Phase-ordering kinetics in ferromagnetic systems with long-range interactions

Federico Corberi,
Salerno University, Italy

I will present a thorough discussion of the ordering kinetics of ferromagnetic systems with long-range interactions decaying with distance as $r^{-\alpha}$, for any α and in any spatial dimension d. I will consider two paradigmatic models: the voter model and the Ising one. The former is solvable in any dimension [1-3]. The latter can be studied analytically in one dimension using scaling arguments [4], or in a continuum (Ginzburg-Landau) approach [5,6]. Besides that, numerical simulations are also available. In general, the kinetics is characterized by the formation and growth of domains. In both models there is an upper critical value α_{SR} of α, such that for $\alpha>\alpha_{SR}$ the model behaves as the corresponding one with short-range interactions (e.g. among nearest-neighbors). In particular, the characteristic size L(t) of the coarsening domains grows as $L(t)\propto t^{1/2}$. There also exists a lower critical value α_{LR} such that some mean-field features (corresponding to $\alpha=0$) are displayed for $\alpha<\alpha_{LR}$. In the voter model these amount to the presence of non-equilibrium stationary states whose lifetime diverges in the thermodynamic limit. In the Ising model, instead, the mean-field character is manifested by the presence of dynamical trajectories without formation of domains whereby the system approaches equilibrium by a fast exponential increase of the magnetization. For intermediate values of α, for $\alpha_{LR}<\alpha<\alpha$, there is an algebraic growth of the domains $L(t)\ )\propto t^{1/z}$, with a non-trivial α-dependent value of the exponent z. A rich pattern of dynamical scaling violations are also observed as α and spatial dimension are varied.

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