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ORDER AND DISORDER IN DILUTE DIPOLAR MAGNETS IN EXTREME AND MODERATE DILUTIONS

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Abstract:

Motivated by experiments on the $LiHo_xY_{1-x}F_4$ system, we study dilute dipolar magnets in two regimes: (i) at moderate spin concentrations, near the boundary between the ferromagnetic phase and the spin-glass phase, and (ii) at extremely low spin concentrations. In regime (i) we find that the disordering of the ferromagnetic phase by random fields occurs via a novel mechanism, intermediate between simple disordering and the Imry-Ma mechanism, and generic to the situation where competing interactions and a nearby spin glass phase exist [1]. We use this result to explain some peculiar experimental findings [2]: an observed sharp, nearly linear, decrease of the critical ferromagnetic temperature with random field; and a diminishing and broadening of the peak of the susceptibility as function of the applied field with *decreasing* temperature. In regime (ii) we address the long standing problem of the nature of the system at low temperatures. We find that, in the absence of random fields, spin glass order persists to any small spin concentration, with critical temperature being linear in the concentration [3]. Upon the application of a random field spin-glass order is destroyed, and the system breaks into domains, with typical size having a non-trivial dependence on spin concentration.

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2. D. M. Silevitch, D. Bitko, J. Brooke, S. Ghosh, G. Aeppli, and T. Rosenbaum, Nature **448**, 567 (2007).

3. J. C. Andresen, H. G. Katzgraber, V. Oganesyan, and M. Schechter, Phys. Rev. X **4**, 041016 (2014).