Experimental measurement of the deformation through the electromagnetic probe: Shape coexistence in exotic Kr isotopes.

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The study of the shape coexistence in exotic nuclei provides important benchmarks for modern nuclear theories. Shape coexistence in the light krypton isotopes was studied in two low-energy Coulomb excitation experiments using radioactive ^{74}Kr and ^{76}Kr beams from the SPIRAL facility at GANIL [1]. The ground-state bands in both isotopes were populated up to the 8^+ state via multi-step Coulomb excitation, and several non-yrast states were observed. Large sets of E2 matrix elements were extracted for both nuclei from the observed γ -ray yields. Diagonal matrix elements were determined by utilizing the reorientation effect. In both isotopes the spectroscopic quadrupole moments for the ground-state bands and the bands based on excited 0^+_2 states are found to have opposite signs. The excited 2^+_2 and 2^+_3 states are interpreted as gamma-vibrational and oblate rotational states, respectively. The matrix elements were interpreted in a phenomenological two-band mixing model. The results confirm the earlier finding of maximum mixing between prolate and oblate configurations in the wave functions of the 0^+ states in ^{74}Kr [2].

The experimental data are interpreted within a phenomenological two-band mixing model and model-independent quadrupole invariants are deduced for the relevant 0^+ states using the complete sets of matrix elements and the formalism of quadrupole sum rules. Configuration mixing calculations based on triaxial Hartree-Fock-Bogolyubov calculations with the Gogny D1S effective interaction have been performed [3] and are compared both with the experimental results and with calculations using the Skyrme SLy6 effective interaction and the full generator-coordinate method restricted to axial shapes [4]. The results emphasize the importance of including the triaxial degree of freedom to describe the shape coexistence in the light krypton isotopes. The present work represents the first direct experimental proof of the proposed shape coexistence scenario, and the reorientation effect has been exploited for the first time with a radioactive ion beam.

The near future studies will be also discussed. With the construction of the SPIRAL2 facility, fission fragments around N=60 in the Kr and Sr chain will be available as beam. The shape coexistence and shape transition between quasi-spherical and highly deformed configurations at N=60 will be presented as well as the first experimental studies carry at REX-ISOLDE [6].

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