The Bethe Ansatz as a Quantum Circuit

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The Bethe ansatz is an analytical method to address exactly solvable models in quantum mechanics. It has been shown that the states of the Bethe ansatz can be prepared by a deterministic quantum circuit whose quantum gates were determined numerically [1]. We report our progress in recasting the Bethe ansatz as a deterministic quantum circuit [2]. We present the analytical expressions of the quantum gates. Formulae rely upon diagrammatic rules that define the wave functions of the Bethe ansatz by matrix-product states. Based on the analytical expressions, we prove the unitarity of the quantum gates. We use our results to clarify on the equivalence between the coordinates and algebraic Bethe ansatze in light of matrix-product states.

References

[1] Alejandro Sopena, Max Hunter Gordon, Diego García Martín, Germán Sierra, Esperanza López, Quantum, 6 (2022) 796

[2] Roberto Ruiz, Alejandro Sopena, Max Hunter Gordon, Germán Sierra, Esperanza López (2023)

Figures

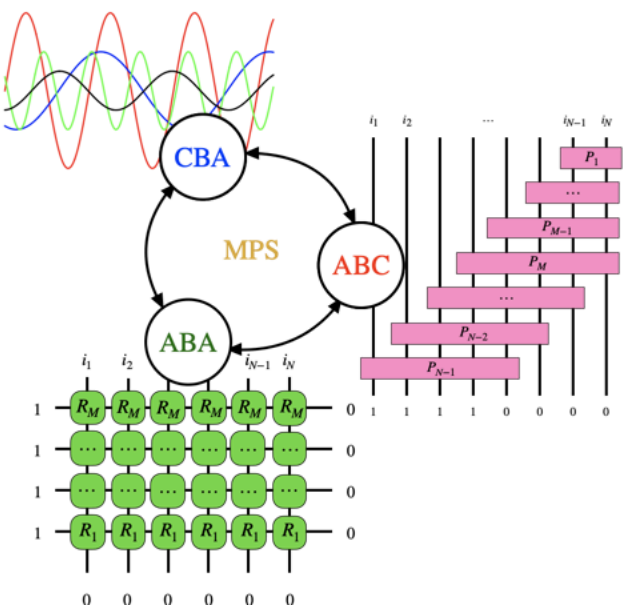

Figure 1: Realisations of the Bethe ansatz: CBA, ABA, and ABC. MPS lie at the core of the trio of equivalences.