Shape coexistence in light krypton and selenium isotopes near N=Z

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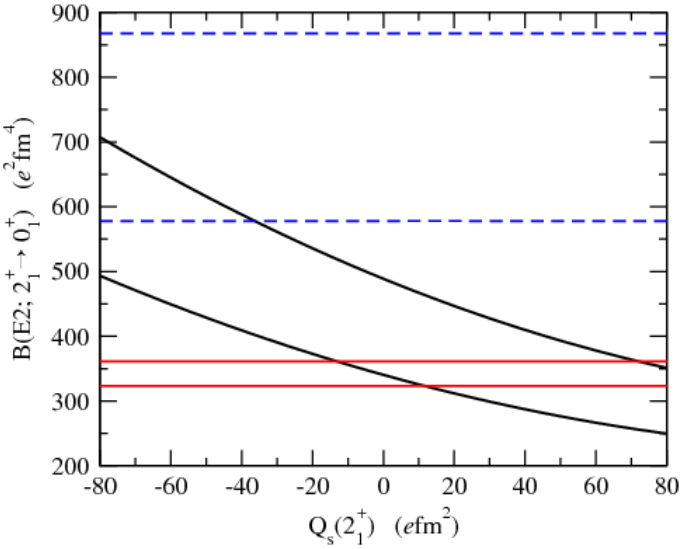
The phenomenon of shape coexistence in the neutron-deficient isotopes of Kr and Se near the *N=Z* line has been studied using various complementary techniques. Low-lying 0^+ shape isomers were studied by conversion-electron spectroscopy using fast fragmentation beams at GANIL. Both yrast and non-yrast states up to spin 8^+ were populated in a multi-step Coulomb excitation experiment using radioactive ^{74}Kr and ^{76}Kr beams at safe energies from the SPIRAL facility at GANIL. Transition probabilities and spectroscopic quadrupole moments were determined from the γ-ray yields observed with the EXOGAM spectrometer. The results represent the first direct evidence for prolate shape of the states in the ground-state band and oblate shape for states above the excited 0^+ state in both Kr isotopes under study [1]. The experimental *B(E2)* values and quadrupole moments are compared to configuration-mixing calculations using the generator coordinate method (GCM) with Skyrme and Gogny effective interactions. It is found that the coexistence of prolate and oblate shapes is only correctly reproduced if triaxial shapes are explicitly taken into account in the calculations. The calculations furthermore confirm the expected inversion of the ground-state shape for the *N=Z* isotope ^{72}Kr.

Similar coexistence of oblate shapes near the ground state and excited prolate configurations is expected in the light Se isotopes. A low-energy Coulomb excitation experiment using a radioactive ^{70}Se beam from the REX-ISOLDE facility at CERN, in combination with the known lifetime of the 2^+ state, suggested prolate shape for this state [2], contrary to the previous interpretation. A new high-precision lifetime measurement [3] using the recoil-distance Doppler shift technique and the GASP spectrometer at Legnaro has shown that the literature values for the lifetimes in ^{70}Se were inaccurate and that the ISOLDE results are indeed compatible with oblate shape for the 2^+ state in ^{70}Se (see figure). The experimental results are again compared to Gogny GCM calculations, resulting in a coherent description of the shape coexistence phenomenon in this region of the nuclear chart.



B(E2) value as a function of the spectroscopic quadrupole moment Q_s for the 2^+ state in ^{70}Se. The sloping lines indicate the 1σ range of values compatible with the Coulomb excitation measurement. The horizontal solid (red) and dashed (blue) lines represent the 1σ limits of the present and earlier lifetime measurements, respectively. Only positive values of Q_s are compatible with both the ISOLDE and Legnaro results, indicating oblate shape for the 2^+ state in ^{70}Se.

References:

[1] E. Clément et al., Phys. Rev. C 75, 054313 (2007)
[2] A.M. Hurst et al., Phys. Rev. Lett. 98, 072501 (2007)
[3] J. Ljungvall et al., Phys. Rev. Lett. 100, 102502 (2008)