Project Title:

Study of nuclear structure by using many-body theory

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Atomic nucleus consists of nucleons (protons and neutrons) interacting each other with the so-called nucleon-nucleon (NN) forces. The structure of atomic nucleus can be studied via many-body theories. Some of them are the well-known random-phase approximation (RPA) and/or the Bardeen-Cooper-Schrieffer (BCS) theory. These theories produce very well the properties of infinite systems such as superconductors, where the quantal and thermal fluctuations are zero or very small.

However, our recent studies have shown that these fluctuations are significant in finite systems such as atomic nuclei. As the result, the physical properties of nuclear systems are changed due to the effects of quantal and thermal fluctuations. Therefore, the conventional many body theories need to be modified to include the effects of these fluctuations when they are applied to atomic nucleus.

Recently, we have proposed a self-consistent quasiparticle RPA (SCQRPA) taking into account the effects of quantal and thermal fluctuations. The SCQRPA has been tested and the results obtained are in reasonable agreements with the exact solutions of the model cases as well as those obtained within the quantum Monte-Carlo method for realistic nuclei.

The purpose of our present project is to apply the SCQRPA to several realistic nuclei, especially to neutron-rich nuclei to study several properties of atomic nuclei such as

+ Nuclear pairing properties at zero temperature, finite temperature, and finite angular momentum,
+ Ground-state correlations and collective motions of atomic nuclei,
+ Nuclear giant and pygmy dipole resonances,
+ BCS-BEC transition in finite systems,
+ Nuclear viscosity.

Fiscal Year 2012 List of Publications Resulting from the Use of RICC

[Publication]

1. N. Quang Hung and N. Dinh Dang, Specific shear viscosity in hot rotating systems of paired fermions, Phys. Rev. C 86, 024302 (2012).
2. N. Dinh Dang and N. Quang Hung, Giant dipole resonance in 201Tl at low temperature, Phys. Rev. C 86, 044333 (2012).
3. N. Quang Hung and N. Dinh Dang, Pairing reentrance in hot rotating nuclei, RIKEN Accel. Prog. Rep 45, 42 (2012).