

New findings for mixed-symmetry states

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Mixed-symmetry (MS) states are quadrupole collective states which have anti-symmetric parts in their proton-neutron (pn) wave function. A study of the collectivity of the lowest 2^+ states and of pn symmetry breaking in those states due to the underlying shell structure has been made for ^{92}Zr [1], and is compared to its N=52 isotones ^{94}Mo [2] and ^{96}Ru [3]. A shell model [4], as well as a QPM [5] analysis describe the lowest two excited 2^+ states in ^{92}Zr as the symmetric and MS one-phonon states, but give quite different predictions for pn symmetry breaking in those states. Sensitive observables of pn symmetry breaking are the g factors of both one-phonon states. The g factor of an MS state has never been measured before because of its short lifetime and higher excitation energy. A first attempt to measure the g factor of the 2_2^+ state in ^{92}Zr has been made at WNSL using inverse coulomb excitation and the transient field technique.

Another well-known MS state is the scissors mode in well-deformed rotational nuclei. This M1 excitation is, in a geometrical picture, a scissors-like counter-oscillation of the deformed proton and neutron bodies, presenting similarities to the E1 giant dipole resonance (GDR). Years ago, a decay of the GDR to the γ -band had been observed and discussed [6] in terms of geometrical models and the IBM with the inclusion of a p boson. However, the IBM is a valence space model, rendering a search for such a decay from a valence space excitation interesting. The scissors mode was found to be such a valence space excitation [7,8], and the validity of the sd-IBM-2 model prediction for its decay to the γ -band was tested via photon scattering techniques using unpolarized photon beams from bremsstrahlung (Stuttgart), and polarized photons from a free electron laser (TUNL).

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