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Evolution of collectivity beyond N=60 for Kr isotopes: First spectroscopy of 98,100Kr

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Across the nuclear chart, some of the most drastic known shape transitions appear in the A~100 region at N=60 for neutron-rich Zr and Sr isotopes [1,2]. Such a sudden rearrangement of a whole nucleus only adding a couple of nucleons is a peculiar feature of the nuclear system highlighting the subtle interplay between collective and microscopic degrees of freedom which keeps on motivating research efforts since decades. Transitional regions or critical points where this phenomenon happens or disappear are thus preferential areas to be mapped experimentally.

Neutron-rich Kr isotopes are especially interesting in this respect since this sudden increase of collectivity at N=60, like in the Zr and Sr chains, was not observed for 96Kr [3]. Instead, a smooth reduction of E(2+1) and rise of B(E2,0+->2+) excitation strength suggest a gradual development of collectivity. Mass measurements of 96Kr, and 98,100Rb isotopes together with charge radii studies also emphasized that this abrupt shape transition at N=60 extends at least up to Z=37 and not to Z=36 in 96Kr but could not rule out that such a transition is not shifted to higher neutron numbers [4,5].

To explore and delineate the boundaries of this nuclear quantum phase transition region [4], we performed the study of very neutron-rich 98,100Kr nuclei during the 2015 SEASTAR campaign using (p,2p) direct reactions from 99,101Rb isotopes at 266 and 257 MeV/u respectively, produced by in-flight fission of 238U. Thanks to the state-of-the-art combination of the RIBF facility, a 100-mm thick liquid hydrogen target and the MINOS+DALI2 setup [6,7], we were able to perform the first in-flight γ-ray spectroscopy of these two isotopes and measure their 2+1 states. The data analysis and the results will be presented and confronted to modern mean-field based theoretical predictions [8].

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