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String Tension and Glueball Mass in a Lattice Theory of Disconnected, Selfintersecting Random Surfaces

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Abstract. We exhibit the analytic structure of a model of disconnected, selfintersecting random surfaces. This model is shown to have features attractive for a Monte Carlo simulation. Previously obtained numerical data show evidence that for a 3-dim embedding space the string tension vanishes above a critical temperature and has a critical exponent between 1 and 2. The glueball mass is shown to be bounded below by the mass-gap of the 3-dim Ising model.

1. Introduction

In a recent article [Sch], we presented some numerical analysis of a lattice theory of disconnected, selfintersecting random surfaces embedded in $\mathbb{R}^{d=3}$. (For motivation of and references to similar and alternative lattice approaches to random surfaces, see [Sch] as well as [DFJ, F].) It is the aim of this paper to continue the analytic discussion of this model. Allowing the embedding space to have arbitrary dimension $d \geqq 3$, we prove existence and properties of the string tension. Comparison with the numerical results obtained in [Sch] indicates that for $d=3$ the string tension vanishes below a critical temperature and goes to zero at the critical temperature with a critical exponent between 1 and 2. The model also allows for a definition of the glueball mass. Exploiting the isomorphy to the $d=3$ Ising model in 3 dimensions, whereby these surfaces correspond to the Peierls interfaces, we show that the glueball mass is bounded below by the mass gap for the $d=3$ Ising model. These results are obtained by showing that in this model all quantities of interest may be written as (quotients of) Green's functions in the Gibbs ensemble consisting of manifolds without boundary. This makes these quantities easily accessible to an efficient Monte-Carlo computer simulation. For example, it is our impression that the new microcanonical algorithm invented by M. Creutz could be applied.

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