Valence bond solids for SU(n) spin chains: exact models, spinon confinement, and the Haldane gap

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Abstract

To begin with, we introduce several exact models for SU(3) spin chains: (1) a translationally invariant parent Hamiltonian involving four-site interactions for the trimer chain, with a three-fold degenerate ground state. We provide numerical evidence that the elementary excitations of this model transform under representation $\bar{\mathbf{3}}$ of SU(3) if the original spins of the model transform under rep. **3**. (2) a family of parent Hamiltonians for valence bond solids of SU(3) chains with spin reps. **6**, **10**, and **8** on each lattice site. We argue that of these three models, only the latter two exhibit spinon confinement and hence a Haldane gap in the excitation spectrum. We generalize some of our models to SU(n). Finally, we use the emerging rules for the construction of VBS states to argue that models of antiferromagnetic chains of SU(n) spins in general possess a Haldane gap if the spins transform under a representation corresponding to a Young tableau consisting of a number of boxes λ which is divisible by n. If λ and n have no common divisor, the spin chain will support deconfined spinons and not exhibit a Haldane gap. If λ and n have a common divisor different from n, it will depend on the specifics of the model including the range of the interaction.

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[2] Martin Greiter and Stephan Rachel, submitted to Phys. Rev. B, cond-mat/0702443.

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