

Quantum Entanglement in Exactly Solvable Models

Hosho Katsura (University of Tokyo)

There is considerable current interest in studying interacting quantum systems from quantum information perspective. The relation between quantum entanglement and quantum phase transitions has been extensively studied. In these studies, exactly solvable models play an important role as a laboratory to test the newly introduced concepts such as entanglement entropy and topological order. In this talk, I will present our recent results for the two kinds of solvable models: i) generalized Affleck-Kennedy-Lieb-Tasaki(AKLT) model [1,2], and ii) Calogero-Sutherland model[3]. For the generalized AKLT model, we found that the reduced density matrix of a subsystem is exactly spanned by the edge states, i.e., the degenerate ground states of the open system. This is the reason why the entanglement entropy coincides with the logarithm of the number of the edge states. For the Calogero-Sutherland model, we studied the entanglement between two subsets of particles in the ground state. Using the duality relations of the Jack symmetric polynomials, we estimate an upper bound of the entanglement entropy and interpret it in terms of fractional exclusion statistics. This work was done in collaboration with Takaaki Hirano, Yasuyuki Hatsuda (U. Tokyo), Ying Hu, Vladimir E Korepin(SUNY,YITP) and Yasuhiro Hatsugai(U. Tsukuba).

[1] H. Katsura, T. Hirano and Y. Hatsugai, Phys. Rev. B 76, 012401(2007).

[2] Y. Xu, H. Katsura, T. Hirano and V. E. Korepin, arXiv:0802.3221[quant-ph], arXiv:0804.1741[quant-ph].

[3] H. Katsura and Y. Hatsuda, J. Phys. A: Math. Theor. 40, 13931(2007).