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Title: **Quantum Rotor - A Powerful Tool in Studying Nuclear Symmetries**

Author(s): J. Dudek,[1] A. Góźdź,[1,2] and D. Rosły[2]
Affiliation(s): [1]*Institut de Recherches Subatomiques, IN2P3-CNRS/Université Louis Pasteur F-67037 Strasbourg Cedex 2, France*
[2]*Institute of Physics, Marie Curie-Skłodowska University Pl-20031 Lublin, Poland*

Many nuclear physicists would most likely say that quantum rotors in nuclear structure physics are very well known objects. The knowledge usually quoted would concern first of all the properties of the hamiltonians that resemble those of a triaxial rotating ellipsoid, possibly coupled to one or some (quasi-) particles and/or to collective vibrations. The symmetry aspects other than those of an ellipsoid, the latter nicknamed with the keyword D_{2h}-symmetry, are nearly absent in the nuclear structure literature, with the notable exception of Ref. [1] where the authors analyze a particular symmetry hypothesis related to nuclear superdefomation. But even the 'elementary' D_{2h}-symmetry is not really exploited in nuclear structure physics. It seems that a part of the reason for such a 'neglect' consists in some specific experimental difficulties encountered when studying the rotors down to sufficiently sophisticated level - but only a part. We believe that with the contemporary level of experimental/instrumental sensitivity much more can be done in this domain as the example of the experimental analyses of the so-called $(\Delta I = 2)$-staggering demonstrates. Despite the existence of positive examples like those quoted, a comparison to what one can find in the literature of other domains of physics, in particular in molecular physics, shows the nuclear structure field as rather underdeveloped.

In the present article we address the problem of studying symmetries through characteristic features of the underlying rotor spectra focusing on the normal-deformed (as opposed to super-deformed) nuclei.

We are going to introduce what we call a generalized rotor hamiltonian that allows to express any point-group nuclear symmetry. This is done through an expression of the rotor hamiltonian with the help of a suitably constructed tensor-operator expansion. We illustrate briefly microscopic results concerning shape isomerism with a particular focus on the normally-deformed nuclei that manifest symmetries *other than* D_{2h}. To introduce the discussion of symmetries we do begin by illustrating the relatively less known (or unknown) properties of the D_{2h} rotors. We mention the problems related to the experimental verifications of the theoretical predictions as well as the problem of possible non-unique manifestations of the rotor symmetries: usually, the manifestations of rotor symmetries through the energy spectra can only be formulated in terms of necessary- but not necessary-and-sufficient conditions. Analogies related to some specific molecular phenomena will be used in parallel to the discussion of purely nuclear physics phenomena together with the simulations of the electromagnetic feeding and deexcitation patterns for rotational bands.

References

[1] I. Hamamoto and B. Mottelson, Phys. Lett. **33**, 294 (1994); Phys. Scripta **T56** 27 (1955).

Invited talk.