Frontier of Statistical Physics and Information Processing 2013

Off-equilibrium Spin Glasses in a Field

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Spin glasses are disordered magnetic alloys whose low-temperature phase state is a frozen disordered state, rather than the uniform patterns one finds in more conventional magnetic systems. They are important because they are widely regarded as the simplest possible model of a complex system.

Whether spin glasses in an external magnetic field undergo a finite phase transition is still an open question in the arena. And it has deserved a long hard debate during the last years. Both experimental and theoretical studies have found conflicting conclusions. Recently, clear signatures of that spin glass transition have been found in four dimensions[1] for the Edwards-Anderson model thanks to the supercomputer Janus[2].

In this presentation I will show you our recent results regarding the Edwards-Anderson model in three dimensions in presence of an external magnetic field. Our off-equilibrium dynamical study reveals clear evidences of a phase transition. I will discuss the implications of the magnetic field dependent relaxation time divergence that we have found at non-zero temperature, studing the system relaxation both for high and low temperature.

We have performed simulations for both a direct quench and annealing algorithm for different values of the external field. Thanks to the special-purpose computer Janus[2] we have reached times up to 0.01 seconds for very low temperatures and a large system of lattice size $L = 80$.

[1] R. A. Banos et al., Proc. Natl. Acad. Sci. USA (2012) 109, 6452-6456.
[2] Belletti F, et al. Comp. Phys. Comm. 178, 208-216 (2008).