ANOMALOUS LINEAR-ALPHA-CLUSTER STRUCTURE AND ROD SHAPE NUCLEI WITH COVARIANT DENSITY FUNCTIONAL THEORY

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In this talk, recent investigations on the 4α-linear-chain structure in high-lying collective excitation states of ^{16}O [1] and anomalous rod shape in Carbon isotopes [2] in the framework of the cranking covariant density functional theory will be presented.

For the study of the 4α-linear-chain structure in high-lying collective excitation states of ^{16}O [1], the low-spin states are obtained by configuration mixing of particle-number and angular-momentum projected quadrupole deformed mean-field states with the generator coordinate method. The high-spin states are determined by cranking calculations. These two calculations are based on the same energy density functional PC-PK1. We have found a rotational band at low spin with the dominant intrinsic configuration considered to be the one whereby 4α clusters stay along a common axis. The strongly deformed rod shape also appears in the high-spin region with the angular momentum $13\hbar$ to$18\hbar$, however, whether the state is a pure 4α linear chain is less obvious than for the low-spin states.

In order to understand the stabilizing mechanism in the anomalous α-linear-chain structure and rod shape, the Carbon isotopes has been investigated in the framework of the cranking covariant density functional theory. Two mechanisms to stabilize such novel shape with respect to the bending motion, extreme spin and isospin, are simultaneously discussed for the first time in a self-consistent and microscopic way. By adding valence neutrons and rotating the system, we have found the mechanism stabilizing the rod shape, i.e., the \sigma-orbitals (parallel to the symmetry axis) of the valence neutrons, important for the rod shape, are lowered by the rotation due to the Coriolis term. The spin and isospin effects enhances the stability of the rod-shaped configuration. This provides a strong hint that a rod shape could be realized in nuclei towards extreme spin and isospin.

REFERENCES

[1] J. M. Yao, N. Itagaki, and J. Meng, Phys. Rev. C 90 (2014) 054307.
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