One-phonon excitations in ^{92}Zr from electron scattering

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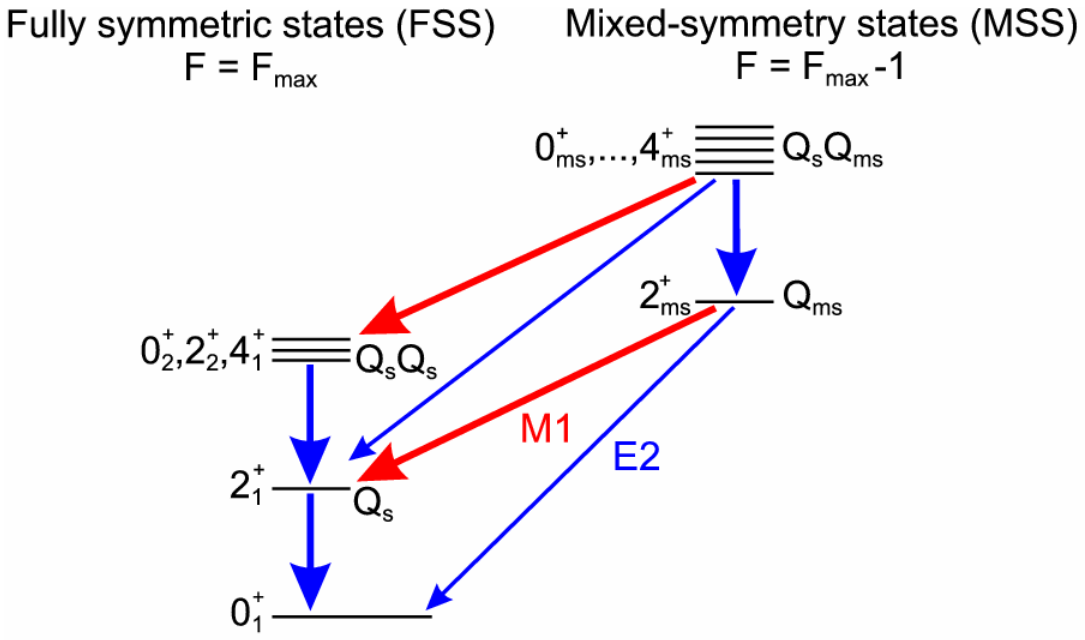
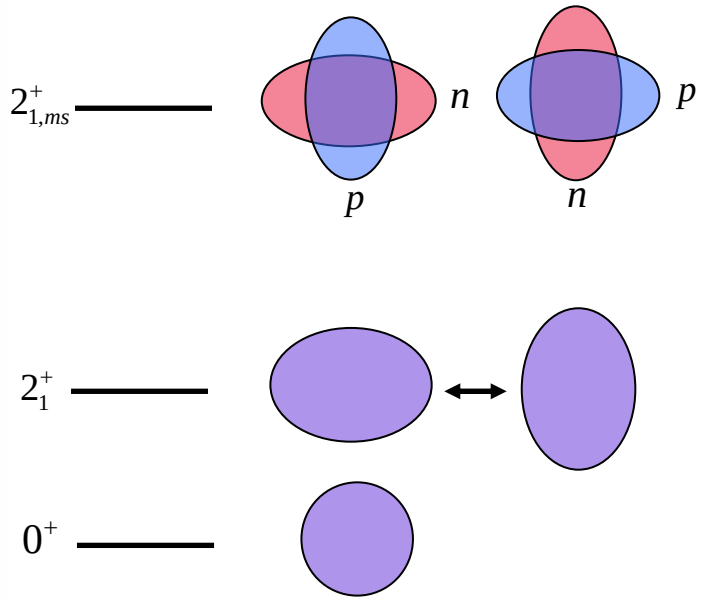
- Motivation
- Experiment
- Analysis and first results
- Summary and outlook

supported by DFG (SFB 634) and LOEWE (HIC for FAIR)

Motivation





- Strong E2 transitions for decay of Q_s-phonon
- Weakly collective E2 transitions for decay of Q_{ms}-phonon
- Strong M1 transitions for decay of MSS to FSS

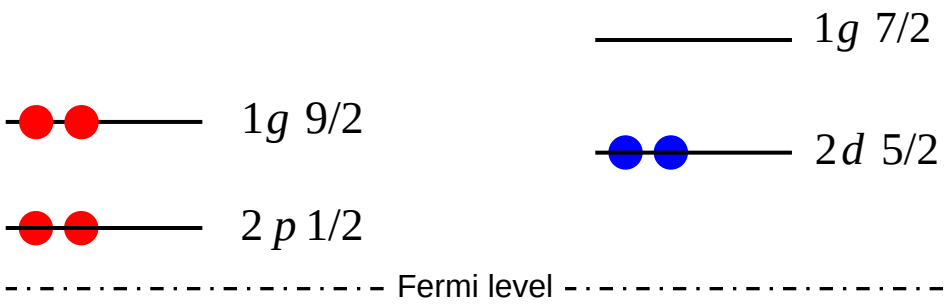
Fully confirmed for ^{94}Mo

From ^{94}Mo to ^{92}Zr

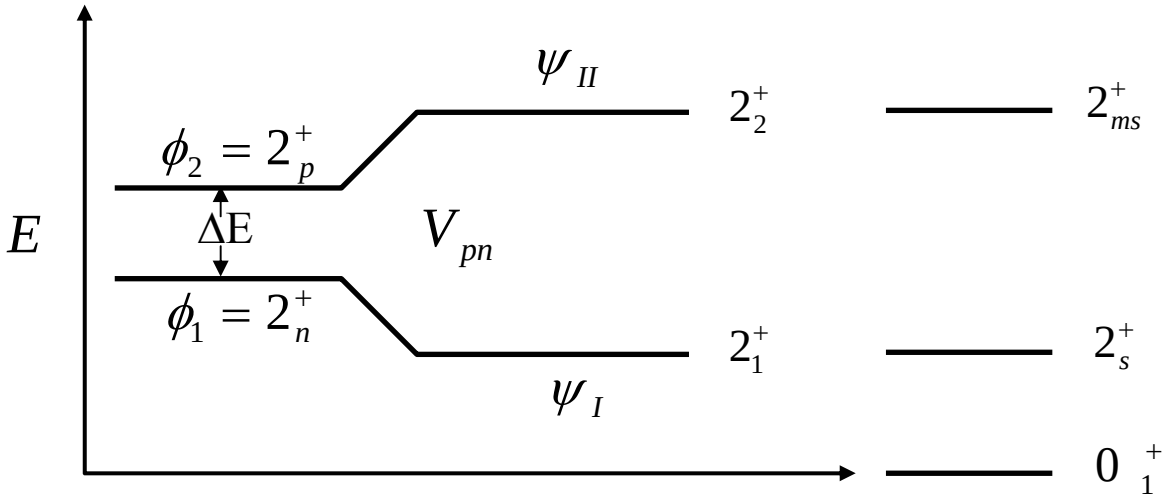
^{94}Mo

$$2_p^+ = \pi\left(1g_{9/2}{}^2\right)_{J=2} \quad \nu\left(2d_{5/2}{}^2\right)_{J=0}$$

$$2_n^+ = \pi\left(1g_{9/2}{}^2\right)_{J=0} \quad \nu\left(2d_{5/2}{}^2\right)_{J=2}$$



Mixing of two states



$$H = \begin{pmatrix} E_{2_p^+} & V_{pn} \\ V_{pn} & E_{2_n^+} \end{pmatrix}$$

$$\psi_I = \alpha\phi_1 + \beta\phi_2$$

$$\psi_{II} = -\beta\phi_1 + \alpha\phi_2$$

$if\ |\alpha| = |\beta| \Rightarrow$ Symmetric and mixed symmetric

$if\ |\alpha| \neq |\beta| \Rightarrow$ Proton and neutron

From ^{94}Mo to ^{92}Zr

^{92}Zr

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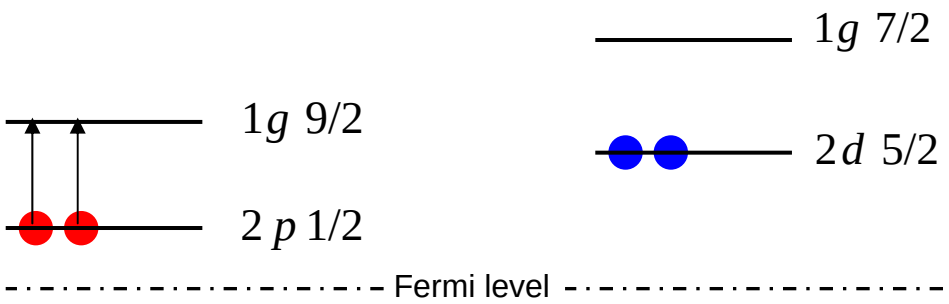

Experimental setup

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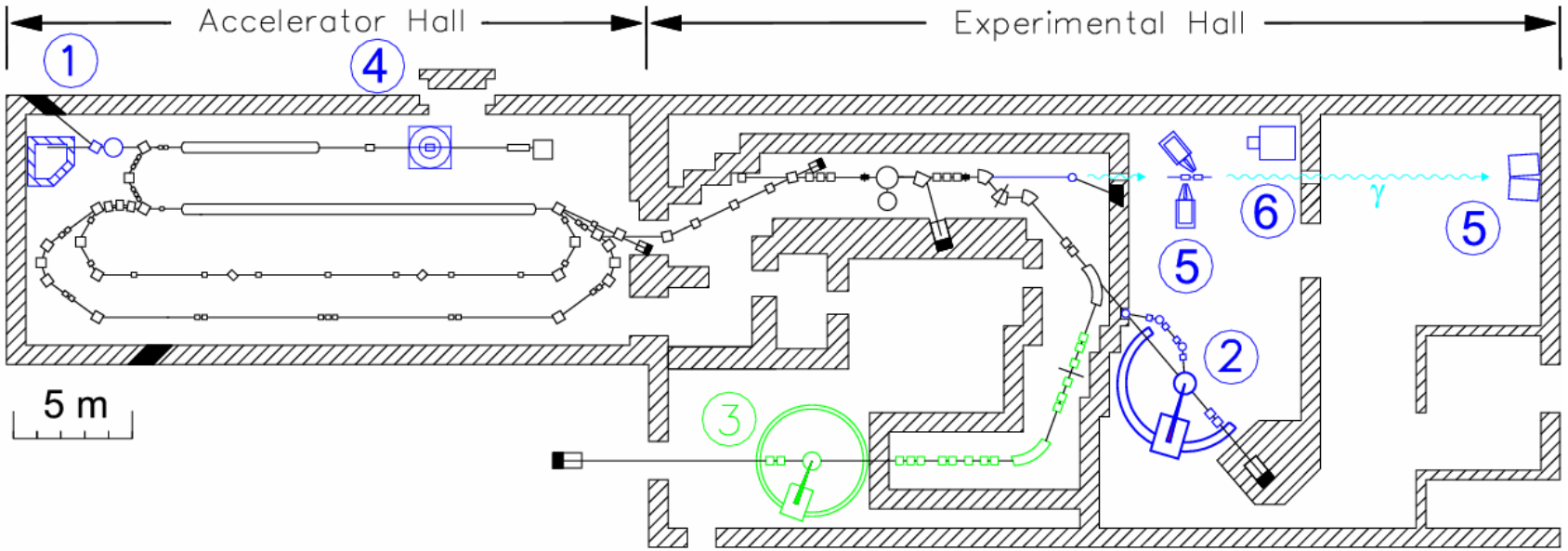
S-DALINAC



1. Nuclear resonance fluorescence
2. (e,e´) and 180° experiments
3. High-resolution (e,e´) experiments
4. Polarized electron source
5. 100 MeV bremsstrahlung for polarizability of the nucleon
6. Photon tagger

Spectrometer

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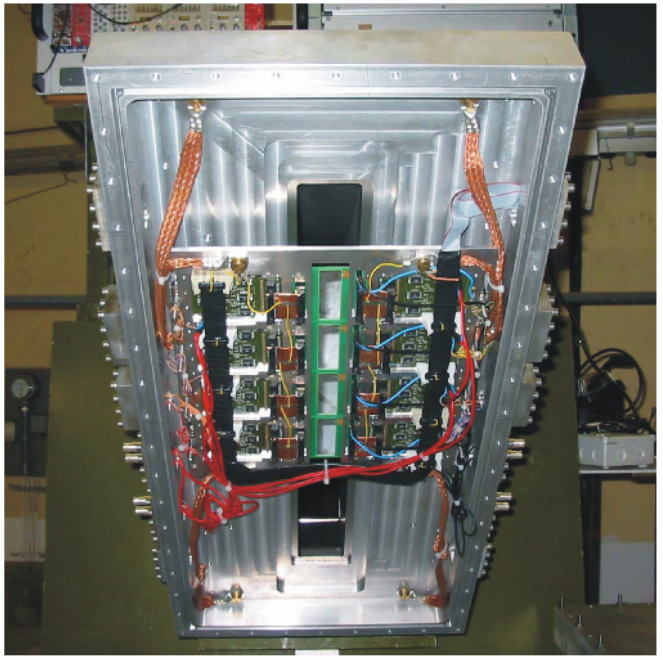
33° - 165° Spectrometer

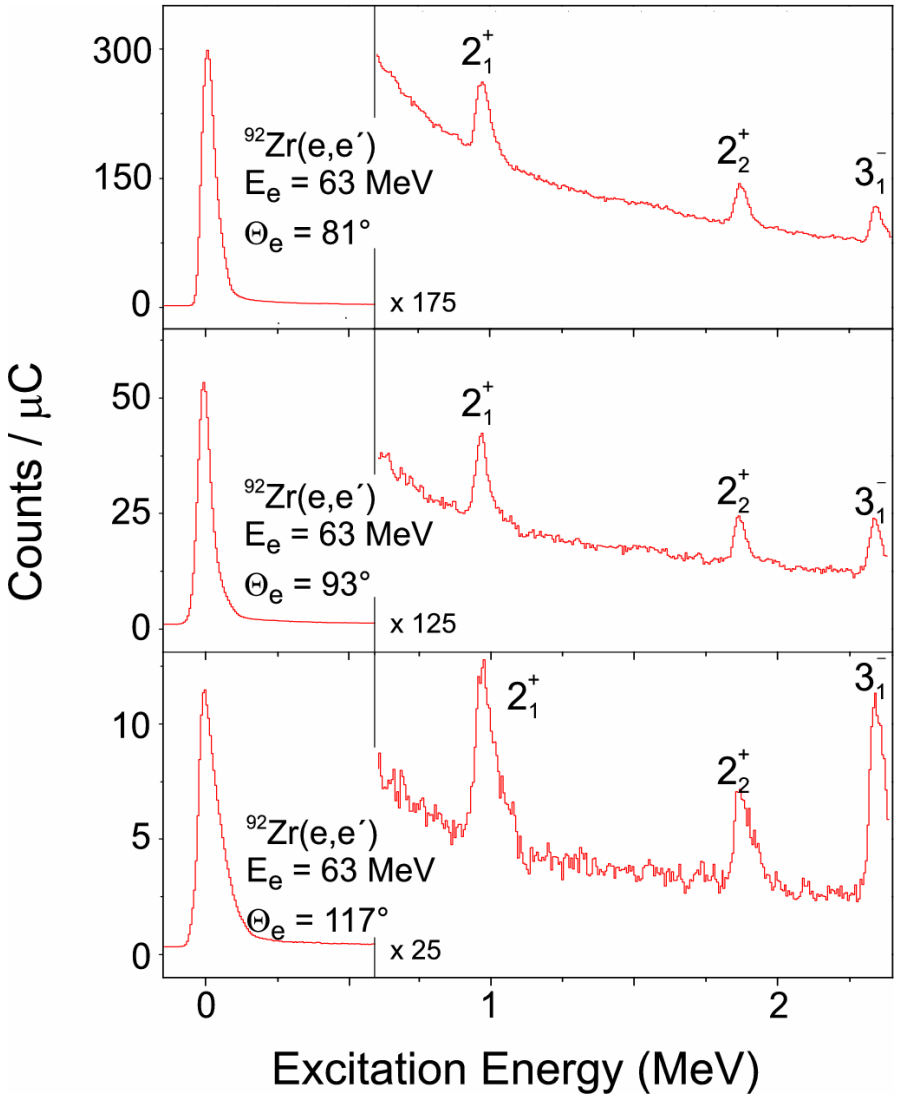
1. Incoming electron beam
2. Scattering chamber
3. Dipole magnet
4. Detector system

Detector System

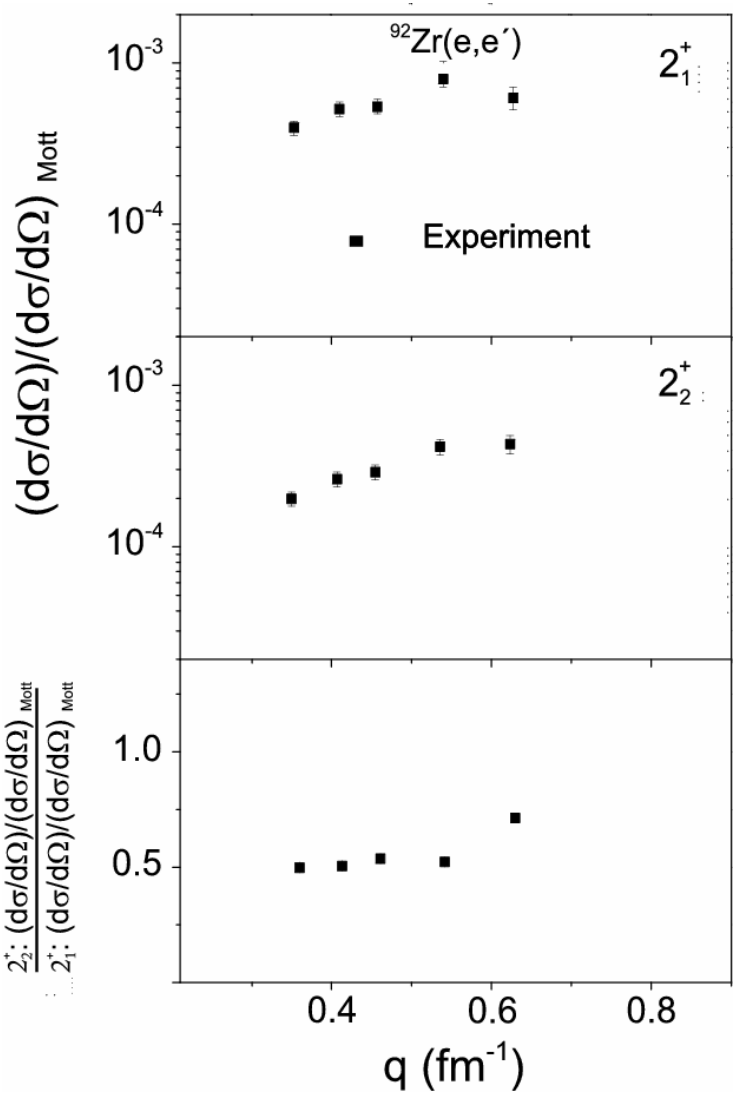


- Si microstrip - detector system: 4 modules, each 96 strips, with pitch of 650 µm
- Count rate up to 100 kHz
- High spatial resolution 1.5×10^{-4}

Measured spectra

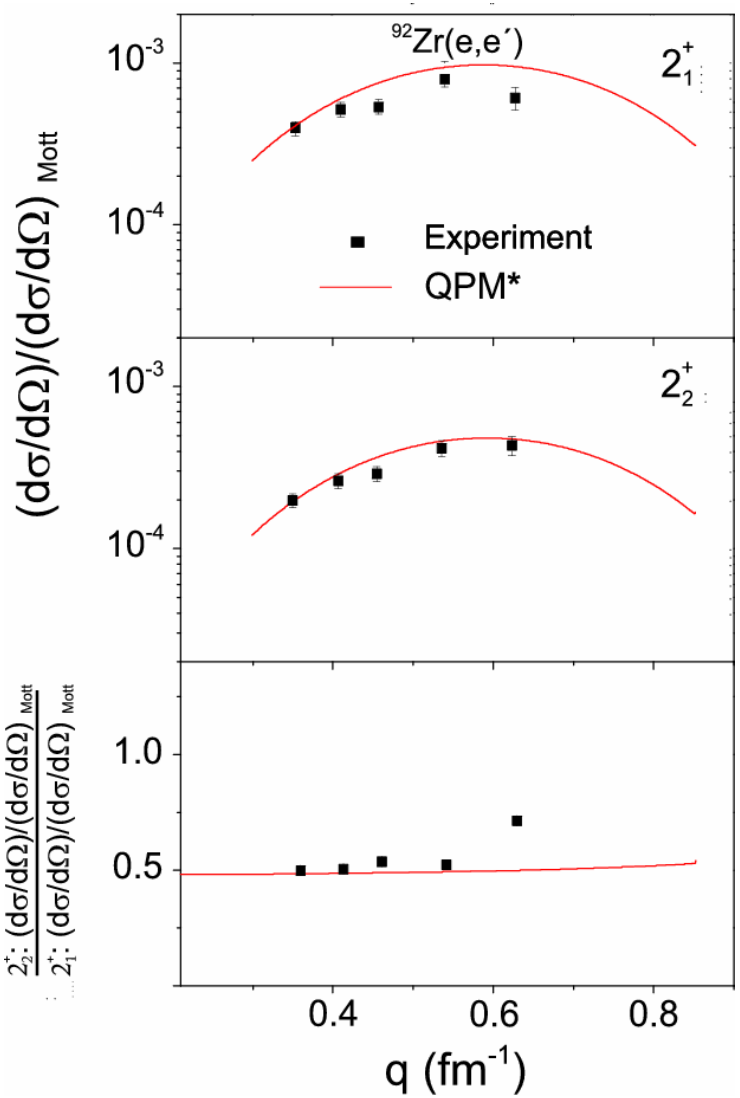


Analysis and results



One phonon states

Comparison to QPM



One phonon states

*V. Ponomarev

Transition strengths

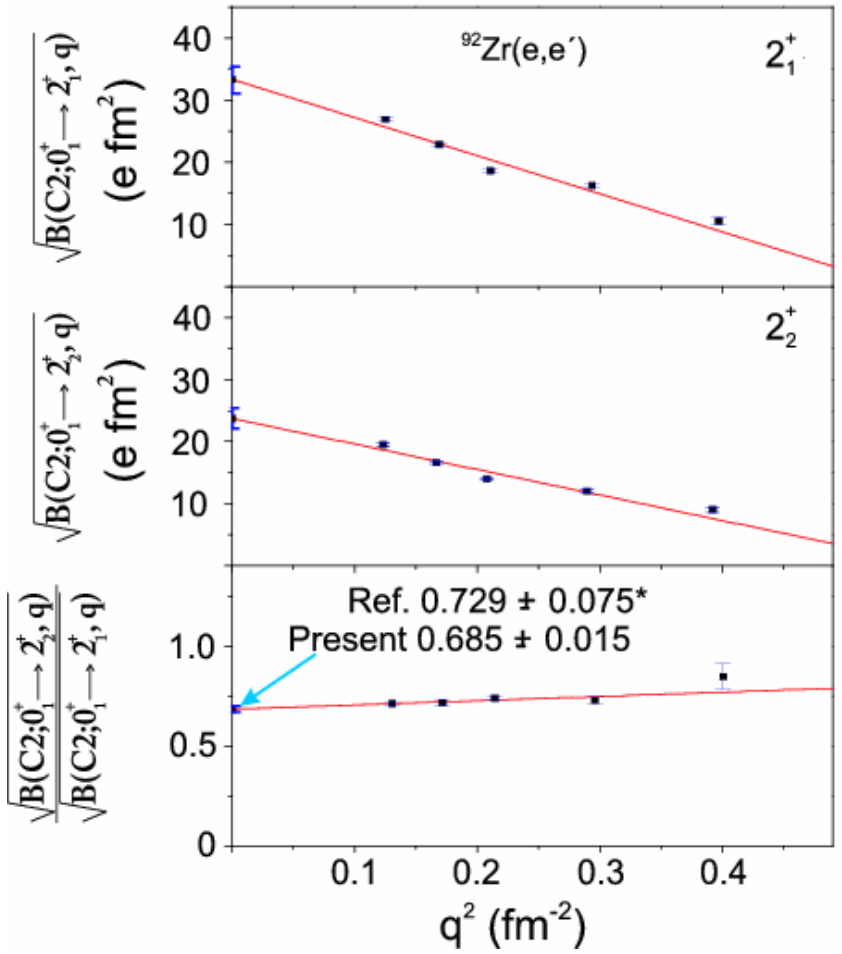
	^{92}Zr(e,e´) Eλ Strength in W.u.	Ref. [1]	Ref. [2]
	With QPM	^{92}Zr(n,n´γ)	^{94}Mo(n,n´γ)
$B(E2;2_1^+ \rightarrow 0_1^+)$	6.2 ± 0.3	6.4 ± 0.5	16.0 ± 0.2
$B(E2;2_2^+ \rightarrow 0_1^+)$	3.3 ± 0.2	3.4 ± 0.4	2.2 ± 0.2
$B(E3;3_1^- \rightarrow 0_1^+)$	16.6 ± 1.7		

[1] C. Fransen et al., Phys. Rev. C**71** (2005) 054304

[2] C. Fransen et al., Phys. Rev. C**67** (2003) 024307

Model-independent extraction of E2 excitation strength

$$\sqrt{B(C2,q)} = \sqrt{B(C2,0)}\left(1 - q^2\frac{R_{tr}^2}{14} + q^4 \ldots\ldots\right)$$



*C. Fransen et al., Phys. Rev. C**71** (2005) 054304

Results

	^{92}Zr(e,e´) Eλ Strength in W.u.		Ref. [1]	Ref. [2]
	With QPM	PWBA	^{92}Zr(n,n´γ)	^{94}Mo(n,n´γ)
$B(E2;2_1^+ \rightarrow 0_1^+)$	6.2 ± 0.3		6.4 ± 0.5	16.0 ± 0.2
$B(E2;2_2^+ \rightarrow 0_1^+)$	3.3 ± 0.2	3.0 ± 0.3	3.4 ± 0.4	2.2 ± 0.2
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Summary

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- High-resolution electron scattering experiments performed
- B(E2), B(E3) extracted
- Shell model calculations