Int. Workshop “Shapes and Dynamics of Atomic Nuclei: Contemporary Aspects”
ed. Nikolay Minkov, Heron Press, Sofia 2026

^{178}Yb near the rigid-rotor limit

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Abstract

The ytterbium isotopic chain provides a clear example of the evolution of nuclear structure in the rare-earth region. With increasing neutron number, from $N = 88$ to $N = 108$, the ytterbium isotopes evolve from nearly spherical nuclei to strongly deformed systems exhibiting pronounced rotational behaviour. This structural evolution is reflected in the systematic increase of quadrupole collectivity and the rise of the $R_{4/2} = E(4_1^+)/E(2_1^+)$ ratio toward the rigid-rotor value of 3.333. The neutron-rich nucleus ^{178}Yb, at $N = 108$, occupies a key position in the rare-earth region, since it is the most neutron-rich ytterbium isotope for which spectroscopic information about its excited states is available. To investigate the properties of this nucleus and its proximity to the rigid-rotor limit, an experiment was performed at the 10 MV FN Tandem accelerator of the Institut für Kernphysik, University of Cologne. Excited states in ^{178}Yb were populated through the two-neutron transfer reaction ^{176}Yb(^{18}O,^{16}O)^{178}Yb and studied using γ-ray spectroscopy. Particular emphasis was placed on observables sensitive to nuclear deformation and collectivity, such as level energies and lifetimes. The spectroscopic results confirm the strongly rotational character of ^{178}Yb and support its placement among the most rigid-rotor-like nuclei in the rare-earth region and provide valuable information on the evolution of collectivity beyond the $N = 104$ mid-shell region. The experimental findings will be discussed in the context of deformation systematics in the ytterbium isotopic chain and compared with neighboring rare-earth nuclei.

This work is supported by the German Research Foundation - 539757749.