PAIRING NAMBU-GOLDSTONE MODES AND BINDING-ENERGY DIFFERENCES OF EVEN-EVEN NUCLEI

Nobuo Hinohara[1,2], Witold Nazarewicz[3]
[1] Center for Computational Sciences, University of Tsukuba, Tsukuba 305-8577, Japan
[2] FRIB Laboratory, Michigan State University, East Lansing, Michigan 48824, USA
[3] Department of Physics and Astronomy and FRIB Laboratory, Michigan State University, East Lansing, Michigan 48824, USA

Nuclear pairing is one of the important collective correlations in atomic nuclei associated with the spontaneous gauge-symmetry breaking. The experimental odd-even mass differences and theoretical pairing gaps are usually used to adjust the coupling constants of the pairing energy density functional (EDF) in the nuclear density functional theory (DFT), but the form of the pairing functional has not been explored well, primarily because the pairing gaps are not experimental observables in the strict sense and they do not have sensitivities to the details. Pairing relevant observables that are easily accessible in terms of the nuclear DFT is desirable to deepen understanding of the nuclear pairing property.

We assessed the performance of the nuclear DFT for pairing rotational bands in even-even nuclei by employing the linear response formalism of the nuclear DFT for the Nambu-Goldstone modes, and concluded that the moments of inertia for the pairing rotational bands are excellent indicators of the nuclear pairing. They involve even-even systems only, thus they are free from the less-known time-odd part of the EDF. The pairing-rotational moment of inertia directly corresponds to the experimental double binding-energy differences. The formalism gives a unified interpretation of the double binding energy differences known as two-nucleon shell gaps δ_{2n}, δ_{2p}, and the proton-neutron interaction energy δV_{pn}. Finally, we discuss the importance of the mass measurements in very neutron-rich semi-magic nuclei for constraining the pairing EDF through the pairing-rotational moment of inertia.