

Project Title:**Properties of finite systems including nuclei at high temperature and angular momentum (Properties of highly excited nuclei)****Name:****Nguyen Dinh Dang, Nguyen Quang Hung, A.K. Rhine Kumar, Le Tan Phuc****Laboratory at RIKEN: Quantum Hadron Physics**

1- In collaboration with A.K. Rhine Kumar (Mumbai), P. Arumugam (Roorkee) and I. Mazumdar (Mumbai), calculating the giant dipole resonance (GDR) observables within the thermal shape fluctuation model by considering the probability distributions of different angular momentum and temperature values estimated recently in the deexcitation process of the compound nucleus ^{88}Mo . These results are found to be very similar to the results obtained with the average T average I corresponding to those distributions. The shape transitions in ^{88}Mo at different T and I are also studied through the free energy surfaces calculated within the microscopic-macroscopic approach. The deformation of ^{88}Mo is found to increase considerably with T and I, leading to the Jacobi shape transition at high I. The combined effect of increasing deformation, larger fluctuations at higher T, and larger Coriolis splitting of GDR components at higher I, leads to a rapid increase in the GDR width. This work was published in Phys. Rev. C.

2- In collaboration with N. Quang Hung and L.T. Quynh Huong, calculating the nuclear temperature from the derivative of the logarithm of the level densities in $^{60-62}\text{Ni}$ and $^{170-172}\text{Yb}$. The latter are obtained within a method, which includes exact pairing for the levels around the Fermi surface in combination with the independent particle model for the rest of the single-particle spectrum. It is found that the increase in this temperature is relatively slow up to the excitation energy $E = E_f$ so that, between

0 and E_f the level density can be described well by the constant-temperature model. The values of E_f are found to be 10 MeV for $^{170-172}\text{Yb}$ and 20 MeV for $^{60-62}\text{Ni}$, that is much higher than the particle separation threshold. Within this energy interval, the constant temperature is found to be around 0.5 MeV for $^{170-172}\text{Yb}$, whereas for $^{60-62}\text{Ni}$ it can be any value between 1.3 and 1.5 MeV, in excellent agreement with the recent experimental finding. It is also shown that pairing plays an important role in maintaining this constant temperature at low excitation energy. This work was published in Phys. Rev. C.

3- In collaboration with N. Quang Hung, L. Tan Phuc (PhD student of the HoChiMinh University of Sciences), and the Indian experimental nuclear physicists, studying the level density and thermodynamics in the hot rotating ^{96}Tc nucleus, where the experimentalists measured and extracted the level densities for the first time at finite excitation energy and finite angular momenta $J = 12\hbar$ and $16\hbar$ by using the reaction $^4\text{He} + ^{93}\text{Nb}$ at $E(^4\text{He}) = 28$ MeV. The experimental data were compared with the results of different microscopic calculations such as HFBCS, HFBC, as well as the exact pairing plus independent particle model developed by us (EP+IPM). It is observed that EP+IPM explains rather well the experimental data. This work was published in Phys. Rev. C.

Fiscal Year 2017 List of Publications Resulting from the Use of the supercomputer

[Publication]

- 1) A. K. Rhine Kumar, P. Arumugam, **N. Dinh Dang**, and I. Mazumdar, [Phys. Rev. C. 96 \(2017\) 024322](#).
- 2) **N. Dinh Dang**, N. Quang Hung, and L.T. Quynh Huong, [Phys. Rev. C 96 \(2017\) 054321](#).
- 3) B. Dey, D. Pandit, S. Bhattacharya, N. Quang Hung, **N. Dinh Dang**, L. Tan Phuc, D.Mondal, S. [Phys. Rev. C 96 \(2017\) 054326](#).

[Proceedings, etc.]

N. Dinh Dang, N. Quang Hung, and L.T. Quynh Huong,
Role of exact pairing in the description of nuclear level density and radiative strength function, in Proc. of the [12th International Spring Seminar on Nuclear Physics Current Problems and Prospects for Nuclear Structure, May 15-19, 2017, Sant'Angelo d'Ischia, Italy](#).

to be published in J. Phys.: Conf. Series.

[Oral presentation at an international symposium]

- 1) N. Dinh Dang, *Simultaneous Microscopic Description of Nuclear Level Density and Radiative Strength Function*, invited talk at [6th Workshop on Nuclear Level Density and Gamma Strength, May 8 - 12, 2017, Oslo, Norway](#).
- 2) N. Dinh Dang, *Role of exact pairing in the description of nuclear level density and radiative strength function*, invited talk at [12th International Spring Seminar on Nuclear Physics Current Problems and Prospects for Nuclear Structure, May 15-19, 2017, Sant'Angelo d'Ischia, Italy](#).

[Others (Press release, Science lecture for the public)]

Major step forward in theoretical description of two key properties of hot nuclei, RIKEN Press Release, 13 January 2017