Experimental Report

Proposal: **4-03-1695** **Council:** 4/2012

Title: Spin dynamics in the frustrated XYantiferromagnet Er2Ti2O7

This proposal is a new proposal

Researh Area: Physics

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Samples: Er2Ti2O7

Instrument	Req. Days	All. Days	From	To
IN5	10	7	02/04/2013	04/04/2013
			02/05/2013	06/05/2013

Abstract:

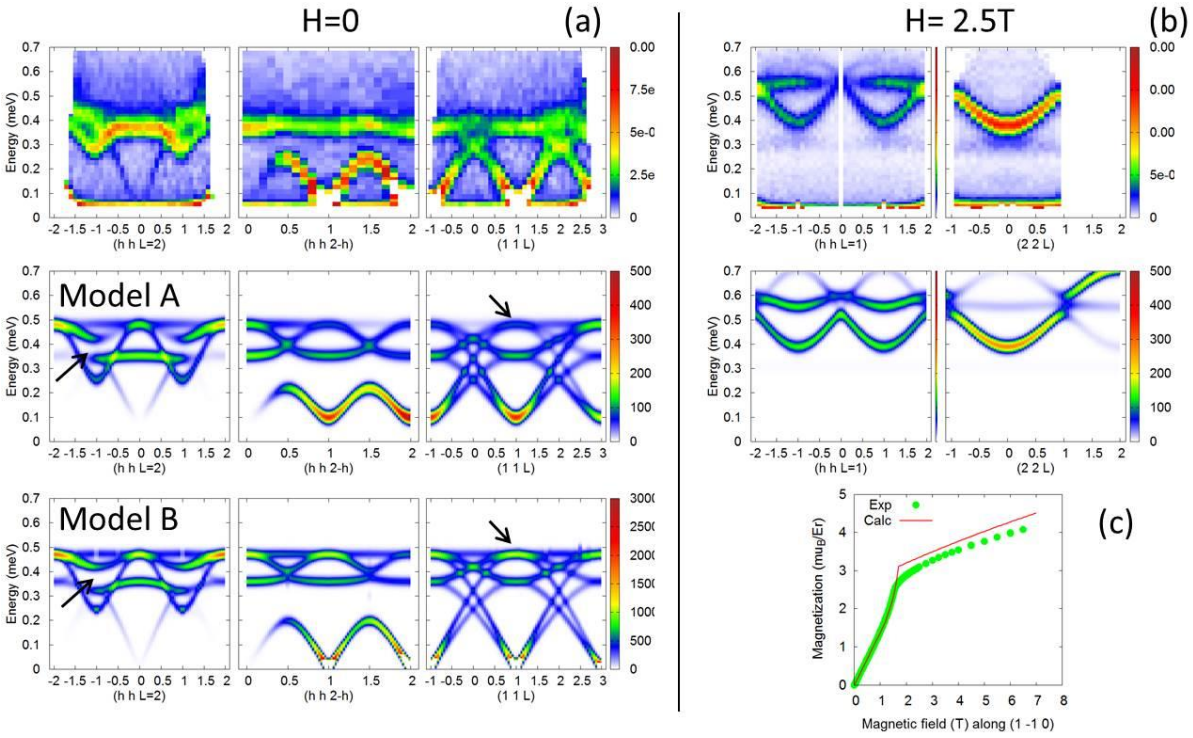
Er2Ti2O7 is a pryochlore XY antiferromagnet, a parent compound of the spins ices (Ho2Ti2O7 and Dy2Ti2O7) where the anisotropy is of uniaxial type. In zero field, Er2Ti2O7 orders below 1.1 K probably by an order-by-disorder mechanism, which is still debated. Recent measurements suggest the existence of a quantum critical point promoted by the magnetic field at H=1.5 T. To shed light on this physics, we propose to study the spin dynamics for different field values across the critical point by means of inelastic neutron scattering.

A paper with the neutron data taken at IN5 during this experiment is currently being written and will be submitted to PRL soon:

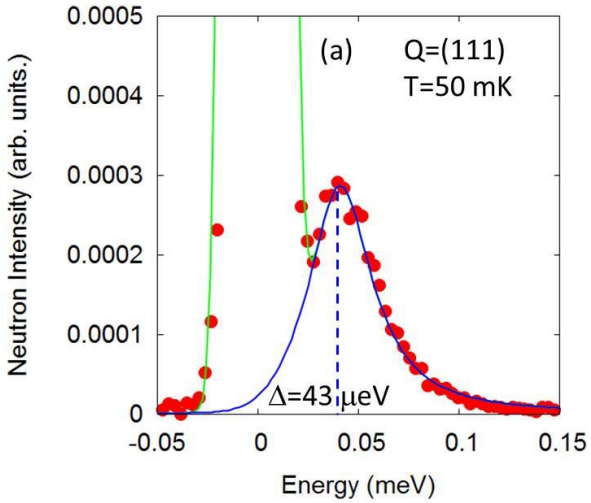
Order by disorder or energetic selection of the ground state in the XY pyrochlore antiferromagnet Er2Ti2O7 ? A neutron scattering study.

Sylvain Petit, Julien Robert, Solene Guitteny, Pierre Bonville, Claudia Decorse, Jacques Ollivier, Hannu Mutka, M.J.P. Gingras, Isabelle Mirebeau

With the following abstract:
Examples of materials where an "order by quantum disorder" mechanism is at play to select a particular ground state are scarce. It has been recently proposed, however, that the anti-ferromagnetic XY pyrochlore Er2Ti2O7, reveals a most convincing case of this mechanism. Observation of a spin gap at zone centers was interpreted as a definitive proof of this physics. In this paper, we argue however that the anisotropy provided by the interaction-induced admixing between the crystal-field ground and excited levels gives an alternative mechanism. We report new high resolution inelastic neutron scattering data characterized by a spin gap of $\Delta \sim 43$ μeV which can be well understood in this scenario. In this energetic selection mechanism, the gap originates from the anisotropy.



IN5 time of flight spectra taken at 50 mK with an incident wavelength of 6 Angstrom, along various directions, in zero field (a) or under a magnetic field of 2.5T applied along the (1,-1,0) direction (b). S(Q, ω) is shown for the RPA (model A) and spin half (model B), taking into account equi-populated $\psi 2$ domains, as described in the text. The global agreement is evident but the arrows point out specific Q regions showing the limits of the models. (c) shows the magnetization curve calculated in the RPA along with experimental results.



INS raw data recorded at Q=(111) and T=50 mK showing the spin gap (blue line) at 43 μeV.