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A Bethe ansatz approach to the Thirring Quantum Cellular Automaton

We explore the integrability of the 1+1 dimensional massless Thirring Quantum Cellular Automaton, which describes the discrete-time evolution of fermionic modes on a lattice with local, number-preserving interactions. This interaction serves as a discrete-time analogue of those characterising integrable Hamiltonian systems such as the Thirring and Hubbard models. Motivated by this correspondence, we apply the Bethe ansatz to analyse the spectrum of the unitary operator defining the QCA's update rule. Our objective is to construct translationally invariant eigenstates under the assumption that they can be expressed as plane waves obtained by only permuting the particle momenta. We aim at recovering the Yang-Baxter equation, which would enable a recursive formulation of the solutions in terms of a representation of the symmetric group. Preliminary findings reveal distinctive features arising from the model's discrete-time structure, particularly constraints stemming from the periodicity of the quasi-energy spectrum, setting it apart from its continuous-time Hamiltonian counterparts.

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