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The critical Ising model on isoradial graphs via dimers

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Abstract

Fisher (1961) showed a correspondence between the Ising model on a planar graph G and the dimer model on a decorated version of G . Using Fisher's correspondence, we study the Ising model on any infinite isoradial graph at criticality.

An isoradial graph is a planar graph, together with an embedding in the plane, such that every face is inscribed in a circle of radius 1. The interactions between the spins fixed by the geometry of the embedding.

We give an explicit expression for the inverse Kasteleyn operator on the dimer graph, which has the following surprising property: the entry between two vertices depends only on the geometry of the embedding on a path between the two vertices.

We then use this property to define a Gibbs measure for the Ising model on the original isoradial graph, to give local expressions for cylindrical events involving a finite number of spins, and compute the free energy.

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