From Exact to Partial Dynamical Symmetries: Lessons From the Interacting Boson Model

A. Leviatan

Racah Institute of Physics, The Hebrew University, Jerusalem 91904, Israel

The concept of dynamical symmetry is now widely accepted to be of central importance in our understanding of many-body systems and had a major impact on developments in diverse areas of physics. Its basic paradigm is to write the Hamiltonian of the system under consideration in terms of Casimir operators of a set of nested algebras. Its hallmarks are (i) solvability of the complete spectrum, (ii) existence of exact quantum numbers for all eigenstates, and (iii) pre-determined symmetry-based structure of the eigenfunctions, independent of the Hamiltonian's parameters. The merits of a dynamical symmetry are self-evident. However, in most applications to realistic systems, the predictions of an exact dynamical symmetry are rarely fulfilled and one is compelled to break it. More often one finds that the assumed symmetry is not obeyed uniformly, *i.e.*, is fulfilled by only some states but not by others. The need to address such situations has led to the introduction of partial dynamical symmetries (PDSs) [1]. The essential idea is to relax the stringent conditions of *complete* solvability so that the properties (i)-(iii) are only partially satisfied. In the present contribution we exploit the rich algebraic structure of the Interacting Boson Model to explain the PDS notion and present algorithms for constructing quantum Hamiltonians with only a subset of solvable states. PDSs of various types will be shown to be relevant to nuclear spectroscopy, to quantum phase transitions and to mixed systems with coexisting regularity and chaos. Special emphasis in this construction will be paid to the role of higher-order terms.

[1] A. Leviatan, Prog. Part. Nucl. Phys. **66** (2011) 93.