Contribution ID: **47** Type: **not specified**

Shape coexistence and E0 transition from the superdeformed band in 40Ca

Thursday, 9 March 2023 14:30 (30 minutes)

The spherical doubly magic nucleus, 40Ca, is a good example exhibiting shape coexistence [1]. A unique feature of this nucleus is an appearance of low-lying 0+ states. First exited state is 0+ at 3.3 MeV and the second excited 0+ state closely locates at 5.2 MeV. These states are understood as band heads of the normal deformed and the superdeformed bands, respectively [2,3], which corresponds to the multiple shape coexistence in 40Ca.
Existence of the superdeformed band starting from the 0+ band head is another unique feature of 40Ca. Although the existence of superdeformed nuclei are reported in many nuclei of various mass regions, A=60, 80, 130, 150, 190 [4], the superdeformed band head 0+ states are only observed in mass 40 region [5,6], and in the fission isomer region [4]. Such situation makes it difficult to understand the property of superdeformed state, such as the mixing of the states with different configurations. Therefore, 40Ca is a quite unique nucleus where one can study the electric monopole (E0) transition strength between the band head of superdeformed state and the spherical ground state, which directly reflects the shape mixing [7]. In order to study the property of superdeformed state of 40Ca, we have performed an experiment to measure the E0 transition from the excited 0+ states. Experiment was carried out using a 40Ca(p,p') reaction at the 14UD tandem accelerator facility in Australian National University. The Super-e pair spectrometer [8,9,10], a superconducting magnetic-lens spectrometer, is employed to measure conversion electrons and electron-positron pairs with excellent background suppression. A single germanium detector was also used to measure gamma transitions from the excited states simultaneously.
In the presentation, the experimental results on E0 transition strength from the normal deformed and superdeformed band in 40Ca and the theoretical studies based on the large-scale shell model calculation will be discussed.

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Experimental study on nuclear physics

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Session Classification: Session 11