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In-beam gamma-ray spectroscopy of 51K and 53K

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One of the major focus of modern nuclear physics is to explore which part of the nuclear interaction gives rise to significant shell modifications. Recently, the evolution of the 2s1/2+ and 1d3/2+ single-particle states in odd-A K isotopes attract particular interests. The energy gap between these two states decrease continuously when neutrons fill f7/2 orbit. Inversion of the ordering of the 2s1/2 and 1d3/2 orbits has been observed in 47K (N=28) and 49K(N=30). As the neutrons continue filling the orbits beyond the N = 28 shell, reinversion was observed for the first time in 51K using laser spectroscopy. Such reinversion is consistent with the shell model calculations using different effective interactions and was revealed to be mainly driven by the central term of the monopole interaction. However, different interactions predict very different energy gaps between 2s1/2 and 1d3/2 in 51K. In addition, the shell model calculation and the recently available ab initio calculation also predict the reversion in 53K but also with very different energy gaps. The experimental spectroscopy of the excited states in 51K and 53K are thus crucial to benchmark the shell model and ab initio calculations and improve our understanding on the shell evolution mechanisms.

The in-beam gamma-ray spectroscopy measurement of 51K and 53K was carried out at RIBF at RIKEN, as part of the third campaign of the SEASTAR program. The low-lying states of 51K and 53K were populated via 52Ca(p, 2p) and 54Ca(p, 2p), respectively. In the presentation, I will report on the energy level scheme of 51,53K, exclusive cross sections and the individual parallel momentum distributions.

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