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Frank Goehmann

Universität Wuppertal

A microscopic approach to the large-distance behaviour of the two-point correlations in the Heisenberg spin chain

Historically, the leading large-distance asymptotics of the two-point functions of the Heisenberg chain in its critical ground state phase was obtained from an effective description by a Gaussian QFT. Here we calculate the asymptotic behaviour directly on the lattice. We consider the model at finite temperature and use an expansion of the two-point functions in terms of form factors of a quantum transfer matrix of the model. We analyse the form factors at small temperature and perform an exact summation of those terms in the form factor expansion that correspond to diverging correlation lengths and thus contribute to the leading asymptotics. This allows us to reproduce the results of the QFT approach and to obtain in addition numerically efficient formulae for the next-to-leading non-universal terms in the asymptotic expansion. Our approach also suits for the analysis of the non-critical antiferromagnetic phase.

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