Search for mixed-symmetry and phonon states in ^{127}I

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Unlike in even-even nuclides, little is known about phonon structures and mixed-symmetry states in nearly spherical odd-mass nuclei. This deficiency is mainly a result of increasing complexity produced by the interplay of phonon, intruder, mixed-symmetry and single-particle degrees of freedom, which perturb the single-particle and intrinsic phonon wavefunctions. Experimentally, angular momenta higher than J=1/2 for the ground state in odd-mass nuclides give rise to a distribution of phonon strength among several levels. Extra difficulties may arise from intruder [1] and mixed-symmetry states [2,3] lying at similar excitation energies [4]. However, consideration of the phonon and particle coupling models partially mitigates these vicissitudes. As the phonon energy increases with λ, only members of the same phonon set are generally expected in the appropriate energy region. In addition, other states which are not members of this phonon structure are not expected to preferentially decay to the lower phonon states ($\Delta n_\lambda = \pm 1$) by strong $E2$ transitions. Mixed-symmetry states are known to decay by strong $M1$ and weakly collective $E2$ transitions to the phonon states. In fact, in the triaxial $O(6)$ region, mixed-symmetry states have only been identified in neighboring $^{128}_{54}Xe_{74}$ [5]. To search for phonon and mixed-symmetry states in the $O(6)$ region, the low-spin structure of $^{127}_{53}I_{74}$ is being studied using the (n,n$'\gamma$) reaction at neutron energies ranging from 1.2 to 2.3 MeV and the (n,n$'\gamma\gamma$) reaction at 3 MeV. Both excitation functions and coincidence spectra were used in constructing the decay scheme and searching for mixed-symmetry and phonon states built on the $5/2^+$ ground state and the $7/2^+[404]$ and $3/2^+[422]$ Nilsson orbitals.

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