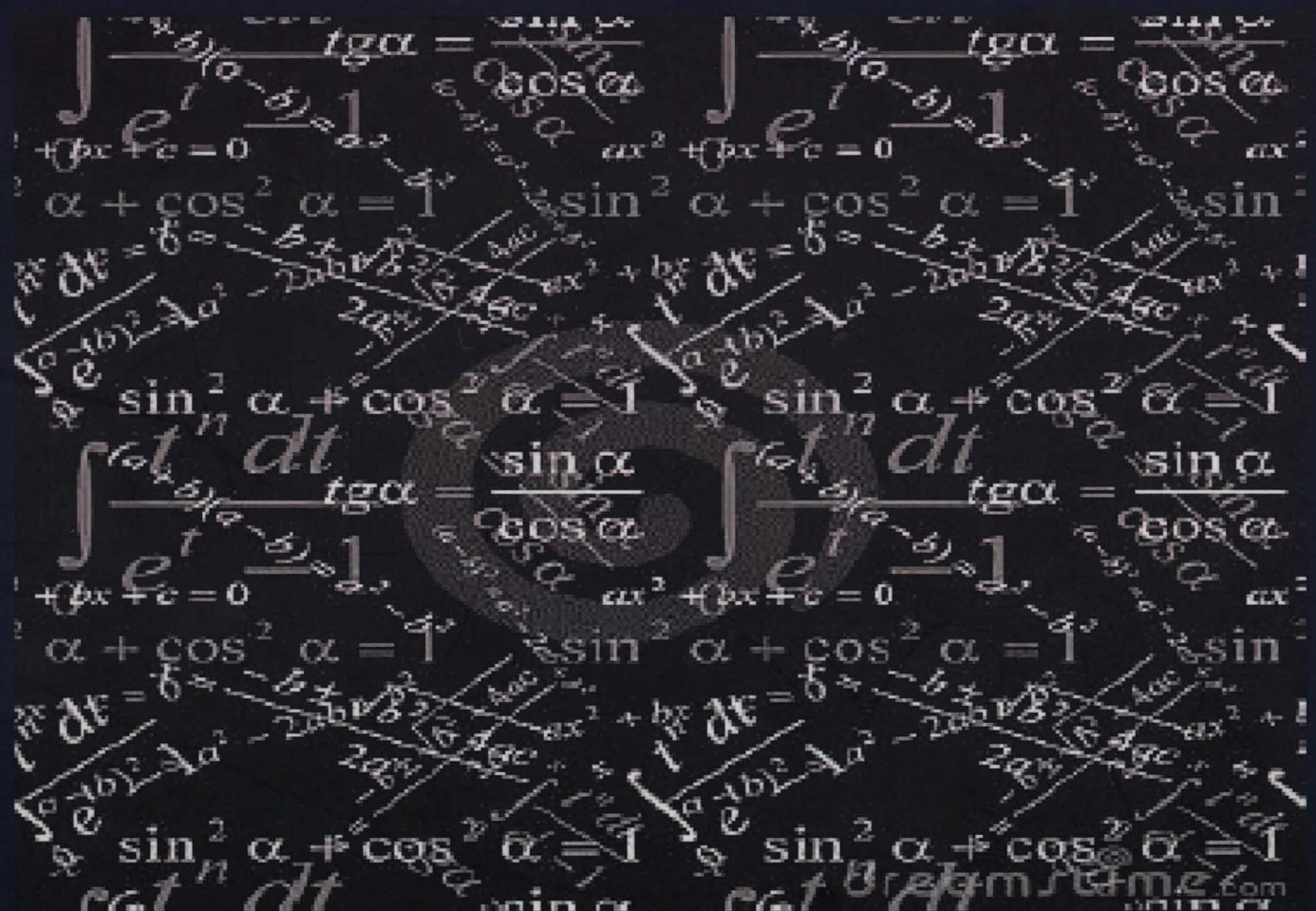




RECENT ACHIEVEMENTS IN DYNAMICAL SYSTEMS

Proceedings of Department of
Computational and Theoretical
Sciences, Faculty of Science, IIUM



Chief Editor : Farrukh Mukhamedov

Editors : Nasir Ganikhodjaev

: Mansoor Saburov

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ISING MODEL ON A GENERAL CAYLEY TREE WITH COMPETING NEXT-NEAREST-NEIGHBOR INTERACTIONS

Nasir Ganikhodjaev¹ and Siti Fatimah Zakaria²

^{1,2}*Department of Computational & Theoretical Sciences,
Faculty of Science, International Islamic University Malaysia,
P.O. Box, 141, 25710, Kuantan, Pahang, Malaysia
E-mail: ¹gnasir@iiu.edu.my; ²sifazasfz@gmail.com*

Abstract

We study the Ising model on a general Cayley tree of arbitrary order and produce the phase diagram with competing interactions prolonged next-nearest-neighbour J_p and one-level k -tuple next-nearest-neighbour J_o . Vannimenus proved the existence of modulated phase in the phase diagram of Ising model with competing nearest-neighbour interaction J_1 and prolonged next-nearest-neighbour interactions J_p , as found for similar models on periodic lattices. Later Mariz et al generalized this result for Ising model with $J_o \neq 0$. For a given lattice model on a Cayley tree, i.e., $J_p \neq 0$; $J_o \neq 0$ with $J_1 = 0$, we describe the general equation, phase diagram and clarify the role of nearest-neighbour interaction J_1 . In the presence of nearest-neighbour interaction J_1 , Vannimenus demonstrated that for arbitrary random initial data one can reach the same phase diagram. We show that in the case $J_1 = 0$ the set of all possible initial data can reach different phase diagrams.

Keywords: Lattice models, Cayley tree, prolonged next-nearest neighbour, one-level next-nearest neighbour, modulated phase

Introduction

Statistical mechanics well known attempts is to predict the properties of complex system containing many interesting components undergoing random thermal motion. These properties might be molecules in a gas, atoms in a magnet, polymer in solution or other interesting physical system. Lattice models are a big industry within statistical mechanics. These models have a variable at each site of a regular grid, and a Hamiltonian or evolution law for these variables. The Ising model is the most extensively studied lattice model in statistical mechanics. The model consists of a set of magnetic spins arranged on a regular square lattice. It has a lattice of N sites i with a single, two states degree of freedom s_i , on each site that may take values ± 1 [1].

In the case of the Ising model with competing nearest-neighbour (NN) interactions J_1 and prolonged next-nearest-neighbour interactions J_p , Vannimenus [8] was able to find new modulated phases, in addition to the expected paramagnetic and ferromagnetic ones. From this result follows that