

# Large-Scale Shell-Model Studies for Exotic Nuclei and Nuclear Level Densities

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Shell-model calculation is one of the most powerful tools for studying the nuclear structure of medium-heavy nuclei. Recent developments of high-performance computing enhance the feasibility of large-scale shell-model calculations. In this talk, I will overview our recent achievements of shell-model studies concerning neutron-rich exotic Ni isotopes [2] and the nuclear matrix element of the neutrinoless double-beta decay [1]. I will also report the recent application of the shell-model calculations to the study of level densities. A novel method to obtain level densities was introduced based on a shifted Krylov-subspace method. It enabled us to study both low-lying spectroscopy and the experimentally observed equilibration of  $J^\pi = 2^+$  and  $2^-$  states in  $^{58}\text{Ni}$  in a unified manner [3].

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- [3] N. Shimizu, Y. Utsuno, Y. Futamura, T. Sakurai, T. Mizusaki and T. Otsuka, Phys. Lett. B **753**, 13 (2016).