

**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 the random-phase approximation (RPA) 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 well-known many body theories need to modify to include the effects of these fluctuations when they are applied to atomic nucleus.

That was the goal of our works, where we proposed a self-consistent quasiparticle RPA (SCQRPA) taking into account the effects of quantal and thermal fluctuations. The SCQRPA provided 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 study is to apply the SCQRPA to several realistic nuclei, especially to neutron-rich nuclei, and compare the results obtained within present approach with experimental data.

## Fiscal Year 2009 List of Publications Resulting from the Use of RICC

### [Publication]

1. N. Quang Hung and N. Dinh Dang, *Exact and approximate ensemble treatments of thermal pairing in a multilevel model*, Phys. Rev. C 79, 054328 (2009)
2. N. Dinh Dang, N. Quang Hung and P. Schuck, *BCS-BEC transition in finite systems*, RIKEN Accel. Prog. Rep. 42, 54 (2009) (no acknowledgments due to the limitation of page numbers, 1-page maximum)
3. N. Quang Hung and N. Dinh Dang, *Thermodynamical ensemble treatments of nuclear pairing in a multilevel model*, RIKEN Accel. Prog. Rep. 42, 53 (2009) (no acknowledgments due to the limitation of page numbers, 1-page maximum)

### [Proceedings, etc.]

N. Dinh Dang and N. Quang Hung, *Nuclear pairing at finite temperature and angular momentum*, AIP Conf. Proc. 1090, 179 (2009) (no acknowledgments due to the limitation of page numbers, 4-page maximum)

### [Oral presentation at an international symposium]

N. Quang Hung, *Ensemble treatments of thermal pairing in nuclei*, Oral Talk at The 3rd joint meeting of Nuclear Physics Division of American Physical Society (APS) and Japan Physical Society (JPS), Oct. 11-17, 2009, Kona's Big Island, Hawaii, USA.