Nature of Mixed-Symmetry 2^+ States in ^{94}Mo from High-Resolution Electron and Proton Scattering *

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- Motivation

- Experiments

- Results and microscopic interpretations

- Summary and outlook

Motivation

- *pn*-IBM-2

    → fully symmetric states (FSS) → isoscalar

    → mixed-symmetry states (MSS) → isovector

- Test case of ^{94}Mo:

    N. Pietralla *et al.*, Phys. Rev. Lett. 83, 1303 (1999); Phys. Rev. Lett. 84, 3775 (2000)
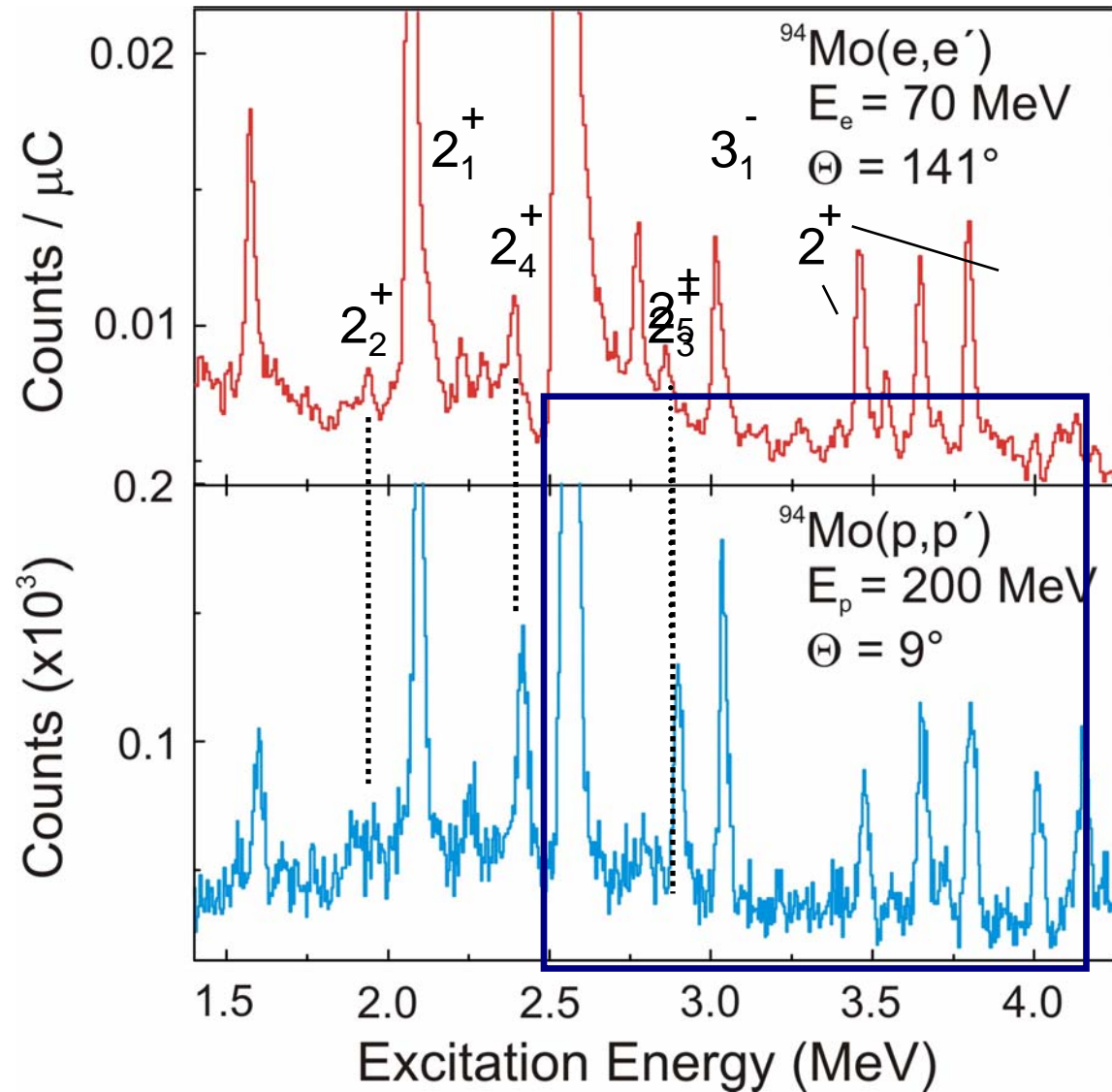   C. Fransen *et al.*, Phys. Lett. B 508, 219 (2001); Phys. Rev. C 67, 024307 (2003)

Why (e,e´) and (p,p´)?

- Study of one- and two-phonon 2^+ FSS and MSS with (e,e´) and (p,p´)

  → sensitive to one-phonon components of the wave functions

  → test of fundamental phonon character

  → isoscalar / isovector decomposition

  → purity of two-phonon states

- Complete observation of all 2^+ states up to 4 MeV
  → high resolution → beam matching techniques

- Experiments:
  → (e,e´) at S-DALINAC
  → (p,p´) at iThemba LABS

Data: Weak Transitions

Theoretical Calculation

- Quasiparticle Phonon Model (QPM)
  - → full (up to 3 phonons)
  - → pure one- or two-phonon states

- Shell Model (SM)
  - → ^{88}Sr core / V_{low-k}

- IBM-2
  - → transition densities from generalized-seniority SM
  - → U(5) limit to describe dominant transitions

- Cross Section
  - → DWBA / Love-Franey effective
    projectile-target interaction for (p,p´)

One-Phonon FSS and MSS
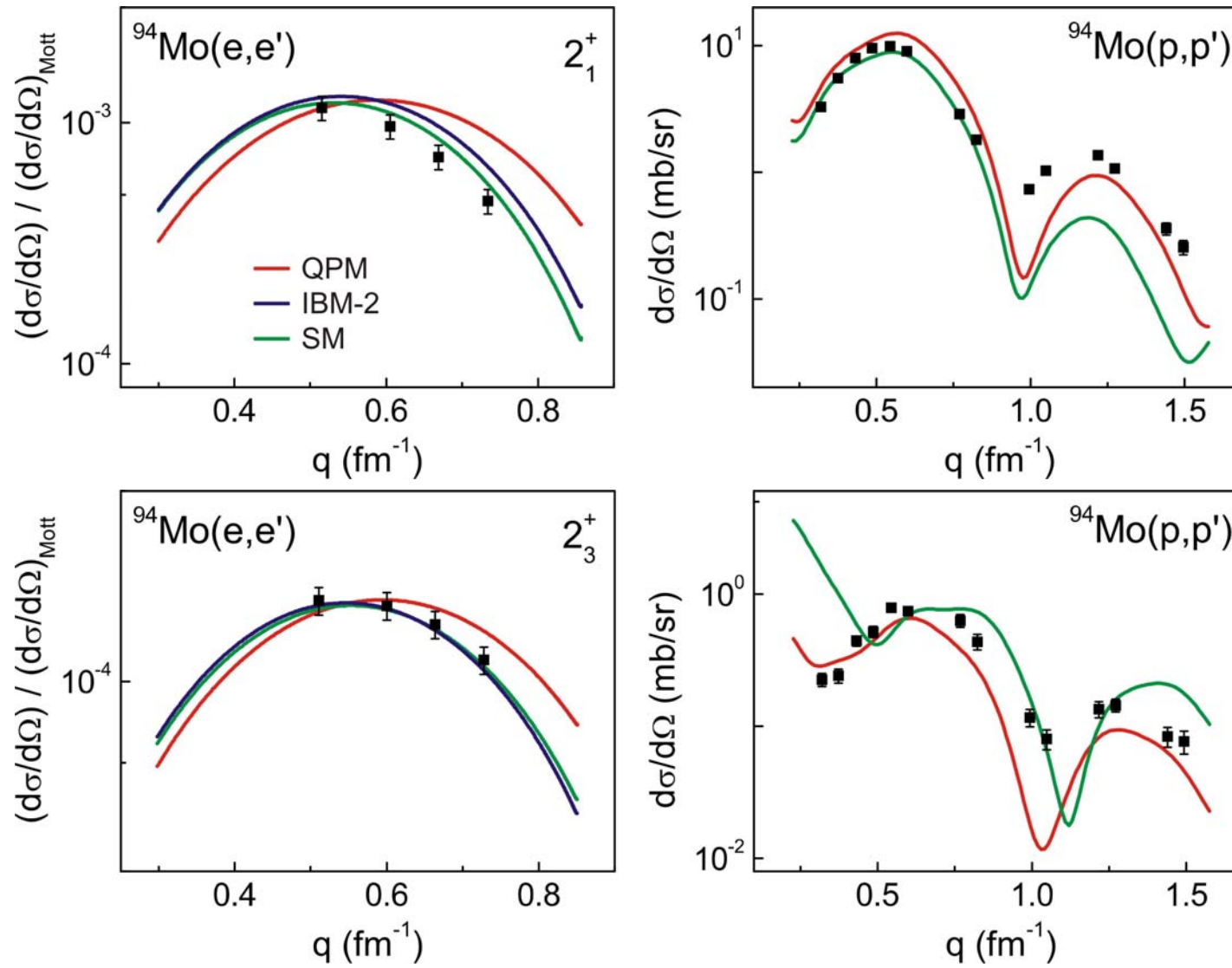
one-phonon character confirmed
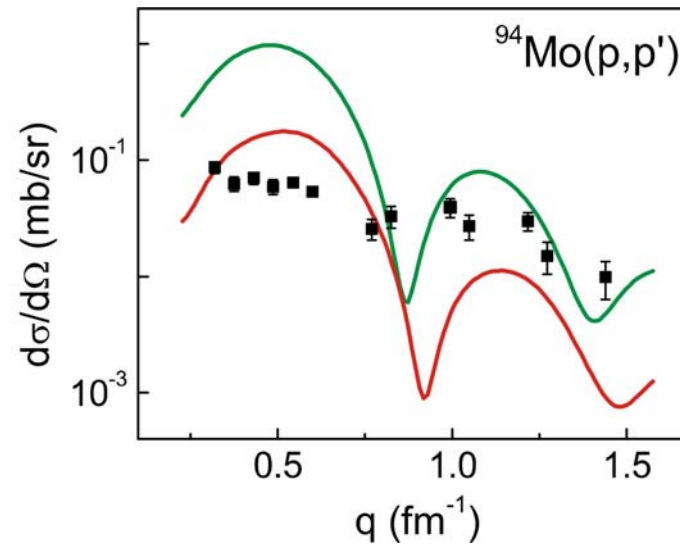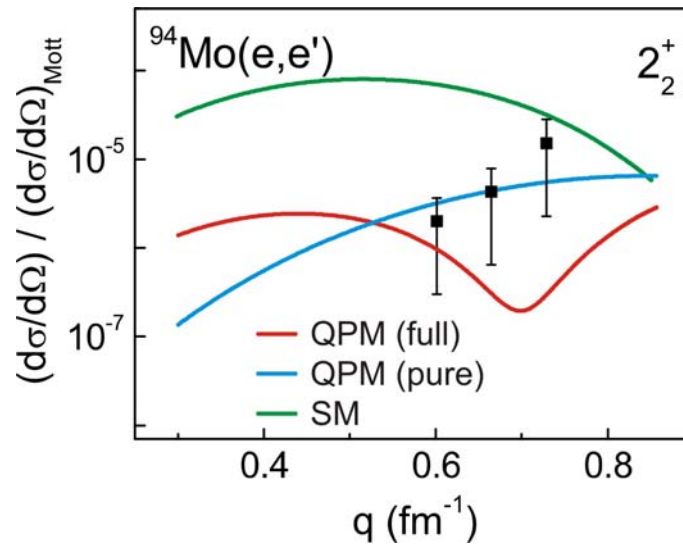
Wave Functions of One-Phonon FSS and MSS

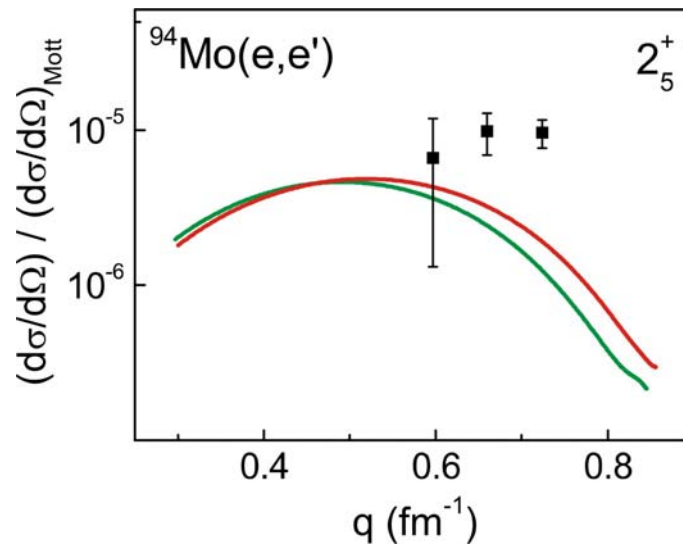| Main config.	$2^+_{1,\text{FSS}}$		$2^+_{3,\text{MSS}}$	
	QPM	SM	QPM	SM
$\pi(1g_{9/2}\, 1g_{9/2})$	0.66	0.39	0.64	0.51
$\nu(2d_{5/2}\, 2d_{5/2})$	0.72	0.55	-0.71	-0.33

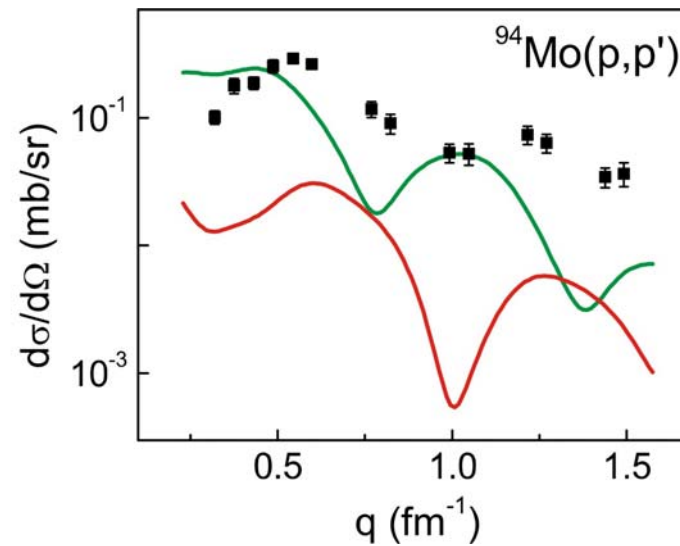- FSS $\rightarrow$ isoscalar
- MSS $\rightarrow$ isovector

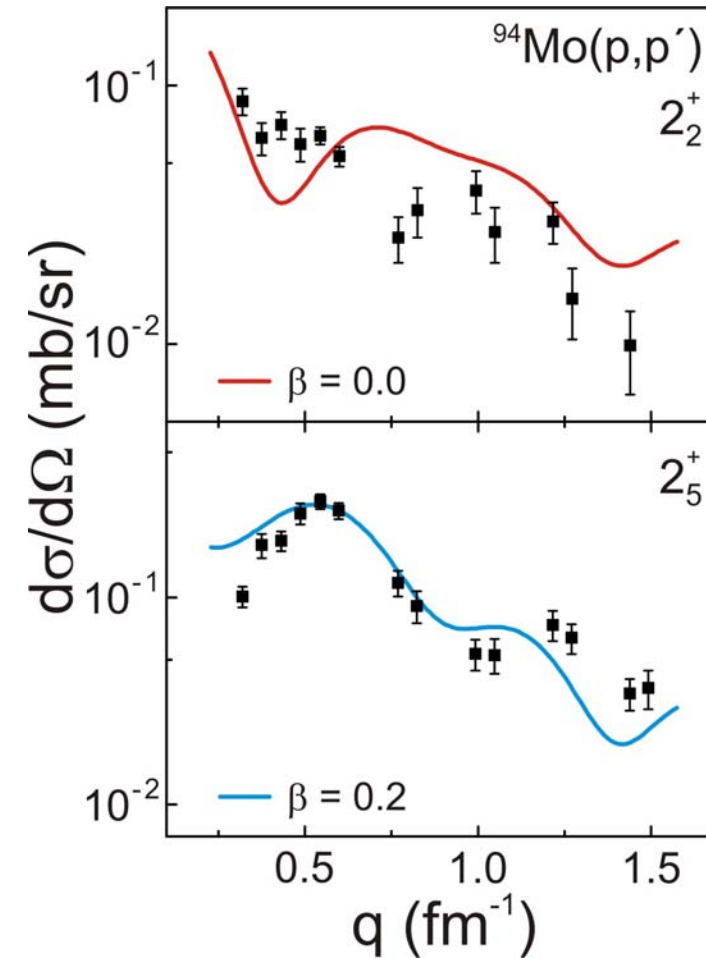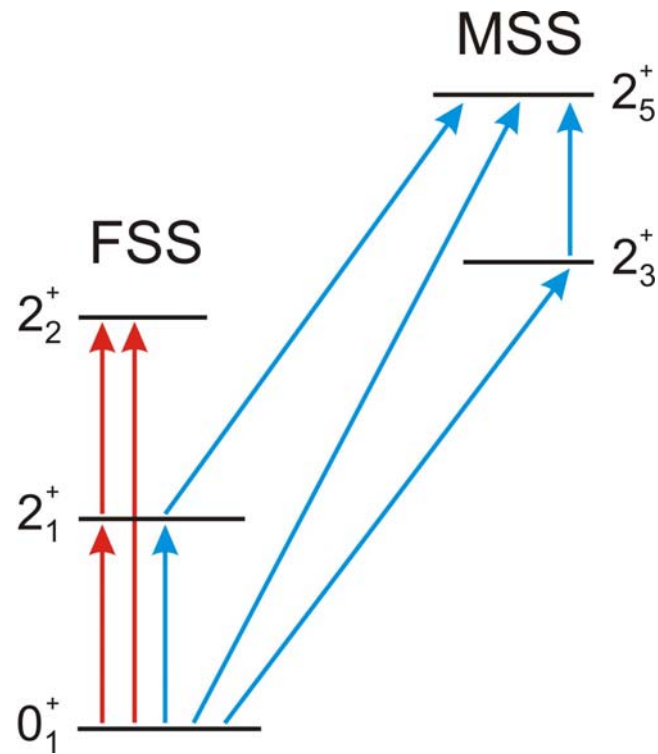# Two-Phonon FSS and MSS

very pure

two-step contributions

~10% one-phonon admixture

two-step contributions

Coupled-Channel Analysis

- pure two-phonon FSS confirmed
- admixture to two-phonon MSS confirmed

Summary and Outlook

- Study of one- and two-phonon FSS and MSS 2^+ states in ^{94}Mo with high-resolution (e,e´) and (p,p´) experiments

- Combined analysis with microscopic models reveals:

  → dominant one-phonon character of 2_1^+ and 2_3^+ states

  → isovector character of one-phonon MSS within the valence shell

  → quantitatively consistent conclusions after inclusion of two-step processes in (p,p´) cross sections

  → two-phonon FSS quite pure

  → about 10% one-phonon and about 17% three-phonon admixtures in two-phonon MSS → but dominant two-phonon character

- The case of ^{92}Zr: Mixed-symmetry concept seems to fail

  C.Fransen *et al.*, Phys. Rev. C71 (2005) 054304