Contribution ID: **40** Type: **Oral**

Neutron-proton pairing and double-beta decay nuclear matrix element

Friday, 20 October 2017 15:30 (20 minutes)

Isovector/isoscalar neutron-proton pairing interaction is known to suppress the Fermi/Gamow-Teller nuclear matrix element. This effect of the neutron-proton pairing was known from the quasiparticle random-phase approximation (QRPA) calculation. However, the QRPA breaks down at the phase transition from the normal like-particle superconducting phase to the neutron-proton pair superconducting phase, and its accuracy is questionable if the strength of the attractive neutron-proton pairing interaction gives the situation close to the point of the phase transition.
We use the generator coordinate method for calculating the nuclear matrix elements. By including the neutron-proton pairing degrees of freedom in addition to the quadrupole deformation as generator coordinates, we expect accurate description of the initial/final states near or even beyond the point of the phase transition. We discuss the nuclear matrix elements for 76Ge [1]. The GCM with neutron-proton pairing has been also applied to light pf-shell nuclei and it has reproduced the shell model results of the Gamow-Teller nuclear matrix elements [2]. Preliminary results for the nuclear matrix elements for 48Ca double-beta decay and the effect of the neutron-proton pairing there will be also discussed.

[1] N. Hinohara and J. Engel, Phys. Rev. C90, 031301(R) (2014).
[2] J. Menendez, N. Hinohara, J. Engel, G. Martinez-Pinedo, and T.R. Rodriguez, Phys. Rev. C93, 014305 (2016).

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Session Classification: Parallel