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Entropy, Limit Theorems, and Variational Principles for Disordered Lattice Systems

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Abstract: We study infinite volume limits and Gibbs states of disordered lattice systems with bounded and continuous potentials. Our main tools are a generalization of relative entropy for random reference measures and a large deviation theory for nonstationary independent processes. We find that many familiar results of invariant potentials, such as large deviation theorems, variational principles, and equivalence of ensembles, continue to hold for disordered models, with suitably modified statements.

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1. Introduction

This paper studies disordered lattice systems, utilizing some recent large deviation theory for nonstationary processes. Our three interrelated goals are to establish infinite volume limit theorems, to describe Gibbs states by variational principles, and to find the natural entropy functions for these models and study the role of entropy in the limit theorems and variational principles.

Disordered lattice models are interacting spin systems on an integer lattice $\mathbb{Z}^d$ whose interaction potential is not necessarily shift invariant. The loss of invariance