Project Title:

Properties of highly excited nuclei

Name:

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1 - In collaboration with theorists from India, we developed a microscopic model based on the random phase approximation (RPA), which is extended to the finite temperature. In this model, fluctuations in shape and pairing field are calculated within the thermal shape fluctuation model (TSFM) extended to include the fluctuations in pairing field. The shell corrections and the results of the microscopic model for the GDR are both calculated by utilizing a realistic triaxial Wood-Saxon (WS) Hamiltonian. We discussed our results for the nuclei ^{97}Tc, ^{120}Sn, ^{179}Au, and ^{208}Pb and corroborate with the available experimental data. We also compared the results obtained within the macroscopic model for GDR and showed that, despite having fewer parameters than the macroscopic model, the microscopic model could reproduce the experimental trend in GDR width at lower T in both the Sn and the Pb regions. More precise measurements in lower temperature regions can yield richer information about phase transitions in warm nuclei.

2 - In collaboration with experimentalists and theorists from India and Vietnam, we studied the pairing phase transition in an odd-even hot rotating ^{69}Zn nucleus by using the nuclear level density (NLD) data, which were experimentally extracted from the γ-gated particle spectra. The experimental NLDs have been compared with those obtained within the microscopic exact pairing plus independent-particle model at finite temperature (EP+IPM) along with the results of other microscopic calculations such as Hartree-Fock BCS (HFBCS) and Hartree-Fock-Bogoliubov plus combinational (HFBC) methods. It is found that the experimental NLDs can be well described by the EP+IPM using the recommended quadrupole deformation parameter β_2 rather than by the HFBCS and HFBC. Intriguingly, the heat capacity calculated using the EP+IPM NLD exhibits a sharp S-shape, which is not expected in such even-odd system as reported earlier. Changing the deformation parameter β_2 does not change much this S-shape. However, increasing or decreasing the pairing gaps could enhance or destroy the S-shaped heat capacity. Therefore, the S-shaped heat capacity in even-odd ^{69}Zn nucleus is explained due to the deformation induced pairing correlation.

Plan for next year

My contract with RIKEN will end on 31st March 2023. Consequently, I will be retired from 1st April 2023. I may consider continuing my research with my current collaborators on a part-time basis provided their positions as RIKEN visiting researchers are renewed.

No job was executed on RIKEN computer because we managed to carry out all the calculations in this FY on the personal PC. However, we would like to keep our account of Quick Use for the FY2022 in case of need, if possible, as my colleagues are planning to visit RIKEN to work with me on the spot in the future. Thank you.