MAR14-2013-008965

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Spin dynamics of molecular nanomagnets unravelled at atomic scale by four-dimensional inelastic neutron scattering

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The application of inelastic neutron scattering (INS) as a microscopic probe of spin dynamics within molecular based magnets (MM) is discussed with focus on results following recent technological developments. It will be shown that recently-developed INS instrumentation enables single crystal studies of MM, yielding the four-dimensional inelastic-neutron scattering function $S(Q_{xyz}, E)$ in vast portions of reciprocal space [1]. Such detailed information of neutron momentum transfer enables spin pair correlations within MM to be directly extracted without the need to pass through a model Hamiltonian. INS results for example MM exhibiting interesting physical properties such as magnetic spin frustration [2] and quantum tunnelling will be presented. The potential of four dimensional INS as a new probe of elusive magnetic phenomena present in MM will be explored. For example, the examination of how a quantum fluctuation propagates around a cyclic antiferromagnetic chain is presented and used to test the degree of validity of the Néel vector tunneling.

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[2] M. L. Baker, G. A. Timco, S. Piligkos, J. S. Mathieson, H. Mutka, F. Tuna, P. Kozlowski, M. Antkowiak, T. Guidi, T. Gupta, H. Rath, R. J. Woolfson, G. Kamieniarz, R. G. Pritchard, H. Weihe, L. Cronin, G. Rajaraman, D. Collison, E. J. L. McInnes and R. E. P. Winpenny. Proc. Natl. Acad. Sci., 109, 19113, (2012).