Checkerboards, stripes and corner energies in spin models with competing interactions

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We study the zero temperature phase diagram of Ising spin systems in two dimensions in the presence of competing interactions, long range antiferromagnetic and nearest neighbor ferromagnetic of strength J. We first introduce the notion of a "corner energy" which shows, when the antiferromagnetic interaction decays faster than the fourth power of the distance, that a striped state is favored with respect to a checkerboard state when J is close to J_c, the transition to the ferromagnetic state, i.e., when the length scales of the uniformly magnetized domains become large. Next, we perform detailed analytic computations on the energies of the striped and checkerboard states in the cases of antiferromagnetic interactions with exponential decay and with power law decay r^{-p}, p>2, that depend on the Manhattan distance instead of the Euclidean distance. We prove that the striped phase is always favored compared to the checkerboard phase when the scale of the ground state structure is very large. This happens for J\lesssim J_c if p>3, and for J sufficiently large if 2<p<=3. Many of our considerations involving rigorous bounds carry over to dimensions greater than two and to more general short-range ferromagnetic interactions.

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