Bitko, Rosenbaum, and Aeppli Reply: In the preceding Comment [1], Mattsson claims that in two papers [2,3] we have used "incorrect" methods for determining where in the field-temperature plane transitions to a glassy magnetic state occur for $\mathrm{LiHo_{0.167}Y_{0.833}F_4}$. Specifically, he feels that our measuring frequencies are not sufficiently low enough to determine the equilibrium behavior of this system. In the real world of finite measuring times and frequencies, we never can be sure that we have achieved true equilibrium so, in this sense, Mattsson is entirely correct, as he would be if he were discussing experimental work on any phase transition. Of course, in spite of this fundamental difficulty, we have good empirical knowledge of phase transitions because there are certain simple experimental tests of whether we are looking at properties representative of the equilibrium state. Mattsson points out one well-known example of such a test, namely, to check whether the property in question depends on the measuring frequency f. In our paper [3], we showed that the nonlinear susceptibility does depend on f for $f > 10$ Hz. However, we also noted that it depends very weakly on f for $f > 10$ Hz. Thus, to within the limits of our ability to control field and temperature, our results for the nonlinear susceptibility represent equilibrium values in the conventional sense that they are derived from ac values in the f-independent regime of χ_3.

In order to reinforce this point, we show in Fig. 1 data on the f dependence of χ_3 for a transverse magnetic field of 8.62 kOe, which is 1% above the critical field strength marking the transition to the magnetic glass at $T = 60$ mK. Our data, which traverse nearly five decades of frequency, clearly illustrate the crossover between high-f (f-dependent) and low-f (f-independent) behaviors. All of the measurements in [3] were collected for $f \leq 2$ Hz, well within the f-independent regime, which actually expands as the underlying magnetic fluctuation rate increases with transverse field. At the same time, our linear susceptibility measurements, reported initially in [2], consistently extended to frequencies well below the measured roll-off frequencies for χ_3. Thus the linear response which we measure is also a reliable indication of the state of the material. The agreement to within experimental error of the phase boundaries determined by the linear and nonlinear susceptibilities reinforces this conclusion. The ac data [4] which Mattsson reproduces for a thermally driven glass transition in an unrelated compound $\mathrm{Fe_{0.5}Mn_{0.5}TiO_3}$ are clearly in the f-dependent regime and, therefore, not relevant to a critique of our papers.

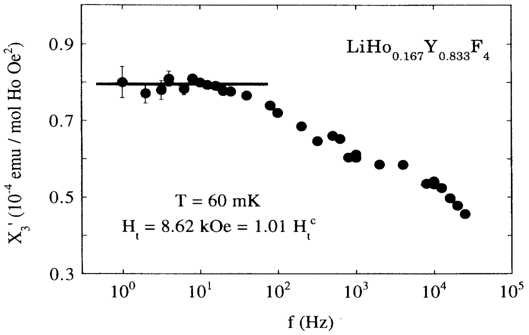

FIG. 1. The nonlinear susceptibility χ_3 vs frequency f at a transverse field H_t 1% above the transition into the spin glass. Data in [2,3] were taken for $f < 2$ Hz, well within the frequency-independent regime.

In conclusion, we have followed [2,3] conventional practice to measure properties of the magnetic glass phase for $\mathrm{LiHo_{0.167}Y_{0.833}F_4}$. By the ordinary criterion that one should be measuring physical quantities at frequencies as far below the crossover to frequency-dependent behavior as possible, our results are generally reliable and indeed become more reliable as the novel $T = 0$ quantum glass regime is approached. Mattsson presents no new data on $\mathrm{LiHo_xY_{1-x}F_4}$ to contradict our conclusions.

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