

Preface

A major part of research in physics involves solving the Schrödinger equation. While one-body motion in a potential field and a two-body system with mutual interaction are subject matters of standard texts of Quantum Mechanics, an *ab initio* formal solution of the many-body Schrödinger equation for interacting many-body systems is not commonly encountered. The reason for this is that mathematical complexity increases enormously as the number of particles increases from two to three. It is not just the difficulty arising from the increasing number of position coordinates, but also the difficulty in imposing the desired symmetry of the system, identification of appropriate conserved quantum numbers, etc. Naturally, physicists tend to depend on *approximate many-body techniques* e.g. Born-Oppenheimer approximation, variational and perturbation techniques, mean-field theories like Hartree-Fock and Hartree-Fock-Bogoliubov methods, etc. or on the use of models, e.g., shell, collective or liquid drop models in Nuclear Physics. However, a number of problems involving systems containing *a few* particles demand description in terms of coordinates of individual particles. In such cases it is necessary to handle the few-body Schrödinger equation in an exact manner. Hyperspherical harmonics is the appropriate basis for this. With developments in mathematical and computational tools, it is becoming increasingly easy to handle the hyperspherical harmonics basis. Hence it is becoming popular as an effective tool in theoretical research. The hyperspherical technique is quite handy for use in the essentially exact Monte Carlo methods for a fairly large number of interacting particles. Unfortunately, there is a dearth of monographs dealing with the hyperspherical technique. This monograph is aimed at fulfilling this necessity. Besides introducing the hyperspherical variables (which are many-body generalization of ordinary spherical polar coordinates) and hyperspherical harmonics basis for the expansion of a many-body wave function, methods to introduce desired symmetry of the wave function has been discussed. Approximation methods, which simplify the calculations, without losing sight of the interesting physics sought after, have also been included. Finally, discussion of a number of current topics in physics like

Bose–Einstein condensation, where this technique has been very useful, have been incorporated.

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Application to Problems in Physics

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