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Systematic Search for Tetrahedral and Octahedral Symmetries In Subatomic Physics: Follow-up of the First-Discovery Case

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In a recent ref. [1] group representation methods have been applied to the nuclear point-group symmetries and combined with realistic mean-field calculation results together with the new specifically designed methods of experimental analysis. The authors demonstrated that existing in the literature experimental data on 152Sm are fully compatible with the extremely restrictive group-theory criteria of simultaneous presence of tetrahedral and octahedral symmetries.

We discuss the theoretical predictions related to the systematic presence of these symmetries throughout the periodic table. Interestingly enough, in some nuclei the presence of one of the two symmetries are predicted whereas in some others theory predictions are compatible with the interpretation of spontaneous octahedral symmetry breaking by its tetrahedral partner (tetrahedral symmetry group is a sub-group of the octahedral one). The corresponding theory predictions aim at an optimisation of the propositions of new experiments, which would employ the advanced mass-spectrometry methods, ref. [2] –in view of the new experimental search criteria of ref. [1]. Since part of the predictions indicates that several exotic nuclei are concerned, we employ the parameter optimisation methods based on the so-called inverse problem theory, ref. [3].

The addressed field of symmetry-research presents particularly promising potentialities in the domain of exotic nuclei studies. Indeed, as it can be demonstrated, in the exact tetrahedral and/or octahedral symmetry limits the corresponding nuclei emit neither E2 nor E1 radiation generating isomeric states with lifetimes which are much longer than the related ground states.

Bibliography

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[2] T. Dickel and Ch. Scheidenberger, private communication
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