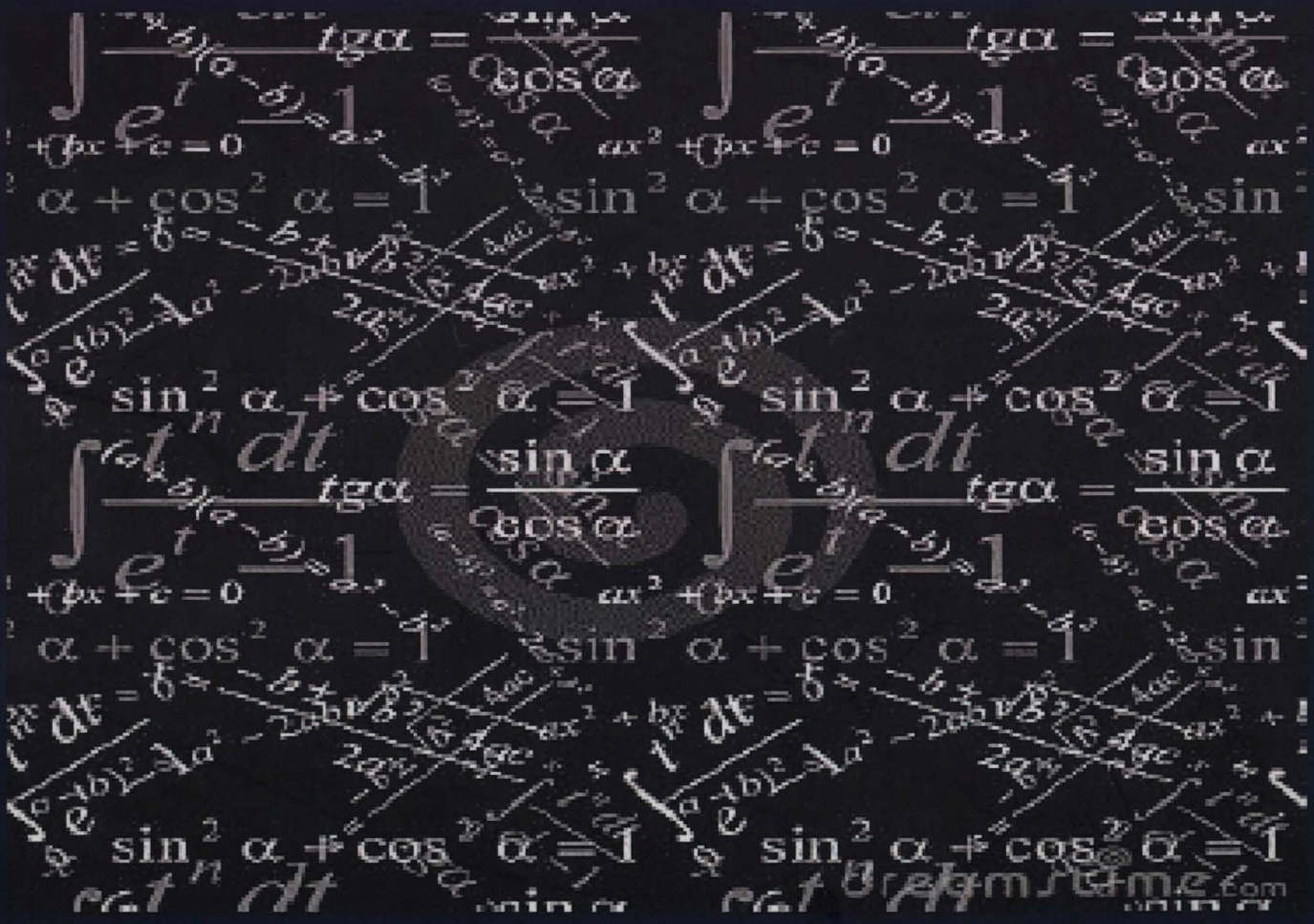
الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيرسيتي إسلام انتارابغسا ملسيا

VOLUME 2

RECENT ACHIEVEMENTS IN DYNAMICAL SYSTEMS

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



Chief Editor : Farrukh Mukhamedov
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Vol. 2

IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Farrukh Mukhamedov, Nasir Ganikhodjaev & Mansoor Saburov
Recent Achievements in Dynamical Systems
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ISBN: 978-967-418-201-4

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN. BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan

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PHASE DIAGRAM OF THE ISING MODEL WITH NEAREST-NEIGHBOR INTERACTIONS

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Abstract

We study the phase diagram of the Ising model on a Cayley tree with competing prolonged next-nearest neighbour J_p and one-level next-nearest neighbour interactions J_0. Vannimenus proved that the phase diagram of Ising model with competing neareast-neighbour interaction J_1 and prolonged next-nearest neighbour interactions J_p contains a modulated phase, as found for similar models on periodic lattices. Later Mariz et al generalized this result for Ising model with $J_0 \neq 0$. For given lattice model on a Cayley tree, i.e., $J_p \neq 0$; $J_0 \neq 0$ with $J_1 = 0$ we describe phase diagram and clarify the role of nearest-neighbour interaction J_1 and show that the class of modulated phases consists of so-called antiphase with period 4 only

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

Introduction

Variety of phenomena in magnetic systems has been observed in certain models with the existence of competing interactions. Systems exhibiting spatially modulated structures, commensurate or incommensurate with the underlying lattice, are of current interest in condensed matter physics [1]. Among the idealized systems for modulated ordering, the axial next-nearest-neighbour Ising (ANNNI) model, originally introduced by Elliot [3] to describe the sinusoidal magnetic structure of Erbium, and the chiral Potts model, introduced by Ostlund [14] and Huse [6] in connection with monolayers adsorbed on rectangular substrates, have been studied extensively by a variety of techniques. A particularly interesting and powerful method is the study of modulated phases through the measure-preserving map generated by the mean-field equations, as applied by Bak [2] and Jensen and Bak [7] to the ANNNI model. The main drawback of the method lies in the fact that thermodynamic solutions correspond to stationary but unstable orbits. However, when these models are defined on Cayley trees, as in the case of the Ising model with competing interactions examined by Vannimenus [17], it turns out that physically interesting solutions correspond to the attractors of the mapping comes to present. This simplifies the numerical work