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VOLUME 1

INVESTIGATIONS ON PURE MATHEMATICS, FINANCE MATHEMATICS AND OPTICS

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$$\varphi_1(x, y, z) = z$$

$$\pi_1 = \begin{pmatrix} x & y & z \\ y & z & x \end{pmatrix}$$

$$z' = x^2 + y^2 + z^2 + 2yz$$

$$\pi_1 \vee_1 \pi_1 = \vee_{17}$$



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Investigations on Pure Mathematics, Finance Mathematics and Optics

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LIMIT BEHAVIOR OF DYNAMIC SYSTEMS CORRESPONDING TO LATTICE MODELS WITH COMPETING PROLONGED AND ONE-LEVEL BINARY INTERACTIONS

Siti Fatimah Zakaria
Nasir Ganikhodjaev

Abstract. *A critical curve is produced to prove the existence of phase transition in ferromagnetic phase of two-dimensional (2D) Ising model. We study the phase diagram of 2D Ising model on Cayley tree with competing next-nearest neighbour (NNN) or second neighbour interactions only; prolonged and one-level, in absence of the nearest neighbour interaction and the external magnetic field. An iterative computational method has been used to investigate the behaviour of the system and critical point is found at zero temperature.*

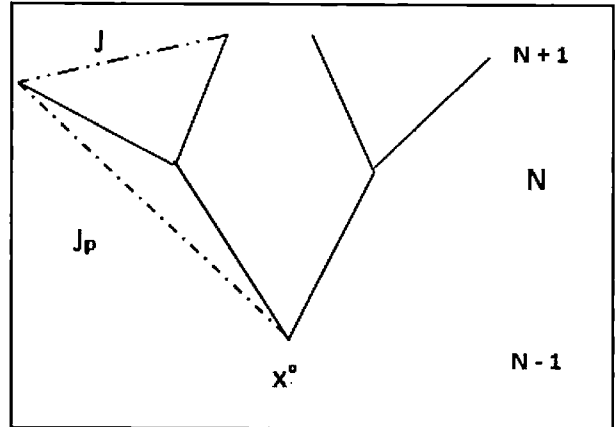
1 Introduction

1.1 Model

Consider an Ising model on Cayley tree. Let Γ^2_+ be a second order of semi-infinite Cayley tree, i.e., an infinite graph without cycles with 3 edges issuing from each vertex except for x^0 which has only 2 edges. Two vertices x and y are called nearest neighbours if there exists an edge connecting them. The distance $d(x, y)$ on the Cayley tree is the number of edges in the shortest path from x to y . For a fixed x^0 , we set $W_n = \{x | d(x, x^0) = n\}$. Two vertices x, y are called the second neighbours if the distance or number of edge $d(x, y) = 2$. The second neighbour vertices x and y are called one level second neighbours if $x, y \in W_n$ for some n and is denoted by $\langle \bar{x}, \bar{y} \rangle$. The second neighbour vertices x, y that are not one level are called prolonged second neighbour vertices and is denoted by $\langle \tilde{x}, \tilde{y} \rangle$.

In this paper, we investigate the existence of phase transition and the phase diagram of the Ising model with competing prolonged and one-level next-nearest neighbours interactions only.

Figure 1.1. Three successive generation of a Cayley tree (solid line: nearest neighbour interactions; dot-dashed line: next-nearest neighbour prolonged interactions; dot-dot-dashed line: next-nearest neighbour one-level interactions).



Then, the Hamiltonian H will have the following form:

$$H(\sigma) = -J_p \sum_{\langle \tilde{x}, \tilde{y} \rangle} \sigma(x)\sigma(y) - J \sum_{\langle \bar{x}, \bar{y} \rangle} \sigma(x)\sigma(y)$$

where first summation is over prolonged second neighbours and second is over one-level second neighbours.

2 Basic Equation