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Rapid Evolution of Collectivity at N=Z : recent results from level lifetime measurements with GRETINA

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Evolution of collectivity in the vicinity of N=Z has attracted a lot of attention due to the large variety of nuclear shapes manifested in the ground and excited states. Above the doubly magic nucleus 56Ni, collectivity in the 2+->0+ transition gradually increases up to 72Kr along N=Z, which is followed by the rapid enhancement of collectivity toward 76Sr[1] and 80Zn with a significant intrusion of the deformation driving g9/2 orbital[2]. Recent lifetime measurement at NSCL quantified B(E2) for the first 2+ state in 76Sr and confirms the large collectivity corresponding to beta=0.45[1]. Additional interest focuses on the pronounced shape coexistence in the A~70 and N~Z region, where prolate and oblate configurations can coexist in a single nucleus or even mix in a single eigenstate.

Here we present recent lifetime measurements[3] of the 2+ and 4+ states in the self-conjugate nucleus 72Kr at N=Z. The occurrence of the oblate ground state in 72Kr[4] has provided unique opportunities to investigate the oblate-prolate shape phase transition along the Kr isotopic chain. In this work, we examined a possible rapid shape transition among the yrast states in 72Kr at low spin. The experiment was performed at NSCL using a combination of state-of-the-art instruments including the next-generation gamma-ray tracking array GRETINA[5]. A novel application of the recoil-distance method based on the use of multi-layer foils was demonstrated by taking advantage of excellent position and energy resolution of GRETINA. The present approach significantly extends the sensitive range of lifetimes that can be covered with a single setup and thus enables us to study several states simultaneously.

In this talk, we will present the excellent performance of GRETINA in the lifetime measurement and discuss our new results in comparison with a variety of theoretical calculations, which points to the possible rapid shape evolution in the yrast states of 72Kr. Perspectives for direct reaction studies on 72Kr will also be discussed.

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