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Theory Predictions of Exotic Nuclear Symmetries and Spontaneous Symmetry Breaking: Identification Methods

Over the past few years, there has been an increasing interest in exotic nuclear shapes and accompanying symmetries in low energy subatomic physics, both from theory and experimental points of view. We are going to address theoretical calculations employing realistic nuclear structure Hamiltonians to provide trustworthy predictions of the still unknown quantum mechanisms; new concepts are also needed to construct experimental identifications of the predicted effects.

We wish to present new developments in this field resulting from large scale calculations with a realistic *phenomenological mean-field Hamiltonian* based on the so-called universal, deformed *Woods-Saxon potential* - combined with powerful mathematical tools, such as *Inverse Problem Theory* and *Group-, and Group Representation Theories*, which allowed for model parameter and predictive power stabilisation.
Using this approach we were able to provide theory contributions to new experimental proposals related to high-rank symmetries predicted to be present along the whole Nuclear Chart as well as exotic isomer phenomena.

We focussed on Tetrahedral T_d and Octahedral O_h symmetries. They are known to cause vanishing of collective $B(E1)$ and $B(E2)$ transition probabilities at the exact symmetry limits, what produces specific difficulties in feeding of the tetrahedral symmetry states and their decay, Ref.[1]. These properties make the experimental detection of such bands extremely challenging, but at the same time induce the presence of exotic isomeric states which may generally facilitate studies of exotic nuclei. We formulate new methods of identification of these exotic states with the help of rotational bands with the structures never seen before. For example, T_d band sequence is built out of the states mixing parities and odd and even spins
$\mathrm{A}_1 \leftrightarrow I^\pi : 0^+, 3^-, 4^+, 6^+, 6^-, 7^-, 8^+, 9^+, 9^-, 10^+, 10^-, ... Followingarecentdiscoveryofthesimultaneouspresenceandcompeti$
$octahedralandtetrahedralsymmetries*in^{152}$Sm, Ref.[2], we discuss the newly obtained results, including the world-first identification of a second T_d band in the same nucleus. The new results allow for the interpretation of the obtained spectra in terms of the "spontaneous symmetry breaking", an exotic mechanisms never seen before, cf. Ref.[3].

References

[1] S. Tagami, Y. R. Shimizu, and J. Dudek, Phys. Rev. C **87**, 054306 (2013)

[2] J. Dudek, D. Curien, I. Dedes, K. Mazurek, S. Tagami, Y. R. Shimizu, and T. Bhattacharjee, Phys. Rev. C **97**, 021302(R) (2018)

[3] S. Basak, D. Kumar, T. Bhattacharjee, I. Dedes, J. Dudek, *et al.*, Phys. Rev. C **111**, 034319 (2025)

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