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Measurements of competing structures in neutron-deficient Pb isotopes by employing Coulomb excitation

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One of the goals of modern nuclear physics research is to understand the origin of coexisting nuclear shapes and exotic excitations and their relation to the fundamental interactions between the nuclear constituents. These subjects can be investigated particularly well in the Pb isotopes close to neutron mid-shell, where a relatively small proton shell gap, together with a large valence neutron space, provides fertile ground for studies of shape transitions within a small energy range [1-5].

In alpha-decay studies, the first two excited states of the mid-shell nucleus 186Pb were observed to be 0+ states [6]. On the basis of alpha-decay hindrance factors, the second 0+ state was associated with mainly (2p – 2h) configuration, whereas the third 0+ state was associated with a (4p – 4h) configuration. Consequently, together with the spherical ground state [7], the three 0+ states with largely different structures establish a unique shape-triplet in 186Pb. Very recently, rotational bands built on these states were observed in in-beam gamma-ray measurement [8] and their collectivity confirmed in lifetime measurements [9].

In order to establish a complete picture of shape coexistence in this region, the knowledge of transition probabilities from nuclear states assigned with different shapes is essential. Transition probabilities are very sensitive to the details of a nuclear wave function and, consequently, information about nuclear shape and configuration mixing can be inferred. The main objective of IS494 experiment is to carry out the investigations of nuclear collectivity and mixing of the low-lying states in the neutron-deficient Pb nuclei, namely even-mass isotopes 188-192Pb, employing the REX-ISOLDE facility. The isotopes of interest are of particular importance as they lie in so-called transitional region, where a transition from a weaker deformed oblate structure to a strongly deformed prolate structure is proposed for the yrast states.

The first part of IS494 was run in August 2010, in which we collected data for 192Pb nucleus. The 192Pb nuclei were extracted from the ISOLDE UCx target and the post-accelerated beam was delivered to MINIBALL target position. At MINIBALL, the Pb nuclei were Coulomb excited in inverse kinematics using the secondary 112Cd target. MINIBALL Ge-detector array was used to detect gamma-rays de-exciting levels under investigation. Both scattered projectiles and target recoils were detected using an annular double sided silicon strip detector (CD) positioned on the beam axis after the secondary target. In this presentation, preliminary results from that experiment will be discussed.

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