Abstract ID : 71

A comprehensive view of nuclear shapes, rotations and vibrations from fully quantum mechanical perspectives

Content

he ellipsoidal deformation of nuclear shapes has been one of the central questions of nuclear structure physics. Fully microscopic approaches with a full range of possible relevant correlations have been naturally difficult. Just recently, such approaches became feasible by using the Monte Carlo Shell Model, particularly by its most advanced version Quasiparticle Vacuua Shell Model (QVSM). In parallel to such computational development, there have been some interesting progresses in the studies on the underlying mechanisms and/or the characteristics of collective bands. It will be shown that the prevailing of triaxial shapes occurs for heavy deformed nuclei (i) due to the restoration of rotational symmetry and (ii) due to particular components of nucleon-nucleon interaction, such as tensor force and hexadecapole part of the central force, between proton and neutron. The gamma (double gamma) band appears not as a vibrational excitation but as a K=2 (K=4) rotation. In fact, the K quantum number is shown to be practically conserved, providing us with a nice classification of collective bands with substantial triaxialities. Beside rotational excitations, vibrational modes are also described, within the quantum many-body framework, for both deformed and nearspherical cases. The former cases show various bands at higher energies, including some relatively low-lying beta bands in some nuclei. The latter case exhibits vibrational excitations from weakly deformed (not spherical) ground states, with characteristic ratios of excitation energies and B(E2) values. However, the interpretation of the so-called two-phonon triplet is very different from the conventional picture. Thus, we present an overall new picture of nuclear quadrupole collectivity as a consequence of nucleon-nucleon interactions in the quantum many-body framework, which shows visible differences from conventional ones.

[1] T. Otsuka, Y. Tsunoda, N. Shimizu, Y. Utsuno, T. Abe, H. Ueno, arXiv: 2303.11299v8 [nucl-th]

Primary author: OTSUKA, Takaharu (University of Tokyo, Tokyo, Japan)

Presenter: OTSUKA, Takaharu (University of Tokyo, Tokyo, Japan)

Status: SUBMITTED

Submitted by GARGANO, Angelina on Thursday, 20 March 2025