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Bethe Ansatz, Quantum Circuits, and the F-basis

We present a systematic approach to unitarise the Bethe Ansatz, enabling the construction of quantum circuits that exactly prepare eigenstates of a class of integrable models. The key step is a change of basis in the auxiliary space of the algebraic Bethe Ansatz to the 'F-basis', known from the theory of integrable models. The F-basis, which ensures symmetry under exchange of auxiliary qubits, connects the algebraic and coordinate Bethe Ansatz and renders the plane-wave superpositions of the latter explicit. The exchange symmetry is central to both the exact computation of the circuit unitaries and the rigorous elimination of post-selection. We illustrate the framework with new quantum circuits for the inhomogeneous spin-1/2 XXZ model. This work is based on [arXiv:2411.02519].

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