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Research field: Applied Mathematics

Keywords: Statistical Mechanics, Integrable Systems, Quantum groups

Present research:

My main research area is physical phenomena that originates in symmetry of physical models. Physical models classified into integrable systems have high symmetry leading to many conserved quantities enough to determine their degrees of freedom. Consequently, their eigenstates and correlation functions can be exactly derived. Many conserved quantities of a model impose strong restrictions on how quantum states relax from a given initial condition. This is because conserved quantities must be invariant under time evolution. On the one hand non-integrable quantum models relax to the distribution described by the normal Gibbs ensemble, but on the other hand quantum integrable models are expected to relax to the distribution called the generalized Gibbs ensemble. I am studying, from the viewpoint of quantum dynamics, which conserved quantities must be included in the generalized Gibbs ensemble and, subsequently, what characterizes integrability of models.

My other research interest is the correspondence between integrable spin chains and field theories. This correspondence derived through exact scattering matrices shows that some non-supersymmetric spin chain corresponds to a supersymmetric field theory, implying that certain integrable spin chains possess hidden supersymmetry. In fact, it is found that these spin chains possess strange quantum states that are not obtained for normal spin chains. I aim to elucidate these strange quantum states and, subsequently, the relation between hidden supersymmetry and integrability of spin chains.

Integrable systems provide good toy models for many research areas including stochastic processes, string theory, and quantum information. I am also interested in the applications of integrable systems to them.

Notice for the students:

The fundamental knowledge of statistical mechanics and quantum mechanics is required. It is desired to acquire quantum groups and field theories.