

The aim of this thesis is an investigation of lattice models in the context of Lebowitz-Penrose limit to provide a link between the underlying statistical mechanical models to the mesoscopic “continuous” description based on the nonlocal free energy functional. First, the basic formalism of statistical mechanics is introduced and an extended Blume-Capel model (r-model) defined. Then the mean-field approximation is discussed including a phase diagram of the classical Blume-Capel model. Further, the Lebowitz-Penrose theorem for the r-model is carried out from the scratch. All bounds are explicitly calculated. As a tool within the proof, the free energy functional is introduced and a transition from discrete to continuous variables is emerges. Finally, the basics of the van der Waals mesoscopic theory are discussed and a link with the original lattice model is established via the free energy functional.