Abstract:

Doped spin-$\frac{1}{2}$ ladder systems are important model systems for 2D high-T_C superconductors. Their one-dimensionality renders them more tractable to various analytic and numerical approaches. Experimentally such ladder systems are realized in the so-called telephone number compounds $Sr, Ca, La, Y_{14}Cu_{24}O_{41}$.

Effective Hamiltonians for such spin ladders are systematically derived in this thesis. The technique of choice are continuous unitary transformations (also known as flow equation method) which are performed self-similarly for the coefficients of operator monomials in real space in second quantisation. The proliferating number of terms is bounded by truncating far reaching processes which reach longer than the finite correlation length. The magnetic excitations are triplons, the charge excitations are holes. Both are living on the rungs of the ladder and include the polarisation of their environment. The effective Hamiltonian allows us to read off the dispersions of single excitations directly. But it also contains their interaction.

Keywords: