Comments

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Comment on "Amorphization of the Ising ferromagnet with a transverse field"

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It is argued that the reentrant ferromagnetic phase found by Kaneyoshi and Kaneyoshi *et al.* for the amorphous two-dimensional Ising model is a spurious result in conflict with an exact solution for the mixed-bond Ising model. Some results for the random Ising model with competing bonds are also discussed.

In a series of papers, Kaneyoshi[1,2] and Kaneyoshi and co-workers[3] have studied the amorphization of a two-dimensional Ising ferromagnet by considering a square lattice with bond distribution

$$P(\mathcal{J}_{ij}) = \tfrac{1}{2}[\delta(\mathcal{J}_{ij} - \mathcal{J} - \Delta\mathcal{J}) + \delta(\mathcal{J}_{ij} - \mathcal{J} + \Delta\mathcal{J})] \quad (1)$$

and applying an effective-field theory with correlations (EFT). Due to amorphization, they claim that a new phenomenon appears, namely, a reentrant ferromagnetic phase (in the absence of transverse field).

However, their model is a special case ($p = \frac{1}{2}$) of the mixed-bond Ising model

$$P(\mathcal{J}_{ij}) = p\delta(\mathcal{J}_{ij} - \mathcal{J}_1) + (1-p)\delta(\mathcal{J}_{ij} - \mathcal{J}_2) \ , \quad (2)$$

whose transition temperature on a square lattice is known exactly from duality arguments[4]

$$\sinh(2\beta_c\mathcal{J}_1)\sinh(2\beta_c\mathcal{J}_2) = 1$$

for $0 \leq \lambda \equiv J_2/J_1 \leq 1$. At $\lambda = 0$ ($\delta = \frac{1}{2}$ in the notion of Kaneyoshi and co-workers[1-3]) the only solution is $T_c = 0$ (the system is at percolation threshold).

Therefore, *for this particular model,* the new phenomenon of Kaneyoshi and co-workers, is a spurious effect due to the fact that, within the EFT, $p = \frac{1}{2}$ is above p_c.

Reentrant behavior has been found within the EFT (Ref. 5) for *some values* of $p > p_c$ and competing interactions [$\lambda < 0$ in (2)], and is related to a nonuniform convergence of the concentration for ferromagnetic breakdown at $T = 0$, $p_c(\lambda)$ (Ref. 6). Sarmento and Tsallis[6] found that their results for $\lambda < 0$ and low temperatures were not reliable: " . . . It is clear that these results are physically unacceptable as there is no reason for such a complex sequence of nonuniform convergences through which large classes of critical lines share, at $T = 0$, single points. Consequently, we consider this fact as a mathematical artifact of the present approximation . . . ."

In summary, reentrant behavior for the square-lattice Ising model with distribution (1) can be ruled out exactly; for more general distributions (2) and other lattices, the question remains open, since Kaneyoshi and co-workers have produced no new argument to make us believe that what was considered fortutious[6] is, in fact, genuine.

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