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Research field : Applied Mathematics

Key words : Quantum solvable models, Solvable stochastic processes

Present research

My research subject is the mathematical structure behind physical systems, especially, quantum integrable systems possessing enough many conserved quantities to determine their degrees of freedom. It is an interesting question how the existence of such conserved quantities affects physical behaviors.

I am currently interested in the correspondence between quantum spin chains and quantum field theories (QFTs). Scattering process in a QFT is described by the transfer matrix of the corresponding spin chain by discretizing the Minkowski space-time. The XXZ model, one of the most famous examples of integrable quantum spin chains, corresponds to the supersymmetric QFT, although the XXZ model itself is not supersymmetric. One of my research goals is to understand why the supersymmetric QFT emerges from the non-supersymmetric spin chain.

Another topic of my research interests is quantum spin chains with boundary dissipation. It has been known that integrable systems, unlike non-integrable ones, show peculiar nonequilibrium phenomena. The results obtained in the context of nonequilibrium phenomena show new insights into the study of integrable systems. For instance, the quasilocal charges introduced to explain the transport phenomena of the integrable systems have been found to form a new family of conserved quantities.

Notice for the students

Patience and continuous effort is required for the students in the Math Department. In mathematical research, most time is devoted to tedious calculations, although it is an irreplaceable pleasure to have valuable results.