Reply to Nishimori's comment on 'On the phase diagram of spin glasses'

1987 J. Phys. A: Math. Gen. 20 4053

(http://iopscience.iop.org/0305-4470/20/12/051)

J. Phys. A: Math. Gen. **20** (1987) 4053-4054. Printed in the UK

COMMENT

Reply to Nishimori's comment on 'On the phase diagram of spin glasses'

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Received 12 February 1987

Abstract. We argue that the boundary conditions in the spin-glass phase can be chosen in analogy with the ferromagnetic case, such that the results of a previous paper are unchanged despite the subsequent remarks of Nishimori concerning the problem of the boundary conditions.

In his comment Nishimori (1987) criticised some points of a recent paper (Nèmeth 1987, hereafter referred to as I). His remarks concern mainly the problem of the boundary conditions (BC) which is not treated explicitly in I. In this reply we argue that the BC in the spin-glass phase can be chosen in analogy with the ferromagnetic case and the results of I are not changed.

How can we define BC in the ferromagnetic system without prior knowledge of the structure of the configurational space? We choose some arbitrary initial conditions and solve the equations of motions of the spin. In this way we can map the whole configurational space. Then, knowing the average value of the boundary spins, we can choose the BC to drive the system into one of the valleys (free energy minimum) of the configurational space.

With the help of the above method we can obtain BC for the spin-glass phase too, independently of the number of the valleys. Afterwards we can use these BC to calculate several thermal averages. Calculating the thermal average of some quantities simultaneously (e.g. in equation (8) in I) we have to use, of course, the same BC for all of them. The BC depend strongly on the concrete realisation of the bond distribution and we have to choose different BC for different realisations. (Treating the ferro- and antiferromagnetic systems, which are gauge equivalent on bipartite lattices, this can be seen quite clearly.)

It has to be noted that there are no proper BC for the 'average' system. We have to treat concrete realisation always, i.e. we have to choose the BC before averaging over the bonds.

Nishimori's other objection concerns the 'analyticity' of the partition function. Of course we can expand it in terms of $(\tanh \beta J)^k$ $(k = 0, 1, 2, \ldots)$ for finite systems. We use the expression 'analyticity' to mean that we have no difficulty with the $N \to \infty$

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0305-4470/87/124053+02$02.50

limiting procedure. This is valid for temperatures above the critical temperature of the pure system.

Finally, we would like to note that we did not trace equation (12) back to equation (9), but we would have liked to present some arguments for its validity.

References

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