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Shape coexistence studies in neutron-rich krypton isotopes around N=60

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Even-even strontium and zirconium nuclei in the A=100 region show a sudden onset of deformation at N=60 while the lighter isotopes up to N=58 are rather spherical. Unlike, the even krypton isotopes exhibit a smooth onset of collectivity up to N=60 [1]. Recent high-resolution gamma-spectroscopy results on 96Kr [2] following projectile fission confirmed the energy of the yrast 2+ –> 0+ transition [1] and reported for the first time on the yrast 4+ –> 2+ transition. Further on, recent results from the SEASTAR 2015 campaign on the extremely exotic 98,100Kr isotopes, populated in nucleon knockout reactions of radioactive beams, reported a decrease in the energy of the yrast 2+ states suggesting a continuation of the smooth shape transition beyond N=60 [3]. The side product data on the neutron-rich 96Kr collected from the same campaign suggested new low-lying excited states [4], which unlike the oblate shape g.s., could correspond to the prolate minimum of the potential energy surface (see ref.[5] for example). Unfortunately the low-resolution data from DALI2 together with the possible lineshape effects due to state lifetimes, made it difficult to establish a reliable level scheme. We performed a subsequent experiment to excite the lowest non-yrast states of 96Kr using Coulomb-nuclear excitation reactions at HIE-ISOLDE, CERN, which suffered from a reduced radioactive beam intensity and increased stable beam contamination.

As shown in the neighbouring nuclei of higher Z, the prolate shape is related to the lowering of the neutron g9/2 orbital. Thus studies of the odd-neutron krypton isotopes 95,97Kr are complementary and of similar importance. The existence of a T1/2 = 1.4 us isomer in 95Kr [6] made it mandatory to measure delayed gamma-rays at the end of Zero Degree spectrometer, which we did in the SEASTAR 2015 campain. The correlation of delayed and prompt gamma-rays worked nice, but again due to the low-resultion of DALI2 and the increased line density of the prompt spectrum only a preliminary level scheme could be built [7].

From the point of view of reaction mechanism and the production yeilds, the RIBF is currently the only place in the world where these shape-coexisting states in the krypton isotopes around N=60 could be studied.

Thus, in order to obtain definite results on the gamma-energies and their coincidence relations, as well as have a more sensitive analysis of the lineshapes, we propose to study the neutron-rich krypton isotopes around N=60 with high resolution gamma-ray spectroscopy at the RIBF populated via nucleon knockout reactions.

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