Reply to ''Comment on 'Erasing the glassy state in magnetic fine particles' ''

M. García del Muro, X. Batlle, and A. Labarta
Departament de Física Fonamental, Facultat de Física, Universitat de Barcelona, Diagonal 647, 08028 Barcelona, Spain
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The Comment affirms that no phase transition occurs in spin-glass systems with an applied magnetic field. However, only according to the droplet model is this result expected. Other models do not predict this result and, consequently, it is under current discussion. In addition, we show how the experimental results obtained in our system correspond to a cluster glass rather than to a true spin glass.

The main point of this Comment is the assertion that no phase transition occurs in spin-glass systems with a finite magnetic field. It is claimed that there are strong indications supporting this fact, but only within the framework of the droplet model[1] is this result predicted. Other models (e.g., mean-field model) predict the existence of transition lines in the (H,T) phase diagram.[2] Experimental evidences for the above statement are based in the analysis of the susceptibility in a single system, which is supposed to be an Ising 3D spin glass.[3] On the contrary, torque measurements in AuFe,[4] which is a Heisenberg spin glass with moderately strong Dzyaloshinski-Moriya anisotropy, clearly show the existence of transverse and longitudinal irreversibility lines in the (H,T) plane with high resemblance to those of the Heisenberg mean-field model.[2] Consequently, this point is far from being clarified and is the subject of a current discussion.

The experimental phenomenology of our nanoparticulate system shows that it behaves as a cluster glass rather than as a true spin glass: (i) hysteresis loops resemble those of a ferromagnetic system with a superimposed high-field susceptibility;[5] (ii) ac susceptibility can be well scaled to an activated dynamics and the relaxation time follows a modified Arrhenius law rather than a power law;[6] and (iii) moderate magnetic fields rapidly destroy the disordered state. Even though this system seems to exhibit an effective irreversibility line similar to that found in other cluster and spin-glass systems, the magnetic fields at which the disordered state is erased are very low compared, for example, to either the effective anisotropy field of the particles or to those values corresponding to archetypical spin glasses.[7] Consequently, the erasing of the low-temperature collective state with a magnetic field cannot be taken as a proof of the existence of a true spin-glass behavior in this system because extra experimental features must be taken into account.

Furthermore, the main goal of our work was to show that in strong interacting nanoparticulate systems, moderate magnetic fields destroy most of the magnetic frustration (collective behavior) leading to a state with an effective distribution of energy barriers, which essentially corresponds to the intrinsic anisotropy of individual particles (slightly shifted by the energy corresponding to the interaction with the dipolar field created by the rest of the system). As far as we know, this limit cannot be achieved in archetypical spin glasses by using the moderate magnetic fields of our experiments.

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