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AN INTEGRABLE AND EXACTLY SOLVABLE NON-HERMITIAN BCS HAMILTONIAN AND GENERALISED EXCLUSION STATISTICS

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It is more than three decades since the quantum inverse scattering method and the algebraic Bethe ansatz have been presented and applied in the area of many body quantum systems. These methods are playing crucial roles in the development of novel integrable and exactly solvable models. The purpose of the present thesis is to apply the quantum inverse scattering method to new contexts.

The first system under consideration describes the interactions of spin-half impurities in an isotropic Heisenberg spin chain with periodic boundary condition. By employing the quantum inverse scattering method and Bethe ansatz techniques, the Hamiltonian, Bethe ansatz and associated eigenvalues of the model are derived. The properties of the system are also discussed.

The main results of the thesis are obtained from an integrable and exactly solvable non-Hermitian Bardeen–Cooper–Schrieffer (BCS) pairing Hamiltonian with two independent, real-valued coupling parameters. Using numerical methods, we investigated the behaviour of the spectrum of the non-Hermitian Hamiltonian as the coupling parameters are varied. This allows for an identification of boundary lines in the coupling parameter space for regions of strictly real spectra. According to their dependence on the coupling parameters, the Bethe ansatz solutions may be categorised into two classes on the boundary lines. We discuss how these solutions could be associated to exotic quasiparticles obeying generalised exclusion statistics, in the sense proposed by Haldane in 1991.

The outcomes of our research and additional information can be found in [1–3].

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