Driven Widom-Rowlinson lattice gas

Ronald Dickman

UFMG

R. K. P. Zia

Virginia Polytechnic Institute and State University

In the Widom-Rowlinson lattice gas, two particle species (A, B) diffuse freely via particle-hole exchange, subject to both on-site exclusion and prohibition of A-B nearest-neighbor pairs. As an athermal system, the overall densities are the only control parameters. As the densities increase, an entropically driven transition occurs, leading to ordered states with A- and B-rich domains separated by hole-rich interfaces. Using Monte Carlo simulations, we analyze the effect of imposing a drive on this system, biasing particle moves along one direction. Our study parallels that for a driven Ising lattice gas – the Katz-Lebowitz-Spohn (KLS) model, which displays atypical collective behavior, e.g., structure factors with discontinuity singularities and ordered states with domains only parallel to the drive. Here, other novel features emerge, including structure factors with cusp singularities (best fitted to $|k|$), maxima at non-vanishing wavevector values, oscillating correlation functions, and ordering into multiple striped domains perpendicular to the drive, with a preferred wavelength depending on density and drive intensity. We analyze the effect of a drive on phase separation and map out the phase diagram in the density-drive plane. Different from the driven lattice gas with attractive interactions (i.e., the KLS model), in which ordered regions are separated by a smooth interface parallel to the drive, here ordered domains form stripes with rough interfaces oriented perpendicular to the drive. We present preliminary evidence for a critical phase under a drive.