Abstract for GR-TR Conference on Statistical Mechanics and Dynamical Systems

Topic: Thermal Conductivity Preference: Poster

The Role of Impurities in the Transport Properties of Heisenberg Chains

A. Metavitsiadis[1*], A. Karahalios[1], X. Zotos[1], A. Gorczyca[2], P. Prelovšek[3]

[1] Department of Physics, University of Crete and
Foundation for Research and Technology-Hellas P.O. Box 2208, 71003 Heraklion, Greece

[2] J. Stefan Institute, SI-1000 Ljubljana, Slovenia and Department of Theoretical Physics, Institute of Physics, University of Silesia, 40-007 Katowice Poland

[3] J. Stefan Institute, SI-1000 Ljubljana, Slovenia and
Faculty of Mathematics and Physics, University of Ljubljana, SI-1000 Ljubljana, Slovenia

[*] Electronic Address: metavits@physics.uoc.gr

Thermal management is a major problem in novel electronic devices, where the overheating of such a device, can reduce its expectation time of life and its reliability. Due to the necessity for efficient heat removal, novel materials which exhibit high values of thermal conductivity are under investigation. These materials exhibit magnetic modes of transport, which are responsible for the dissipation-less heat transport. Moreover these materials are electric insulators and highly anisotropic, characteristics, that make them of high technological interest. Transport properties along the axis in which ballistic transport occurs, can be well described by one dimensional spin Heisenberg models.

We consider the case of one dimensional Heisenberg Hamiltonian (XXZ model)

$$H_0 = J \sum_l S_l^x S_{l+1}^x + S_l^y S_{l+1}^y + \Delta S_l^z S_{l+1}^z \ , \tag{1}$$

under various perturbations. The unperturbed Heisenberg model exhibits infinite d.c. spin (for the special case $\Delta = 0$ (XY model)) and thermal conductivity for any value of the anisotropy Δ at all temperatures. Using numerical diagonalization we explore two types of impurities, local magnetic fields and extra spins out of chain within memory function formalism [1] . In the former case, comparison with results for spin and thermal conductivity obtained from the full Hamiltonian diagonalization [2], shows a good agreement in the range of validity of memory function.

[1] W. Gotze and P. Wolfe, Phys. Rev. B **6**, 1226 (1972)

[2] P. Prelovšek, X. Zotos et al. cond-mat/0803.1379 (2008)