Nature of One- and Two-Phonon Mixed Symmetry States in ^{92}Zr and ^{94}Mo from High-Resolution Electron and Proton Scattering*

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The concept of symmetric and mixed-symmetric quadrupole phonons as building blocks of the low-energy structure in spherical nuclei has been thoroughly investigated in recent years. A particularly interesting case are the $N = 52$ isotones. The nucleus ^{94}Mo has been studied in great detail and candidates for the mixed-symmetry one-phonon [1] and most of the two-phonon states [2–4] have been established based on characteristic decay pattern. This approach also provides a good description of ^{96}Ru [5] but seems to fail for ^{92}Zr indicating a substantial breaking of F spin in the latter [6,7].

We present high-resolution inelastic electron scattering (performed at the S-DALINAC) and proton scattering (performed at iThemba LABS) experiments on ^{92}Zr and ^{94}Mo with emphasis on $E2$ transitions populating 2^+ states. The energy resolution $\Delta E \approx 30$ keV (FWHM) was sufficient to resolve all experimentally known 2^+ states below $E_x = 4$ MeV. The measured form factors and angular distributions represent a sensitive test of a possible two-phonon character of excited states by comparison to QPM, shell model, and IBM-2 predictions. The results are complementary to the experimental approaches used in [1–7] by measuring the one-phonon content in the wave functions of two-phonon candidates. The comparison of (e,e′) and (p,p′) results furthermore provides a measure for the F-spin purity, respectively the isovector nature, of the proposed one-phonon mixed symmetry states.

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