Quantum Computing with Spin Ice?

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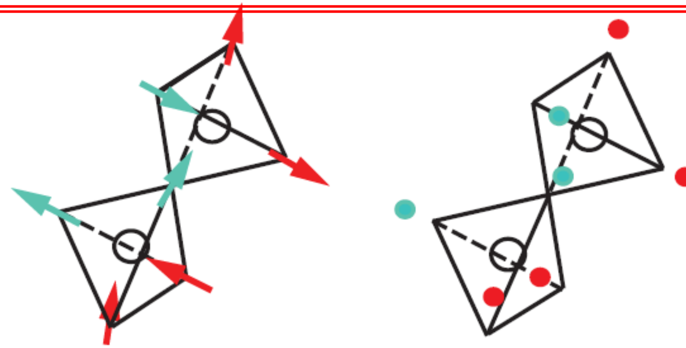
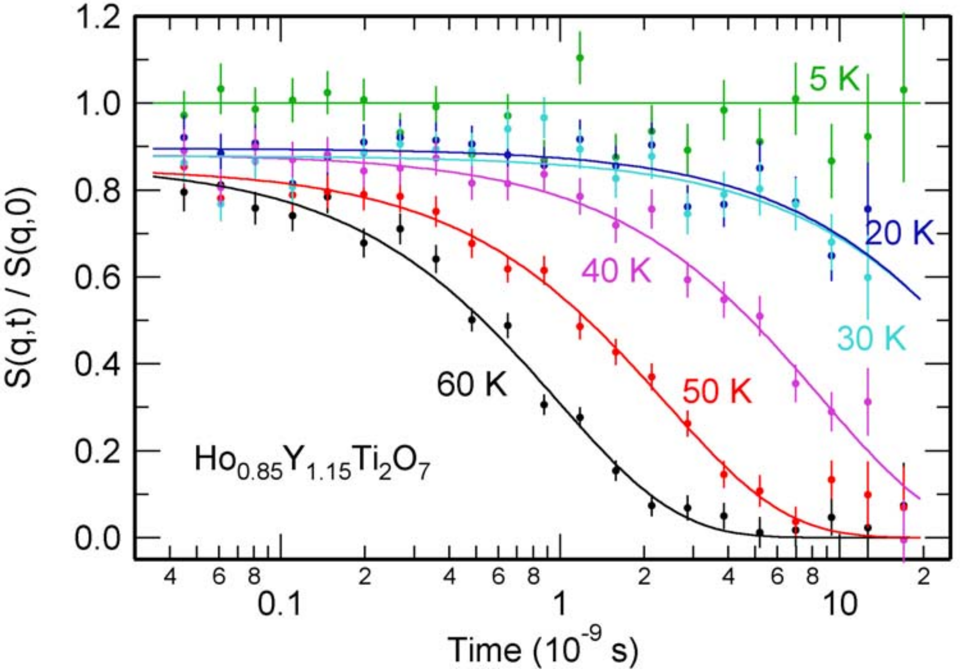
In $Ho_2Ti_2O_7$ the Ho spins order at low temperature into a structure that is identical to the arrangement of hydrogen bonds in water ice – hence the label spin ice. More significantly, the spin system has a complex ground state that can be considered a superposition of many spin configurations – an condition considered favorable for quantum computing.

We have studied the spin dynamics of a spin-ice system using the CHRNS Spin Echo spectrometer. We find that there is a temperature range below 30 K where the spin relaxation time is temperature independent, an indication that the relaxations in this region are dominated by quantum mechanical tunneling. The existence of a material in which tunneling occurs at relatively high temperatures would make it easier to exploit such phenomena for applications in spintronics or quantum computing. $Ho_2Ti_2O_7$-type compounds may constitute just such materials.





Neutron spin-echo measurements of the spin-spin time correlation function. Note the temperature independence below 30 K.

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