Evaporation/Condensation of Ising droplets

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In [1] Kotecky *et al.* study the behaviour of finite-volume liquid-vapour systems at a fixed excess N of particles above the ambient gas density. They identify a dimensionless parameter Δ and a universal constant Δ_c and show that for $\Delta < \Delta_c$ a droplet of the dense phase occurs while for $\Delta > \Delta_c$ the excess is absorbed in the background. The fraction λ of excess particles forming the droplet is given explicitly. Furthermore, they state that the same is true for solid-gas systems.

To verify these results, we have simulated the spin-1/2 Ising model on a square lattice at constant magnetisation equivalent to a fixed particle excess in the lattice-gas picture. We measured the largest minority droplet, corresponding to the condensed phase, at various system sizes ($L = 40, \ldots, 640$). Using analytic values for the spontaneous magnetisation m_0, the susceptibility χ and the free energy of a droplet with Wulff shape τ_W for the infinite system, we were able to determine λ in very good agreement with the theoretical prediction [2]. The measurements were repeated on a triangular lattice and for the next-nearest neighbour interaction giving similar good results.

References

[1] M. Biskup, L. Chayes, and R. Kotecky, Europhys. Lett. 60, 21 (2002).

[2] A. Nußbaumer, E. Bittner, T. Neuhaus, and W. Janke, Europhys. Lett. 75, 716 (2006).