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Activated quantum criticality of complex systems

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Magnetization measurements performed on single crystals of $Ho_xY_{1-x}LiF_4$ with x = 16.5% and 4.5% show the same behavior for both compositions: (i) absence of divergence of the non-linear susceptibility in a transverse field (ii) same absence of divergence in zero field. These results are in sharp contrast with earlier studies of $Ho_xY_{1-x}LiF_4$. In (i) the observed lack divergence results from the presence of random fields induced by the applied transverse field (no spin-glass phase transition, as predicted by Schechter, Laflorencie and Stamp). In (ii) it results from important slowing down of the dynamics due to huge energy barriers. Excellent fits are obtained for the linear and non-linear susceptibilities with $\ln(M) = -Tf(H,T)$ (f is a functional form), suggesting the possibility of a dynamical phase transition involving thermally activated tunneling states. This model may also be useful for more general quantum dynamics of complex systems at finite temperatures.

Scaling of non-linear susceptibility in MnCu and GdAl spin-glasses, B. Barbara, A. P. Malozemoff, and Y. Imry, PRL, 7, 1852 (1981).
Absence of Conventional Spin-Glass Transition in the Ising Dipolar System $LiHo_xY_{1-x}F_4$, P. E. Jönsson, R. Mathieu, W. Wernsdorfer, A. M. Tkachuk, and B. Barbara, PRL, 98, 256403 (2007).
Nuclear spin driven quantum relaxation in $LiHo_{0.002}Y_{0.998}F_4$, R. Giraud, W. Wernsdorfer, A. M. Tkachuk, D. Mailly, and B. Barbara, PRL, 87, 057203 (2001).
Significance of the hyperfine interactions in the phase diagram of $LiHo_xY_{1-x}F_4$, M. Schechter and P. C. E. Stamp, PRL, 95, 267208 (2005).
Quantum spin-glass and the dipolar interactions, M. Schechter and N. Laflorencie, PRL, 97,137204 (2006).
Induced Random Fields in the $LiHo_xY_{1-x}F_4$ Quantum Ising Magnet in a Transverse Magnetic Field, S. M. A. Tabei, M. J. P. Gingras, Y.-J. Kao, P. Stasiak, and J.-Y. Fortin, PRL, 97, 237203 (2006).
Quantum spin-glass in anisotropic dipolar systems, M. Schechter, P.C.E. Stamp, and N. Laflorencie, J. Phys: Cond. Matt., 19, 145218 (2007).
Activated Scaling of Classical and Quantum Spin Glasses, B. Barbara. PRL, 99, 177201 (2007).