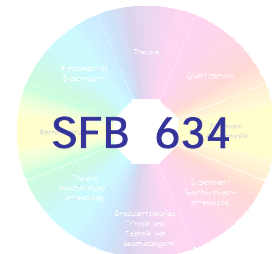


The Photoresponse of Atomic Nuclei: Collective Excitations and Photodissociation

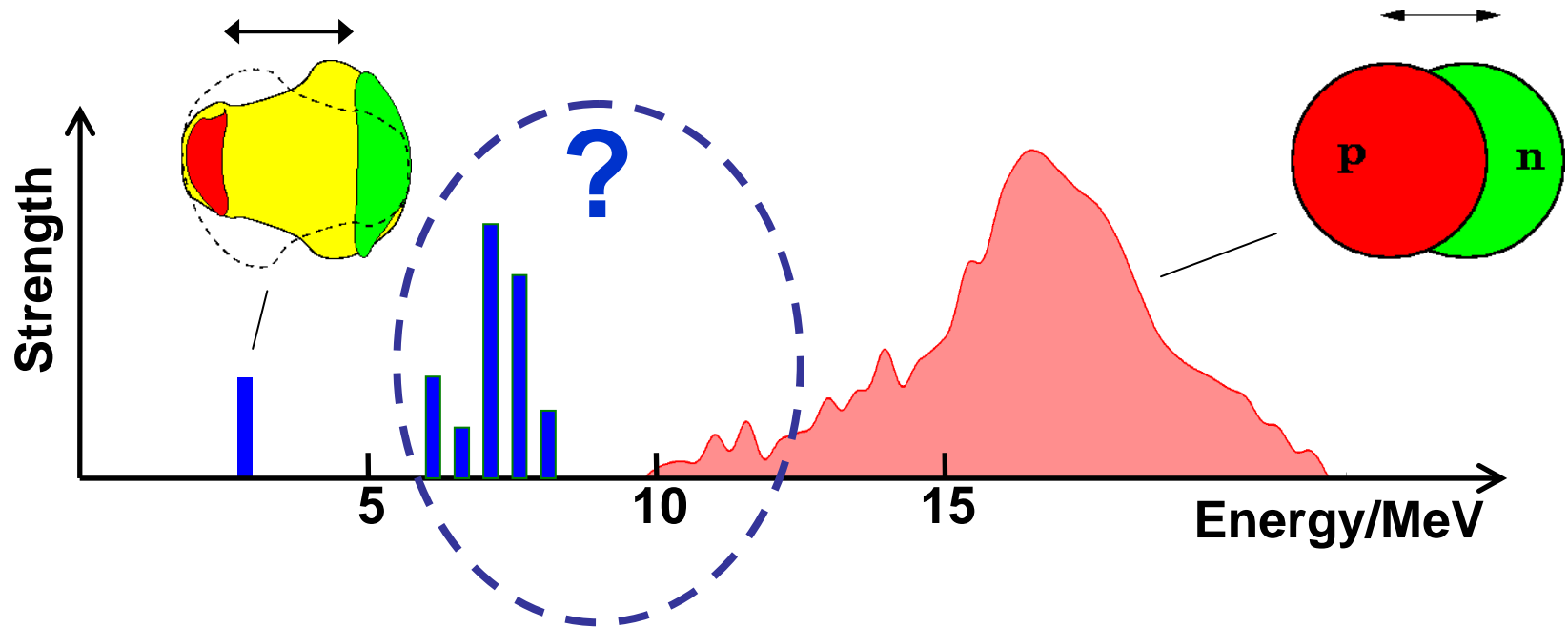
- The photoresponse of atomic nuclei
- The Pygmy Dipole Resonance
- Outlook



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Institut für Kernphysik
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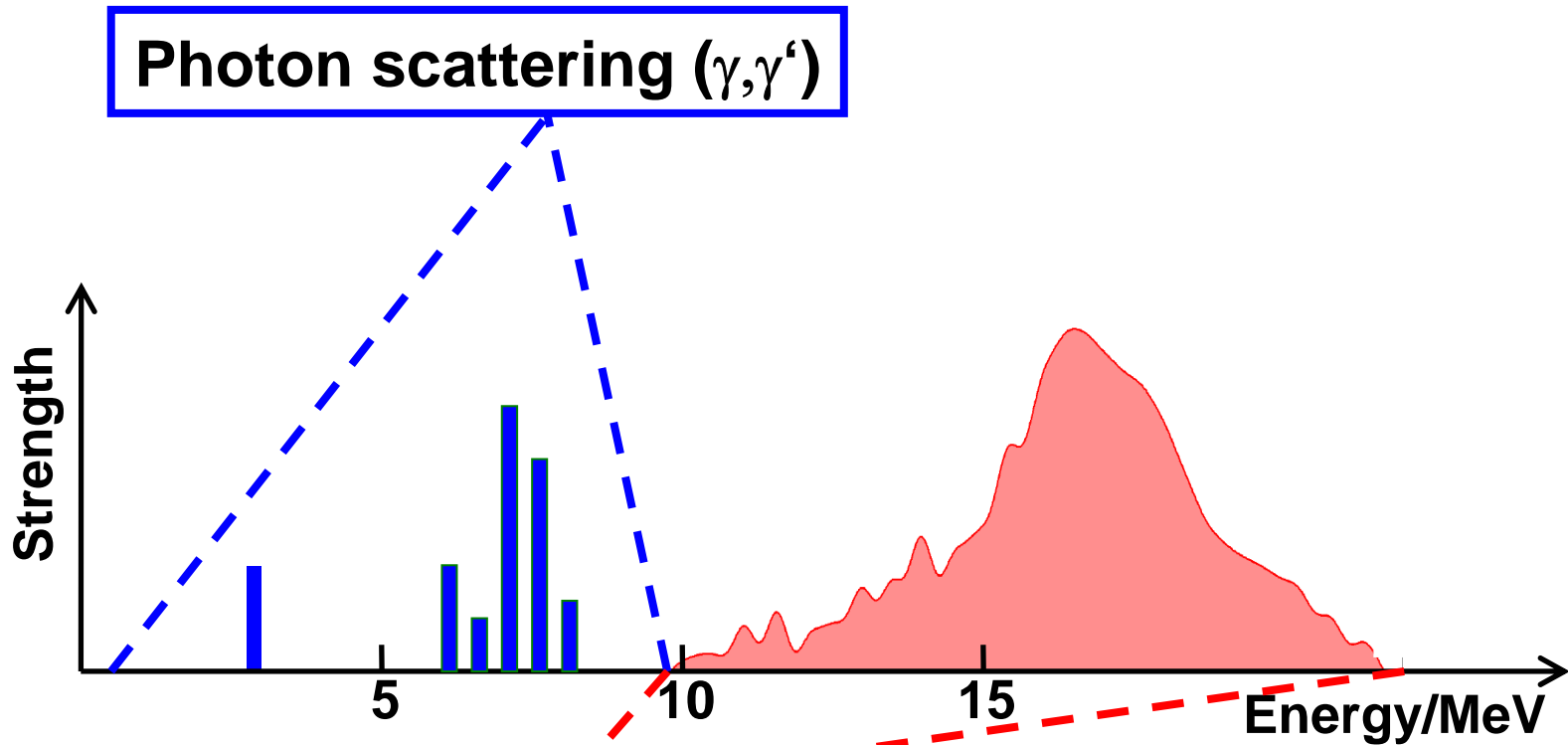


The photoresponse of atomic nuclei – E1 strength



- **Two Phonon Excitation:** $E_x \sim 3$ MeV, $B(E1) \sim 10^{-2}$ W.u.
- **Giant Dipole Resonance:** $E_x \sim 18$ MeV, $B(E1) \sim 10$ W.u.
- **Pygmy Dipole Resonance ?**
 - F. Iachello, PLB 160 (1985) 1
 - G. Colò et al., PLB 485 (2000) 362
 - D. Vretenar et al., PLB 487 (2000) 334

Experimental tools



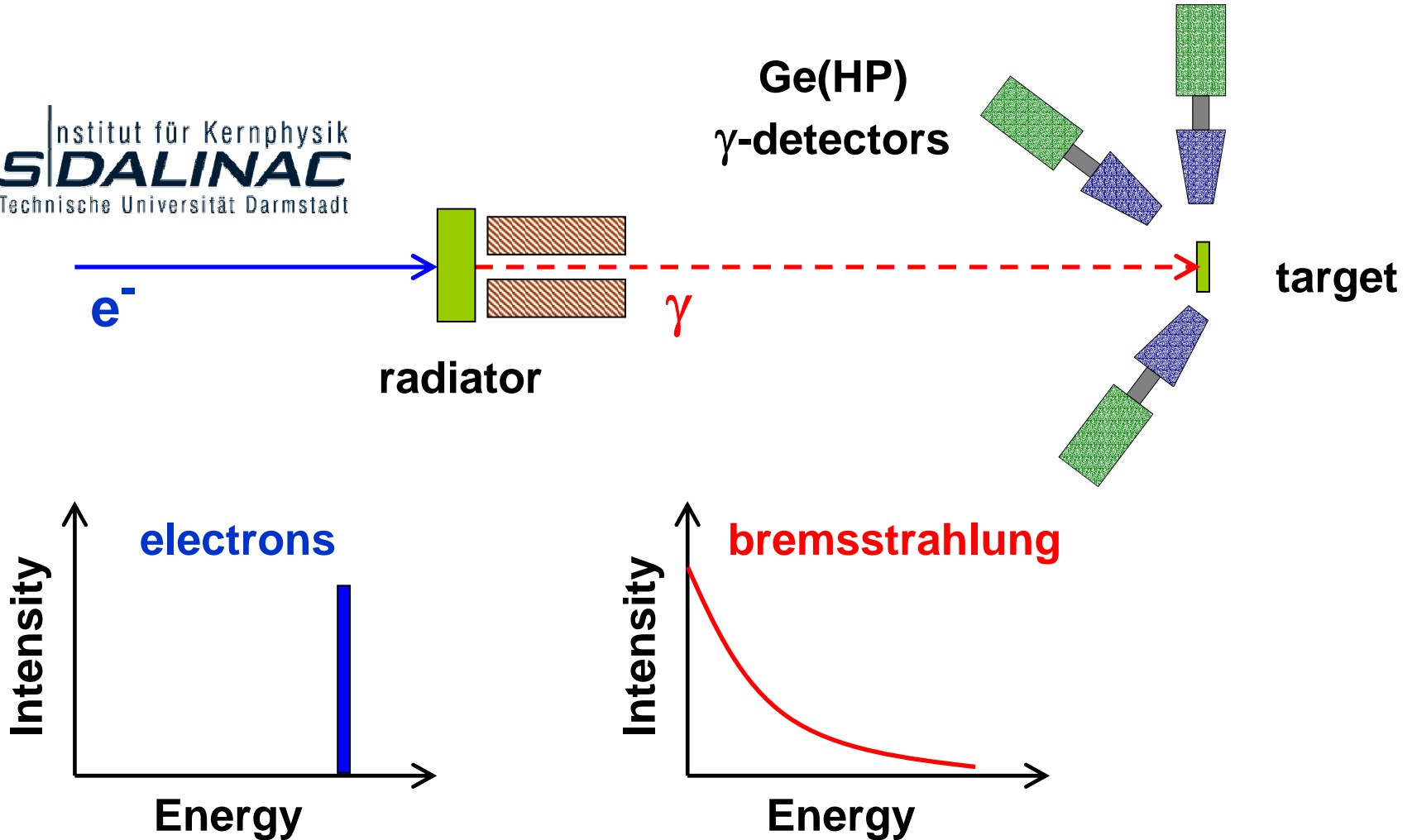
Photodissociation (γ, n)

Real and virtual photons can be used for excitation!

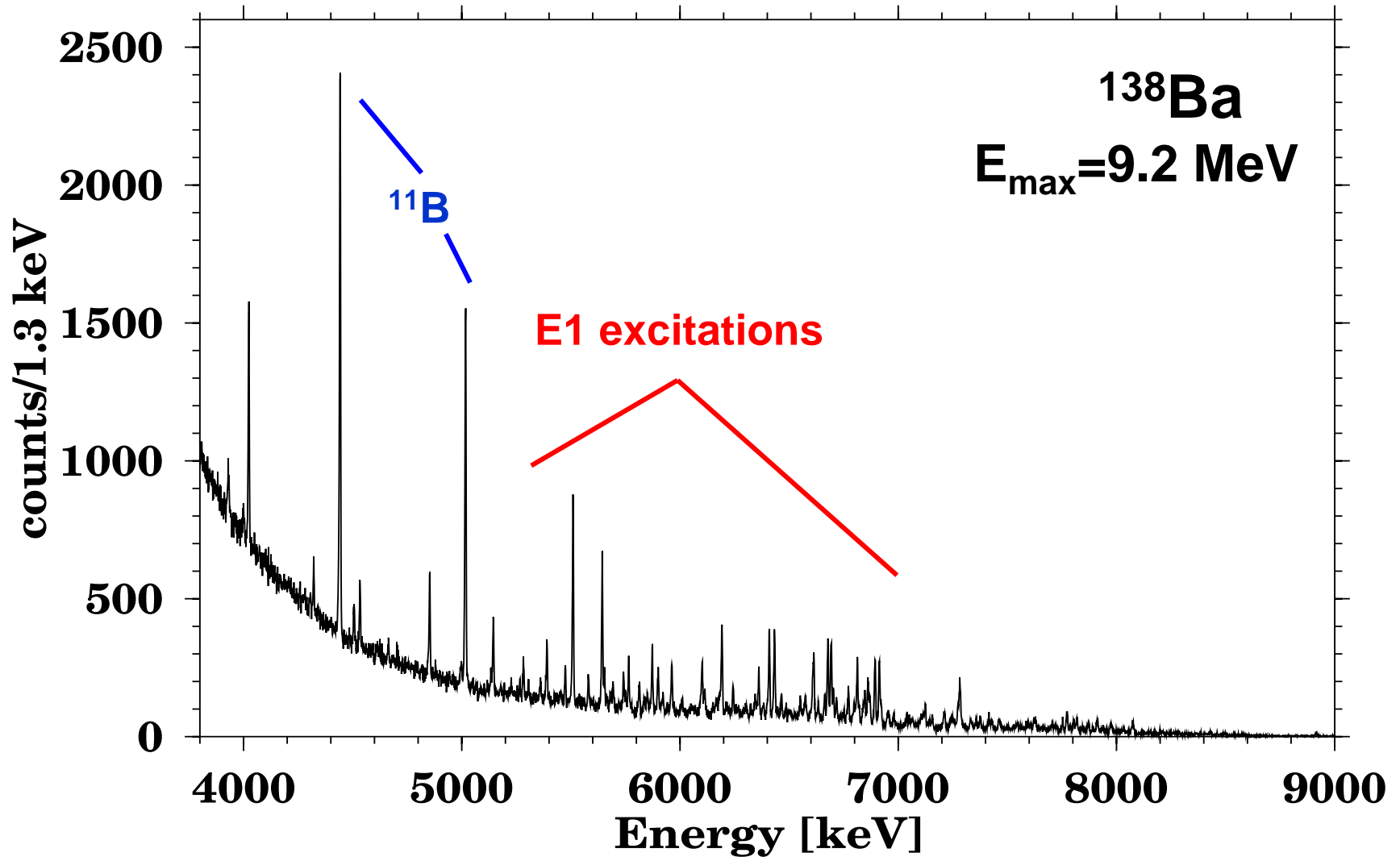
→ GSI experiments: K. Boretzky et al.

Photon Scattering (Nuclear Resonance Fluorescence – NRF)

Institut für Kernphysik
SIDALINAC
Technische Universität Darmstadt

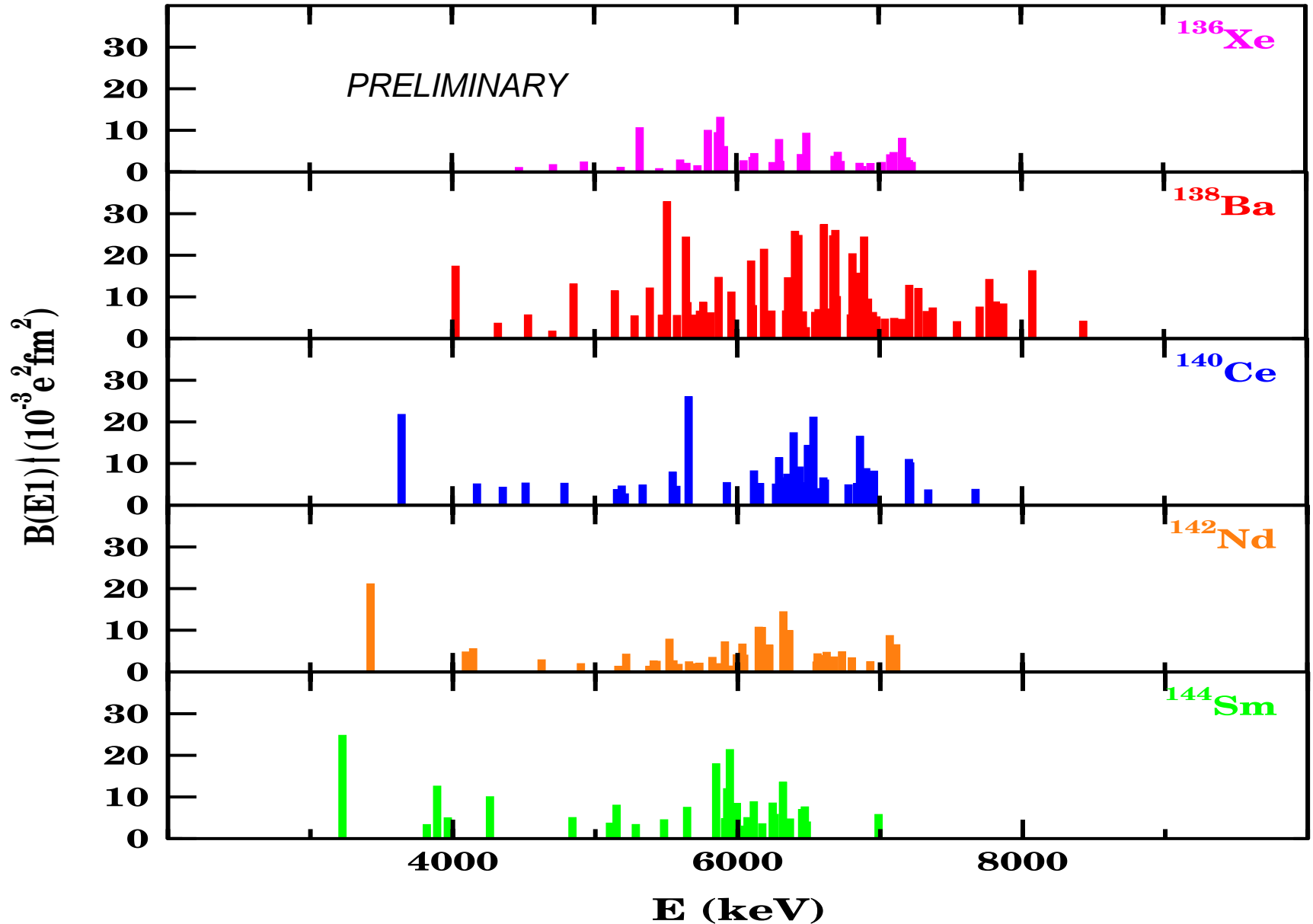


Photon scattering off ^{138}Ba

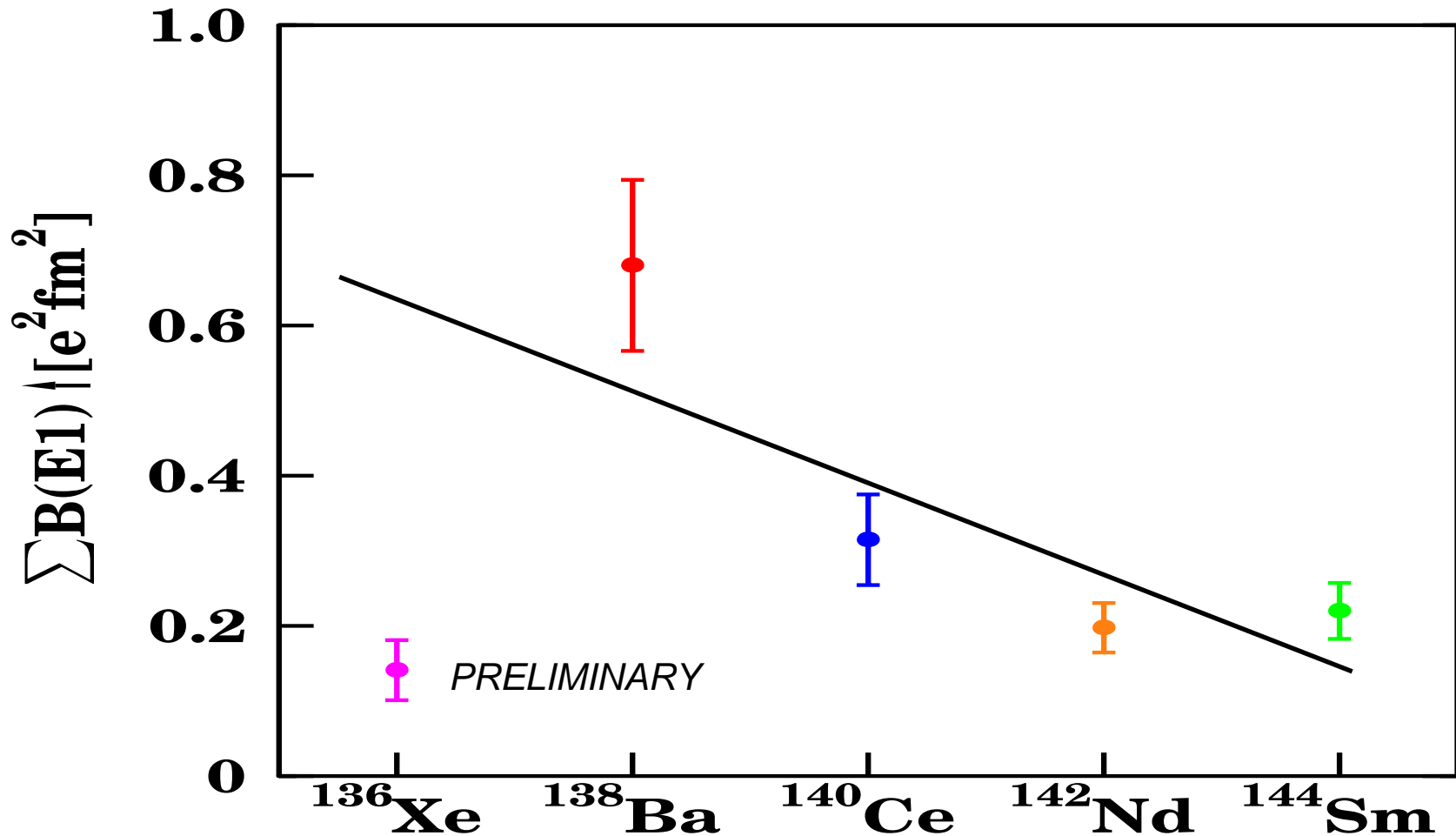


A. Z. et al., *Phys. Lett. B* **542** (2002) 43

E1 strength distribution in N=82 nuclei

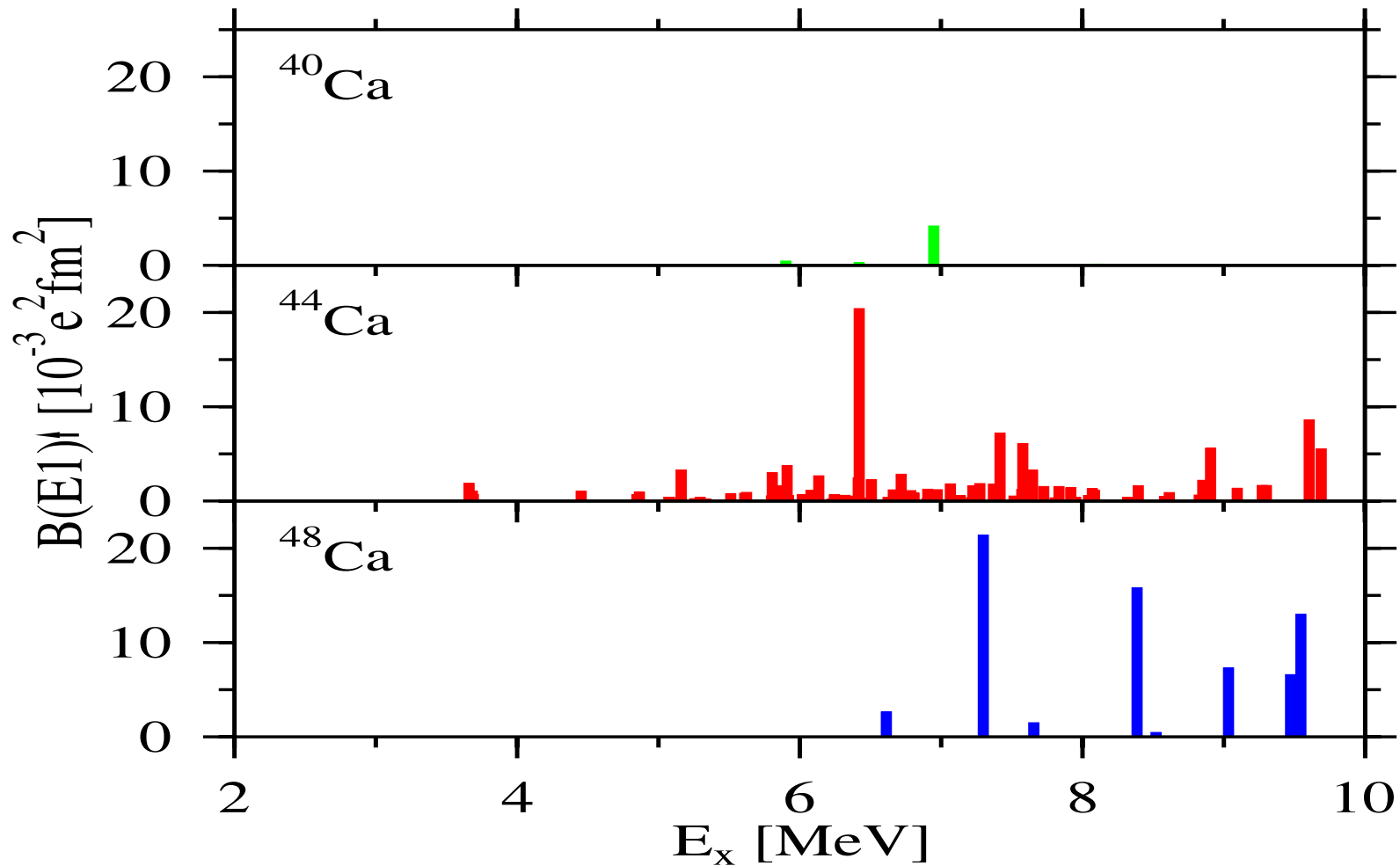


E1 strength below 9 MeV in N=82 nuclei



A. Z. et al., *Phys. Lett. B* **542** (2002) 43, and
S. Volz et al., to be published

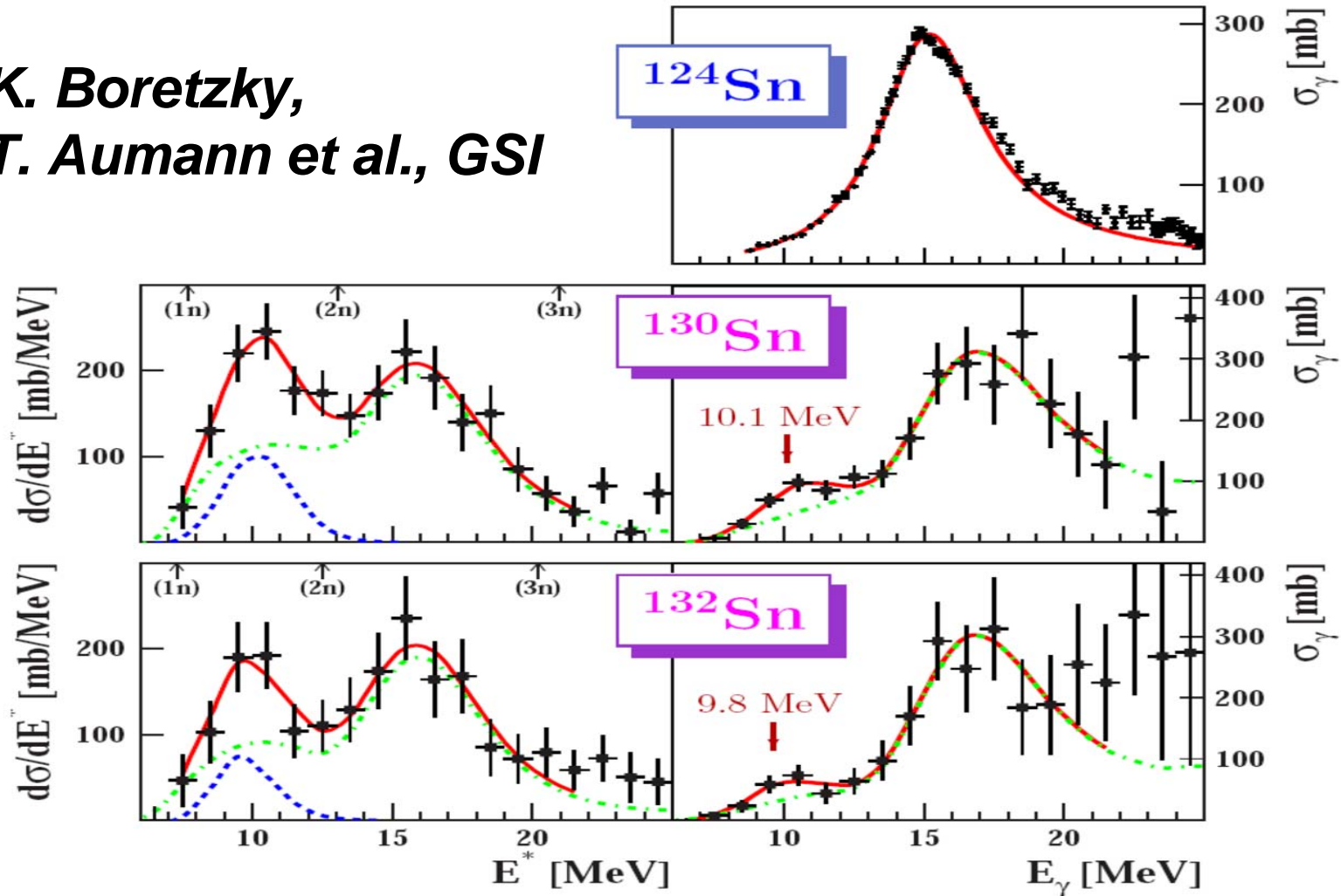
E1 strength distribution in Ca isotopes



*T. Hartmann et al., PRL 93 (2004) 192501,
PRC 65 (2002) 034301,
PRL 85 (2000) 274*

E1 strength in exotic nuclei

**K. Boretzky,
T. Aumann et al., GSI**



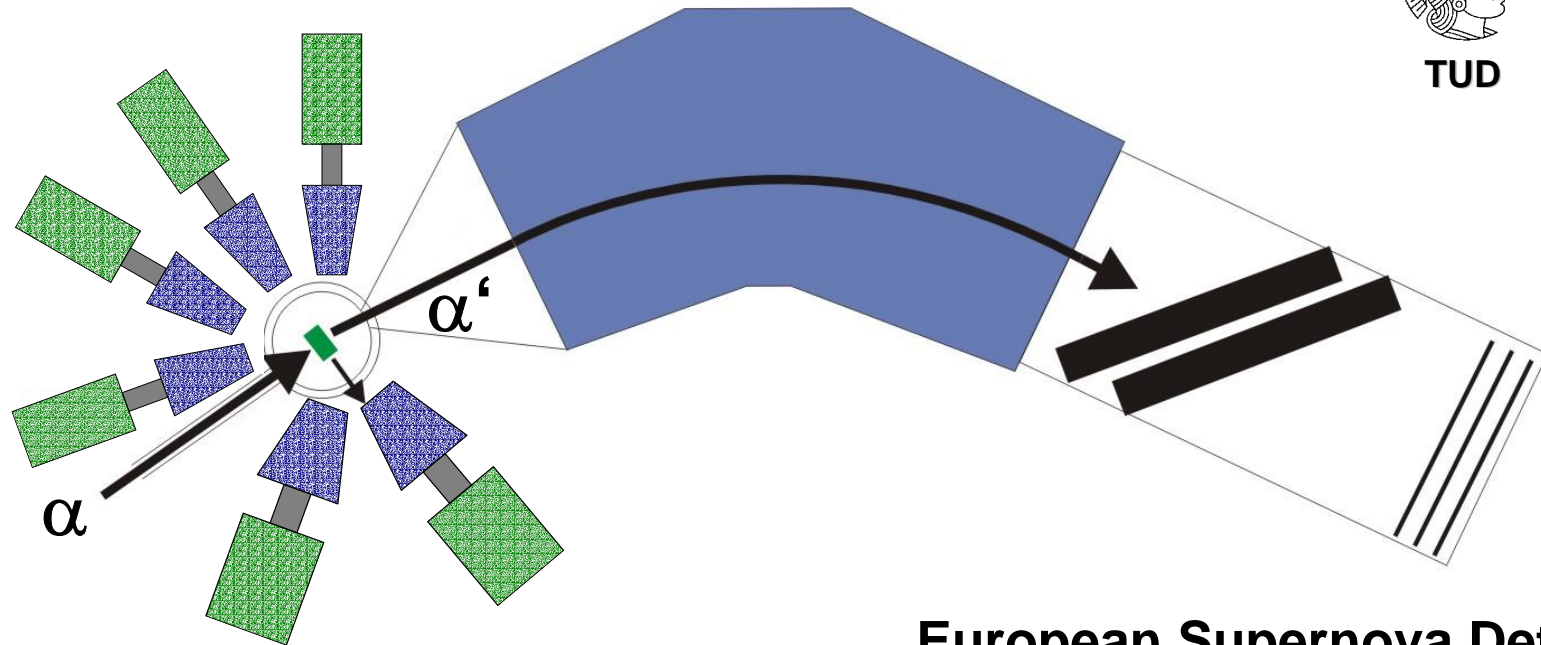
(Coulex on $^{18,20}\text{O}$: E. Tryggestad et al., PRC 67 (2003) 064309)

Summary

- An E1 resonance exhausting up to 1% of the EWSR is observed in all examined stable nuclei around about 7 MeV
- We do not know the complete systematics, the isospin character, the decay pattern and the form factor of these states
- More resonance like strength is found above the particle threshold in n-rich systems
- We do not understand the connection between the strength below and above the threshold and the strength in stable and exotic nuclei

The new ISOSPIN setup at KVI

Big Bite Spectrometer (BBS)

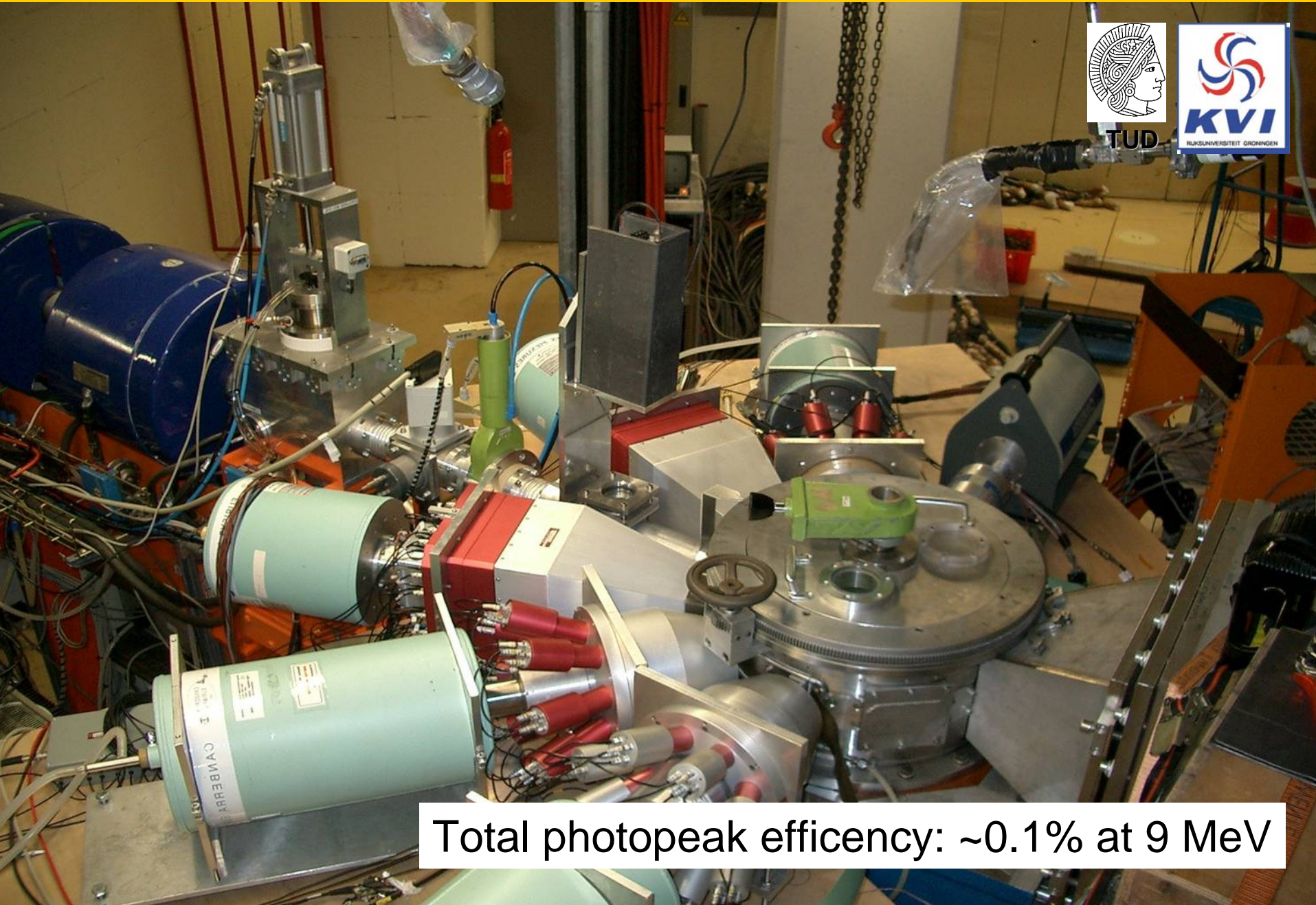


Ge detector array
for detection of γ decays

European Supernova Detector
for detection of α particles,
 $\Delta E \sim 100\text{-}200$ keV

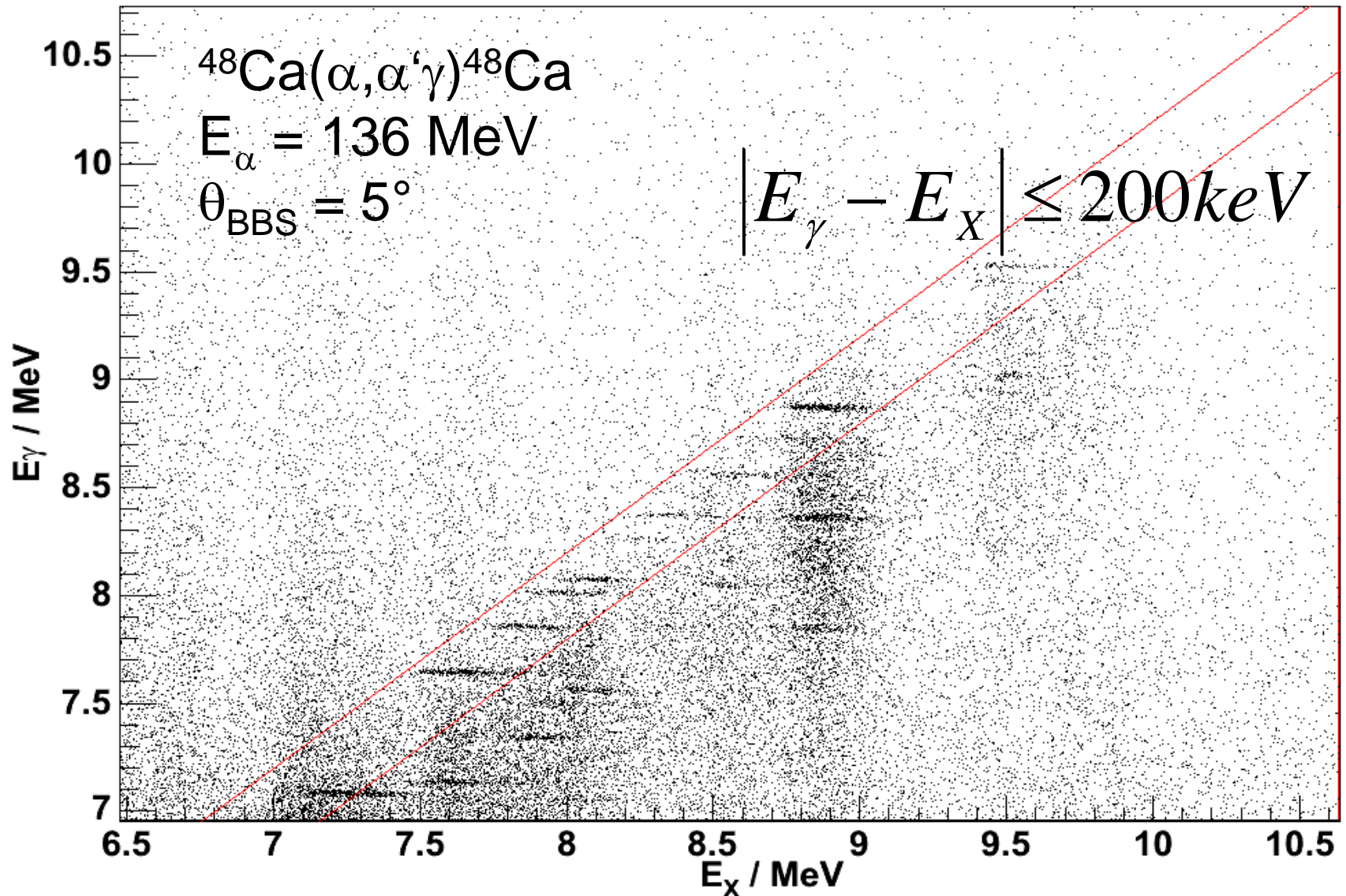
**This setup allows to determine
the isospin character of bound states !**

The new ISOSPIN setup at KVI

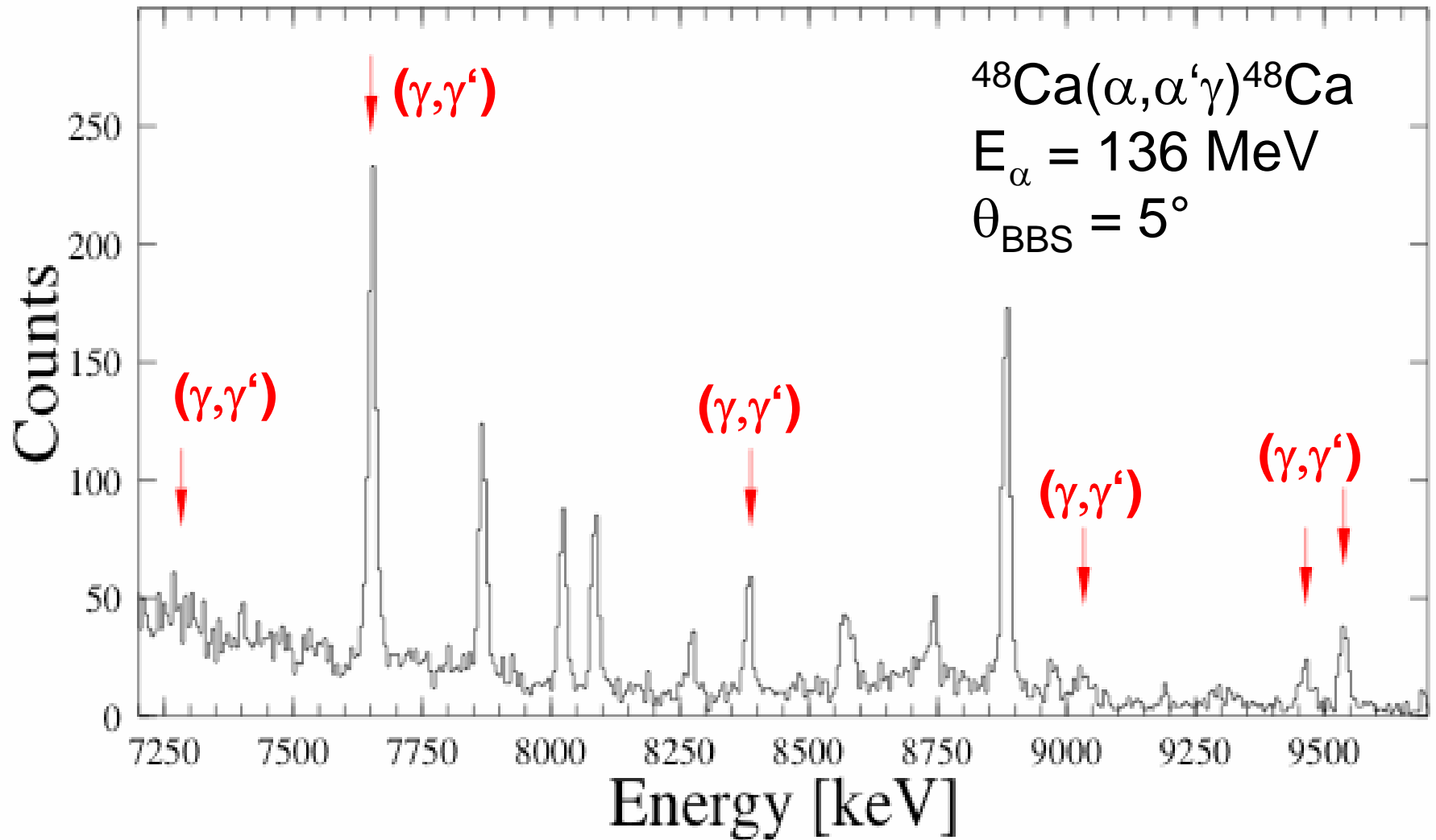


Total photopeak efficiency: $\sim 0.1\%$ at 9 MeV

Investigation of E1 strength in ^{48}Ca

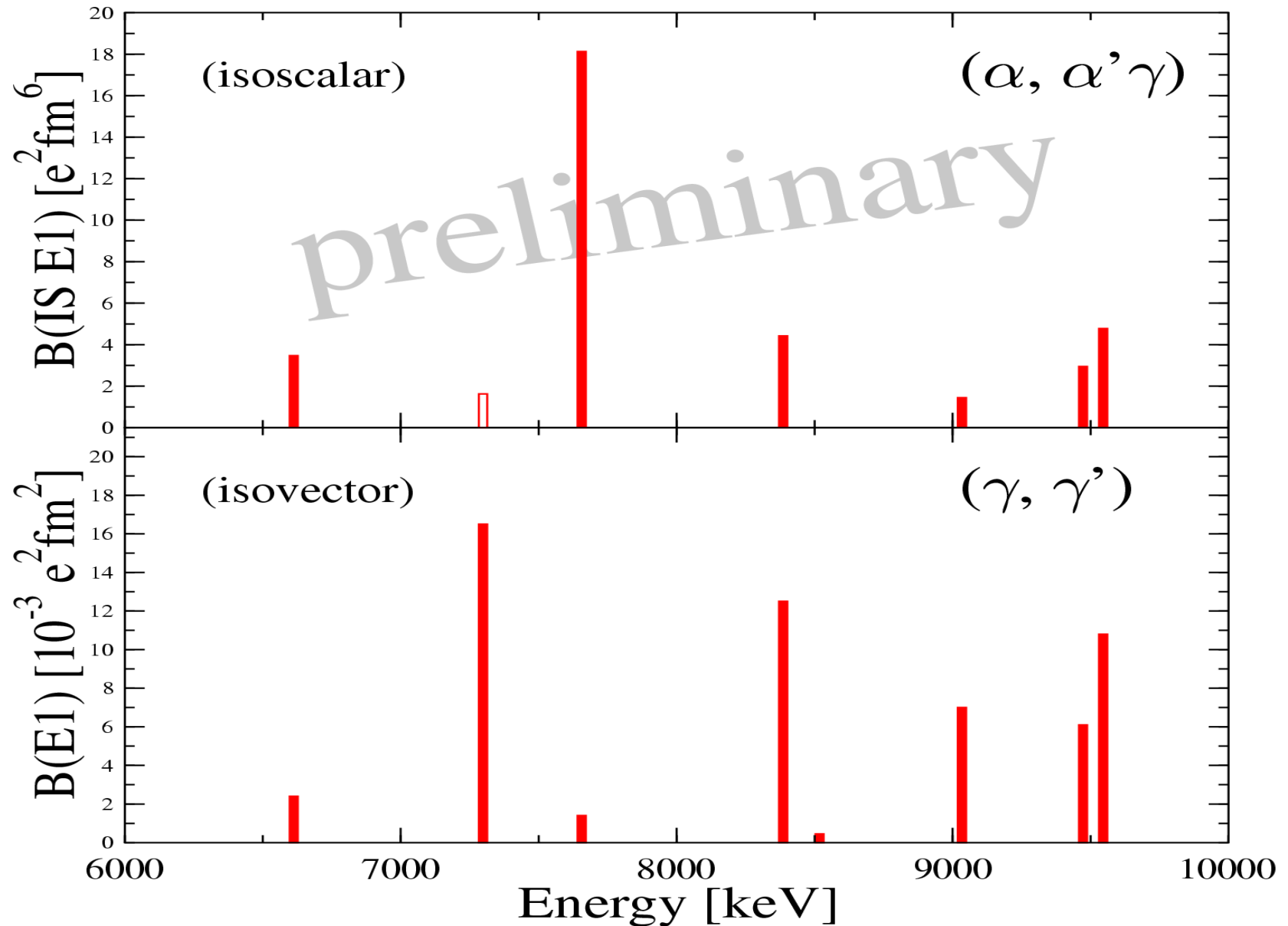


Investigation of E1 strength in ^{48}Ca



D. Savran, H.J. Wörtche, M. Harakeh, K. Ramspeck, A. van den Berg, A.Z.

Investigation of E1 strength in ^{48}Ca



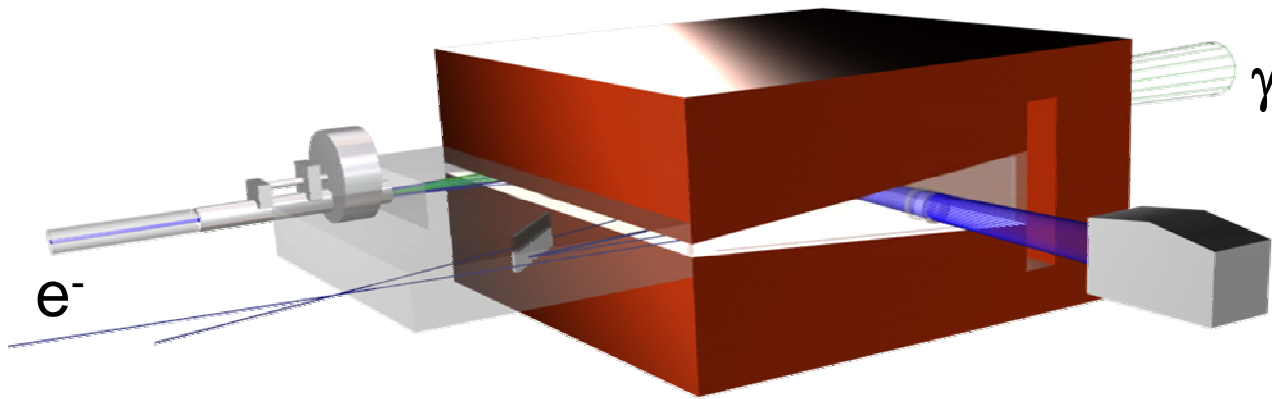
Summary

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Connection to E1 strength above the threshold in stable nuclei

Measurement of (γ, n) cross section in the tail of the GDR

High Resolution Photon Tagger @ S-DALINAC



- „Clam Shell“ magnet design
- scintillating fibres for electron detection
- energy resolution $< 0.25 \%$ for $8 \text{ MeV} < E_\gamma < 16 \text{ MeV}$

The Photoresponse of Atomic Nuclei: Collective Excitations and Photodissociation

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T. Hartmann, K. Lindenberg, S. Müller,
K. Ramspeck, D. Savran, K. Sonnabend, S. Volz**
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Supported by **DFG** (SFB 634)

More information and references: www.zilges.de

