RICC Usage Report for Fiscal Year 2014

Project Title:

Properties of highly excited Nuclei

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The study of nuclear properties at extreme limits of temperature, spin, and iso-spin etc are possible due to the developments in experimental facilities. The giant dipole resonance (GDR) is a fundamental mode of nuclear collective excitation. GDR is considered to be an important tool to probe the nucleus at these extremes. Recently, number of experimental results is available for the GDR measurements at low temperatures. We have studied the properties of low temperature GDR within the framework of thermal shape fluctuation model (TSFM). The GDR widths obtained with TSFM calculations at low temperatures are not able to explain the experimentally measured GDR width. The TSFM overestimates the GDR width at low temperatures. At low temperatures the pairing effects are more dominant, but this is not included in TSFM. The success of a proper pairing approach suggests the necessity of including pairing correlations to cure this shortcoming of the TSFM. We have carried out the TSFM calculations with proper treatment of pairing and its fluctuations along with the thermal shape fluctuations.

We have performed the shape fluctuation and pairing fluctuation calculations in numerically exact method with the free energies and the observables calculated exactly at the integration mesh points. These calculations consume a lot of time and require advanced computing facilities. I have used the RIKEN RICC computation facility to do a part of these calculations.

We have constructed for the first time a theoretical framework to study the GDR with proper treatment of pairing and its fluctuations and the temperature dependent shell corrections along with the thermal shape fluctuations. We can successfully explain the recently observed quenching of GDR width at low temperature with our formalism. The important results are published in Physical Review C [Phys. Rev. C 90, 044308 (2014)].

We can extend our model to understand the role of temperature and angular momentum in pairing along with thermal shape fluctuations and fluctuations in pairing filed, occurrence of pairing reentrance. The study of nuclei far from stability requires better understanding about the nuclear pairing is one of the essential factors defining the limits of nuclear existence. In future also I wish to continue using Riken RICC facility.

Fiscal Year 2014 List of Publications Resulting from the Use of RICC

[Publication]

A.K. Rhine Kumar, P. Arumugam, and N. Dinh Dang.,
Pairing effect in the thermal shape-fluctuation model on the width of the giant dipole resonance,
Phys. Rev. C 90 (2014) 044308.