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Nuclear structure studies of the neutron-rich Rubidium isotopes using Coulomb excitation

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The neutron-rich A=100 mass region has recently attracted a high interest of the nuclear structure studies. In this area of the nuclear chart one can observe the most sudden transition from spherical to well deformed shapes. This occurs by adding just few neutrons for the Zr(Z=40) and Sr(Z=38) isotopes across N=60. Some works claim as well that this phase transition allows the presence of a shape coexistence at N~60.
The onset of deformation at N = 60 is clearly observed between the Zr and Rb isotopes from the two-neutron separation energies from mass measurements. However, a recent study of the Kr isotopes at ISOLTRAP [1] showed no deformation observed for the ground states of Kr's. This has been confirmed as well in a Coulomb excitation measurement [2]. The interplay between down-sloping and up-sloping neutron orbitals [3, 4, 3] is evoked as one of the main reasons for the sudden change at N = 60. The question stays which are the active proton orbitals and what is their contribution to the structure of the region. The Coulomb excitation study which we report here aimed at identifying these orbitals in the neutron-rich Rb's - the last isotopic chain showing the onset of deformation. An additional interest towards 93,95,97,99 Rb comes from astrophysical aspect. According to some of the scenarios the r-process path might go through those exact nuclei.
The nuclei of interest were produced at ISOLDE, CERN using an UCx target. 93,95,97,99Rb were post-accelerated up to 2.83 MeV/u using REX-ISOLDE and Coulomb excited on a secondary target (60Ni,120Sn,196Pt) positioned in the center of the Miniball array used for particle and gamma-ray detection.
A number of excited states in 93Rb were previously known from beta-decay and isomeric studies [5]. The results from the present measurement allowed for a firm spin and parity assignments of those states and for determining their transition probabilities. The observed gamma-ray spectrum for 95 Rb strongly resembles the one of 93 Rb. This should allow obtaining very similar information on the structure of those assumed spherical nuclei. On contrary the Coulomb excitation spectrum of 97 Rb shows completely different characteristics with a higher number low-energy transition being populated. The gamma-gamma coincidences allowed building a level scheme that indicate the presence of rotational-band like structure in this deformed nucleus. The present status of the analysis will be discussed and the obtained level schemes and transition probabilities would be compared with theoretical calculations.

References

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