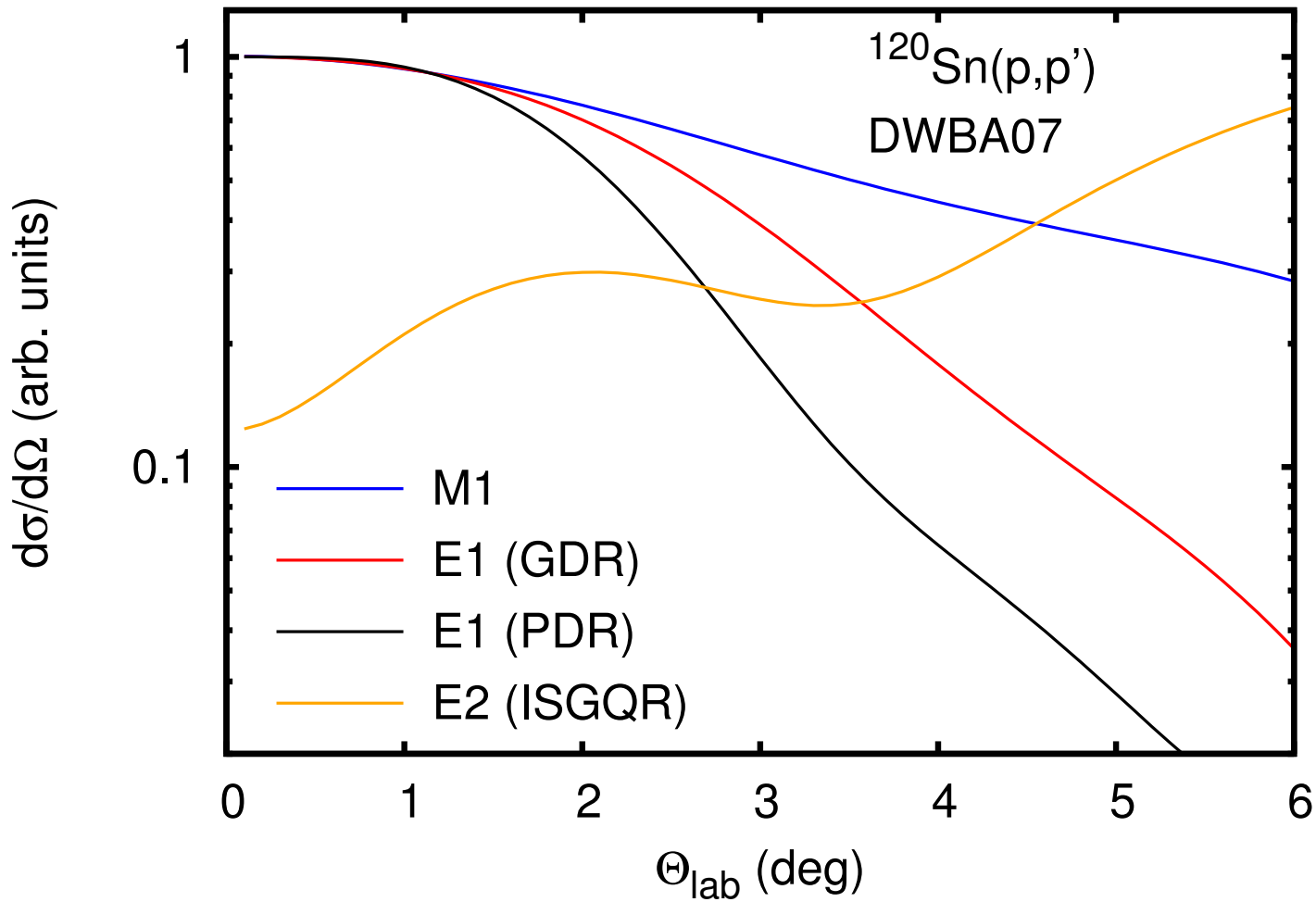

Example of Multipole Decomposition of Angular Distributions in ^{208}Pb

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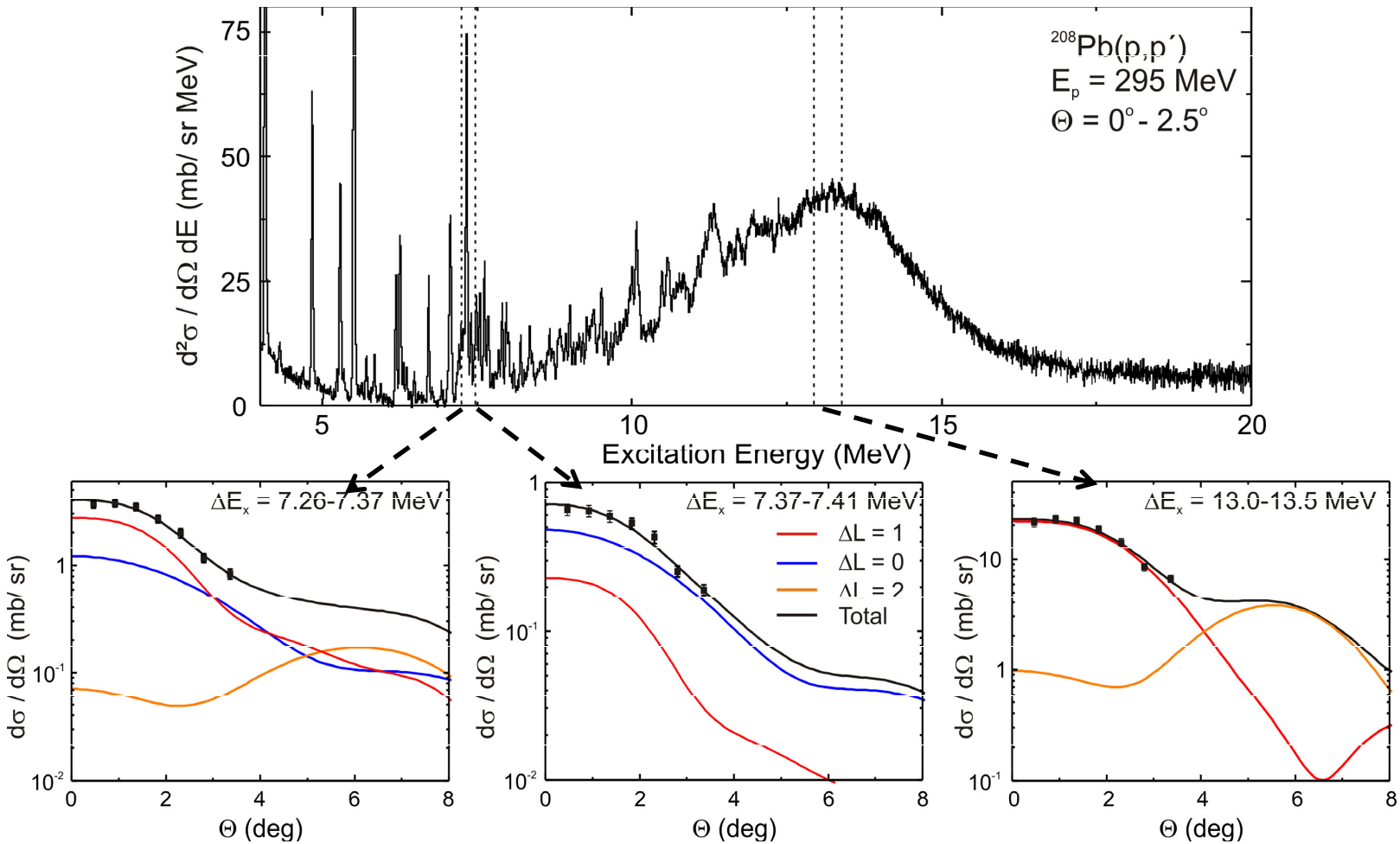

I.Poltoratska, Doctoral Thesis, TU Darmstadt (2011).→ **HK 13.7**

Outlook

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- extraction of the differential cross sections and multipole decomposition
- analysis of polarization transfer
- identification of M1 excitations
- comparision with theoretical models
- $\rightarrow$ better understanding of the pygmy dipole resonance

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