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Nature of the low-spin states in the moderately-deformed triaxial ¹⁹³Au nucleus

Unlike axially symmetric nuclei, triaxial nuclei give rise to exotic collective phenomena, such as nuclear wobbling and chirality—topics that have garnered significant attention in recent years. These phenomena not only challenge our understanding of nuclear deformation, but also enrich the landscape of gamma spectroscopy with distinctive signatures that demand both experimental and theoretical exploration. It has been recently proposed that odd-mass triaxial nuclei can exhibit wobbling motion even at low spins [1]. Excited bands interpreted as wobbling modes have been reported in several nuclei, including the gold isotopes ¹⁸³Au and ¹⁸⁷Au, which are excellent candidates for studying such phenomena due to the presence of triaxial shapes in this mass region [2,3].
In ¹⁸³Au, an excited band built on the h_{9/2} configuration was associated with transverse wobbling, where the odd proton aligns along the short nuclear axis [4]. In contrast, ¹⁸⁷Au showed evidence for longitudinal wobbling, with the odd proton aligned along the intermediate axis [5]. This difference in the angular momentum alignment of the valence proton in these two isotopes is particularly intriguing, as their proton Fermi levels are expected to be similar. The strongest experimental evidence supporting the wobbling interpretation was based on the evaluated large mixing ratios of the transitions linking the excited and yrast h_{9/2} bands. However, a recent remeasurement of these mixing ratios in ¹⁸⁷Au revealed a dominant M1 component [6], which rules out the earlier proposed wobbling interpretation. These contrasting findings highlight the challenges of such measurements and underline the need for further investigations—particularly in the gold isotopes.
In the present study, low- to medium-spin excited states of ¹⁹³Au were investigated using the tape station setup at iThemba LABS. These states were populated via β-decay following the ¹⁹⁷Au(p,5n)¹⁹³Hg reaction at E_p = 50 MeV. The resulting gamma rays were detected with three Compton-suppressed clover detectors and one Compton-suppressed segmented clover detector. In addition, a Si(Li) detector was used to measure internal conversion electrons. These measurements allowed us to explore the interplay between single-particle and collective excitations in bands based on the h_{9/2} and h_{11/2} configurations at low to medium spin. Various techniques were employed to extract multipole mixing ratios and assign spins and parities to the observed states. Furthermore, Quasiparticle plus Triaxial Rotor (QTR) calculations were performed to characterize the nature of the excited states.
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