

Title: Many-body methods within the nuclear Lipkin model

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Abstract: The subject of the present thesis is the Lipkin model, a two-level degenerated quantum system enhanced by two-body interactions. The exact solutions and properties of the model are reviewed and summarized. Several many-body methods common in nuclear physics are used to solve the eigenvalue problem of the time-independent Schrödinger equation. The many-body methods applied to the Lipkin model in the present thesis are the Hartree-Fock mean-field method, the random phase approximation, the Tamm-Dancoff approximation, and the Bardeen-Cooper-Schrieffer method. We propose an instructive iterative extension to the random phase approximation method. For the listed methods, we provide a comprehensive comparison of the approximation quality for either the ground state energy or excited state energies.

Keywords: Lipkin model, Hartree-Fock mean-field method, random phase approximation, Bardeen-Cooper-Schrieffer method