de Vegvar and Lévy Reply: In our previous work [1] we experimentally demonstrated that phase coherent electron propagation is possible in 1000-ppm CuMn spin-glass alloys over 0.4-μm length scales. By appealing to the fact that in a frozen spin state the magnetization has the property $M(-H)\neq -M(H)$, we showed that by interchanging current and voltage leads we could construct a linear combination of four-point magnetoresistances sensitive only to the frozen spins. In the accompanying Comment [2] it is remarked that these spin fingerprints were observed to be 30%–70% correlated across anneals through $T>T_g$ but would be expected to have a vanishing averaged correlation coefficient over an ensemble of anneals provided: (1) Time-reversal invariance of the *total* Hamiltonian implies the *spin* Hamiltonian has the property that $\{\mathbf{S}_i(H)\}$ and $\{-\mathbf{S}_i(-H)\}$ are degenerate nonidentical spin configurations in an external field H. (2) These two configurations generate oppositely signed Onsager-Büttiker antisymmetrized four-point resistances $R_{a,s}(H)$ and $R_{a,a}(H)$. (3) The $H=0$ anneal to $T=2.8T_g$ accesses all low-energy configurations with equal probability starting from any given one. Here we examine these points in turn.

We have confirmed that a simple spin Hamiltonian of the form

$$\sum_i \mathbf{H}\cdot\mathbf{S}_i(H)+\sum_{i,j} J_{ij}\mathbf{S}_i(H)\cdot\mathbf{S}_j(H)+\sum_{i,j}\mathbf{D}_{ij}(H)\cdot[\mathbf{S}_i(H)\times\mathbf{S}_j(H)]$$

is actually invariant under the transformation $\{\mathbf{S}_i(H)\}\to\{-\mathbf{S}_i(-H)\}$ using the microscopic expressions for the indirect exchange interaction J_{ij} and the Dzyaloshinsky-Moriya interaction $\mathbf{D}_{ij}$ in the presence of a given nonmagnetic disorder [3–5]. This supports assumption (1) above.

To investigate point (2) we have studied the spin properties probed by $R_{a,s}(H)$ and $R_{a,a}(H)$. These may be expressed in terms of the transmission probability [6] from point 1 to point 2 expressed as a sum, over paths p and p', of probabilities generated by interfering p with p' in the presence of the external field $\mathbf{H}$ and configuration $\{\mathbf{S}_i(\mathbf{H})\}$. Each of these terms is invariant under a simultaneous rotation of spin and orbital coordinates and can be expanded as a sum over invariant combinations of spins and momenta such as $\mathbf{S}_1\cdot\mathbf{S}_2$, $\mathbf{S}_1\cdot(\mathbf{k}_1\times\mathbf{k}_2)$, and $\mathbf{S}_1\cdot(\mathbf{S}_2\times\mathbf{S}_3)$. It is readily shown that these lowest-order contributions generate an Onsager-Büttiker antisymmetrized resistance which changes sign under $\{\mathbf{S}_i(H)\}\to\{-\mathbf{S}_i(-H)\}$.

Any mechanism preventing the configurations from being equally probable under the anneal conditions could lead, however, to a nonzero average correlation. This is especially true if the number of possible low-energy configurations for the 10^5 or so spins in our wires is not large. One possibility, mentioned by Weissman in his Comment, is that of Mn clustering. A massive clustering in our films and wires would imply a g factor for clusters of N ions enhanced by a factor $N^{1/2}$. The corresponding characteristic field scale in the magnetoresistance would be reduced by a factor $N^{1/2}$ from the bulk value $k_BT_g/g\mu_B=8$ kG, which is not observed. We cannot, however, completely rule out the presence of chemical short-range order or antiferromagnetic manganese oxide involving perhaps 30% of the magnetic moments, since the resistance saturates below T_g. Another potential mechanism preventing the configuration $\{\mathbf{S}_i\}$ from reaching its time-reversed configuration $\{-\mathbf{S}_i\}$ in $H=0$ at $T=2.8T_g$ is that there still may be barriers between low-energy configurations even at temperatures several times T_g. Numerical simulations of Ising spin glasses [7] have shown that the paramagnetic regime is only reached above $T_c\approx 3.8T_g$. Below this temperature Griffiths singularities [8] appear, giving rise to nonexponential behavior of correlation functions and energy barriers comparable to k_BT. In addition, the distribution of RKKY exchanges J_{ij} in the presence of disorder has a broad non-Gaussian form [9], and many $|J_{ij}|$ (and hence barrier heights) exceed k_BT_g. The non-negligible spin-orbit forces [10] that break rotational invariance may also play a role in raising barriers between low-energy spin configurations since they can no longer be continuously deformed into their time-reversed images. More generally, any mechanism generating local order among the spins could result in large energy barriers between spin configurations. Spin anisotropy, like spin-orbit interactions, can raise large barriers between a low-energy configuration and its time-reversed conjugate, and film samples particularly might possess a net spin anisotropy.

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