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Study of N=34 sub-shell closure in 54Ca from knock-out reaction

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The structure of neutron-rich Ca isotopes have attracted interest from both experimental and theoretical side for a decade. The N=32 sub-shell gap is found to be well established from the measured 2+ energy in 52Ca[1]. Recently, with the availability of intense radioactive beam, the N=34 sub-shell closure was also found experimentally in 54Ca[2]. To quantitatively study the nature of N=34 sub-shell closure, the spectroscopic factor of 54Ca(p,pn) reaction is a useful index. Besides, the 53Ca nucleus, located in between 52Ca and 54Ca, its single-particle properties of low-lying states are of importance to the study of structures for very neutron-rich Ca isotopes above 54Ca and shell evolution towards the potential sub-shell closure nucleus 60Ca. We therefore performed 54Ca(p,pn) experiment at the RIBF facility of the RIKEN Nishina Center.

In this experiment, proton induced neutron knock-out cross sections from 54Ca ground state to individual final states of 53Ca have been investigated. The in-beam gamma-ray spectroscopy technique has been employed to tag the final states in 53Ca. The exclusive cross section as well as the residues momentum distribution to individual final states have been measured. The spectroscopic factors deduced from the experimental knock-out cross sections and momentum distribution of the residues to individual final state will be compared to the reaction theory for quantitative structure study. In this report, the experimental setup as well as the preliminary result of data analysis will be presented.

[1] A. Gade et al., Phys. Rev. C 74,021302 (R) (2006)
[2] D. Steppenbeck et al., Nature, 502, 207-210, (2013)

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