

Scientific Report, ESF-INSTANS Short Visit Grant 2525: O. Zozulya

Awarded to: O. Zozulya, Institute for Theoretical Physics, University of Amsterdam, Valckenierstraat 65, 1018XE Amsterdam, the Netherlands.

Host: M. Haque, Max Planck Institute for Physics of Complex Systems (MPI-PKS), Noethnitzer Strasse 38, 01187 Dresden, Germany.

Duration of stay: eleven days, from July 27 till August 6, 2008.

Purpose of the visit

One aim of a visit was to finish a project concerning entanglement signatures of quantum Hall phase transitions and to prepare obtained results for publication. The other purpose was to initiate a collaboration on "particle entanglement" calculation in certain Bethe ansatz states.

Work carried out during the visit

We have studied quantum phase transitions involving fractional quantum Hall states using numerical calculations of entanglements and related quantities. We tuned interactions away from Coulomb potential for a system of electrons on a sphere and compared calculated finite-size scaling of entanglement entropy with the expected results in thermodynamic limit. It was previously suggested that the subleading correction to the scaling of the entanglement entropy with system size contains information about the topological order. By changing interactions across quantum critical points we explored whether the behavior of entanglement entropy can be served as tool to detect both topological order and topological phase transitions in the numerically accessible systems corresponding to Laughlin and Moore-Read states. The obtained results provide independent evidence that some of the simplest forms of abelian and non-abelian topological order are realized in experimentally accessible systems. In addition to the entanglement entropy we have found that signatures of quantum phase transitions can be found in other properties of reduced density matrices of the system on a sphere.

Future collaboration with host institution

A fruitful discussion has taken place during the visit concerning the projected work on particle entanglement in a 1D bose-fermi mixture model solvable via Bethe Ansatz. An ongoing work with Dr. Haque in this direction addresses some recent interesting conjectures raised in our previous publication.

Publications

A preprint "Entanglement signatures of quantum Hall phase transitions" (ArXiv:0809.1589) has been put online and submitted to Phys. Rev. B.