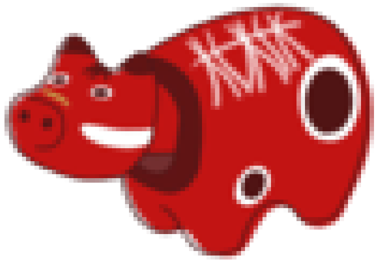

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Semiclassical origin of nuclear exotic deformations and their systematics

Wednesday, 5 March 2025 11:50 (20 minutes)

The shapes of nuclei are essentially determined by the single-particle shell structures. Semiclassical periodic orbit theory (POT) gives us a very powerful tool in describing the origin of gross shell structures and their properties. The POT formula expresses the quantum level density in terms of the contributions of classical periodic orbits (POs). The major gross shell structure is governed by the shortest PO, and finer structures are reproduced as the interference effect by superposing the contributions of longer POs. In this talk, I will discuss the origin of the systematics in nuclear octupole and hexadecapole deformations. The breaking of reflection symmetry is one of the most important topics in nuclear structure physics. It is suggested experimentally and theoretically that the ground-state octupole deformation exclusively appear around the 'north-east' neighbors of doubly magic nuclei on the nuclear chart. This systematics has been long attributed to the octupole correlations between nearly-degenerate $\Delta l = 3$ levels above the fermi energy, but I would like to emphasize the significance of the role of gross shell structure originated from a particular PO family and its bifurcation. To clarify the essential feature, numerical analyses are carried out with the simple mean-field models. The hexadecapole shape degree of freedom also play important roles in stabilizing nuclei. It is suggested that on the way varying nucleon numbers from a spherical magic to the upper magic one, diamond-type hexadecapole shapes (with $\beta_4 > 0$) appear first and then turn into oblong-types (with $\beta_4 < 0$). This simple systematics found in realistic mean-field models are also reproduced in simpler mean-field models as cavity and oscillator. I will show that the origin of such systematics can be explained in a simple manner using the POT in relation to the dynamical symmetry restorations.

Type of contribution

Are you a student or postdoc?

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