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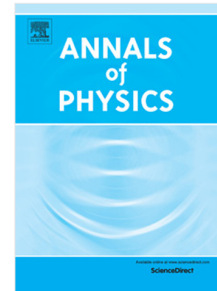
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Exact bosonization in two spatial dimensions and a new class of lattice gauge theories

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Abstract

We describe a 2d analog of the Jordan-Wigner transformation which maps an arbitrary fermionic system on a 2d lattice to a lattice gauge theory while preserving the locality of the Hamiltonian. When the space is simply-connected, this bosonization map is an equivalence. We describe several examples of 2d bosonization, including free fermions on square and honeycomb lattices and the Hubbard model. We describe Euclidean actions for the corresponding lattice gauge theories and find that they contain Chern-Simons-like terms. Finally, we write down a fermionic dual of the gauged Ising model (the Fradkin-Shenker model).

Keywords: bosonization, lattice gauge theory, spin systems

1 Introduction

It is well known that the Jordan-Wigner transformation establishes an equivalence between the quantum Ising chain in a transverse magnetic field and a system of free spinless fermions on a 1d lattice. This equivalence is very useful and is the quickest way to solve the 2D Ising model.¹

¹2D here means “two Euclidean space-time dimensions.”

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