Shape coexistence in neutron-deficient Krypton isotopes studied by low-energy Coulomb excitation of radioactive ion beams

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The coexistence of prolate and oblate shapes in the light krypton isotopes was investigated through Coulomb excitation of radioactive ^{74}Kr and ^{76}Kr beams, which were produced by fragmentation of a $70 \cdot A$ MeV ^{78}Kr beam of 10^{12} pps intensity on the carbon production target of the SPIRAL facility at GANIL. The pure secondary beams were accelerated to the "safe" energy of $4.5 \cdot A$ MeV with the CIME cyclotron, and intensities of $5 \cdot 10^5$ and 10^4 pps for ^{76}Kr and ^{74}Kr were reached, respectively. States up to the 8^+ in the ground-state band and several non-yrast states were populated in both cases via multi-step Coulomb excitation on a ^{208}Pb target of 1 mg/cm^2 thickness. The scattered projectiles and the recoiling target nuclei were detected in a highly segmented double-sided annular silicon detector in coincidence with the de-excitation γ rays detected with the EXOGAM array of large segmented Ge clover detectors.

The γ-ray yields were measured for several ranges of center-of-mass scattering angles. The code GOSIA was used to find the set of transitional and diagonal matrix elements that best describes the observed γ-ray yields in a χ^2 minimization. The results are not compatible with the literature values for the lifetimes of the states in the ground-state bands of both isotopes. A new recoil-distance lifetime measurement was performed that resolved all ambiguities [1]. The precise knowledge of the lifetimes enhances the sensitivity to the static quadrupole moments in the GOSIA analysis, which shows the complementarity of experiments with stable and radioactive beams. About 20 transitional matrix elements could be determined in each isotope combining the results from the Coulomb excitation and lifetime measurements. The main result, however, is the first direct measurement of static quadrupole moments, including the signs, via the reorientation effect in radioactive nuclei for several excited states. The quadrupole moments confirm the scenario of coexisting prolate and oblate states. The results will be discussed and compared to recent configuration mixing calculations of angular-momentum projected mean-field states based on Skyrme Hartree-Fock-Bogolyubov calculations.

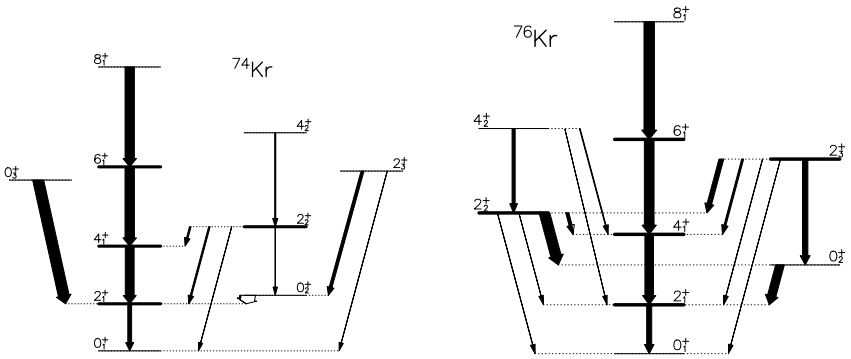

Figure 1: Partial level schemes of ^{74}Kr and ^{76}Kr showing all transitions for which $B(E2)$ values were determined. The width of the arrows corresponds to the transition strengths. The states for which the static quadrupole moment was measured are shown with bold lines.

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