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Application of the DMRG in two dimensions: a parallel tempering algorithm[1] SHIJIE HU, Department of Physics and Research Center Optimas, Technical University Kaiserslautern, 67663 Kaiserslautern, Germany, JIZE ZHAO, Institute of Applied Physics and Computational Mathematics, Beijing 100088, China, XUEFENG ZHANG, SEBASTIAN EGGERT, Department of Physics and Research Center Optimas, Technical University Kaiserslautern, 67663 Kaiserslautern, Germany — The Density Matrix Renormalization Group (DMRG) is known to be a powerful algorithm for treating one-dimensional systems. When the DMRG is applied in two dimensions, however, the convergence becomes much less reliable and typically "metastable states" may appear, which are unfortunately quite robust even when keeping a very high number of DMRG states. To overcome this problem we have now successfully developed a parallel tempering DMRG algorithm. Similar to parallel tempering in quantum Monte Carlo, this algorithm allows the systematic switching of DMRG states between different model parameters, which is very efficient for solving convergence problems. Using this method we have figured out the phase diagram of the xxz model on the anisotropic triangular lattice which can be realized by hardcore bosons in optical lattices.

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