Second Laureate
Fundamental Research

Project Title: Studying of one and two dimensional integrable models

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Abstract:

Integrable systems are the physical systems which can be exactly solved, i.e. the systems which some of their physical quantities can be calculated without any approximation. Studying these systems is important from both physical and mathematical points of view. Two classes of integrable models have been studied in this project.

The first class is the classical many-particle systems which live in one- dimensional (spatial) space. By imposing some special constraints on interactions, different integrable stochastic models have been obtained. Some of these interactions are two-particle and some are many-particle and they also include the creation and annihilation processes.

The second class is the quantum two-dimensional systems, i.e. the quantum field theoretical models based on Yang-Mills theory, which is the only theory that can successfully describe the interactions between the elementary particles, including the main three interactions of nature: strong, weak and electromagnetic interactions.

Unfortunately, the Yang-Mills theory can not be exactly solved in four dimensions, but in two dimensions, it is possible to exactly solve this model for various kinds of two-dimensional surfaces. In this project, different aspects of Yang-Mills, and its natural extension, the so-called generalized Yang-Mills theories, have been studied on arbitrary two-dimensional surfaces. The results of our studies have been published in more than 25 papers in international journals.