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Metastability for the Widom-Rowlinson model: microscopic and mesoscopic fluctuations of the critical droplet

This presentation consists of two talks in tandem.
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In the first talk we define the static Widom-Rowlinson model on a two-dimensional finite torus. The energy of a particle configuration is determined by its halo, defined as the union of small discs centred at the positions of the particles. We discuss the metastable behaviour of a dynamic version of the model, in which particles are randomly created and annihilated as if the outside of the torus were an infinite reservoir with a given chemical potential. We start with the empty torus and are interested in the first time when the torus is fully covered by small discs. We view this as the crossover time from a ‘gas phase' to a “liquid phase”. We consider the metastable regime where the temperature is low and the chemical potential is supercritical. In order to achieve the transition from empty to full, the system needs to create a sufficiently large droplet, called critical droplet, which triggers the crossover.

In the second talk we give a microscopic and mesoscopic description of the surface of the critical droplet. It turns out that the critical droplet is close to a disc of a certain deterministic radius, with a boundary that is random and consists of a large number of small discs that stick out by a small distance. We show how an analysis of the surface fluctuations allows us to derive both a volume term and a surface term in the asymptotics of the average crossover time. Our analysis relies on large deviations for the volume of the halo and moderate deviations for the surface of the halo, in combination with stability properties of isoperimetric inequalities.

This is a joint work with Sabine Jansen (Munich) and Roman Kotecky
(Prague & Warwick).