Finite-size scaling is a very useful tool for analyzing phase transitions in lattice QCD. Values of critical exponents can be confirmed and consequently the order and the universality class of a transition can be established by investigating the scaling behavior of certain observables [1]. In order to do this, critical exponents have to be known accurately, and it is advantageous to also know the universal finite-size scaling functions.

For the investigation of the chiral and deconfinement phase transitions in QCD, the O(N) universality classes for N=2, 3, 4 are highly relevant. Finite size scaling for these universality classes has been investigated mainly by means of lattice simulations of O(N) spin models [2]. While this approach has been very successful, results are usually limited to the critical temperature or the transition point and QCD lattice data cannot be readily matched against the resulting universal scaling functions.

We have previously used non-perturbative renormalization group methods to investigate finite-size effects on particle masses and the chiral phase transition [3], and we have now established finite-size scaling behavior for an O(N)-model in a non-perturbative renormalization group calculation. These results also serve as a check on the values of the critical exponents obtained in our calculation.

We have calculated the critical finite-size scaling behavior and the universal scaling functions for the O(4)-model for a very wide range of temperatures and values of the symmetry-breaking parameter (which corresponds to the quark mass in QCD) [4]. Our results are suitable for a comparison with e.g. susceptibilities from lattice QCD and can be used to check consistency of the finite-size scaling behavior with that of the O(N) universality class.