Abstract

One of the most fascinating concepts in condensed matter is that of emergence; sometimes, interactions within a vast collection of one type of degree of freedom (for example, electronic spins) can lead to the emergence of new degrees of freedom (for example, magnons - i.e. spin waves). The excitations of the system can then be more compactly described by these new degrees of freedom. A beautiful example is that of emergent magnetic monopoles in “spin ice”, a type of magnetic system on the geometrically frustrated pyrochlore lattice. I will discuss a quantum version of spin ice, in which not only magnetic monopoles, but also “magnetic electrons” and “magnetic photons” are predicted to be the fundamental excitations. I will then show how we synthesized a material which could support such a state, Yb2Ti2O7, and quantitatively determined its relevant microscopic Hamiltonian using a very powerful technique called time-of-flight neutron scattering. I will discuss how Yb2Ti2O7’s Hamiltonian holds promise for supporting emergent electrodynamics, but also how the material presents experimental challenges in observing this state. A brief survey of other types of novel physics that can be observed in such materials will be presented.

Bio

Kate grew up in Ontario, Canada. She received her Bachelor’s from the University of Waterloo, and her PhD from McMaster University in 2012. She then worked at the NIST center for Neutron Research and Johns Hopkins University as a postdoctoral researcher until 2014. She is currently a postdoctoral researcher in the Chemistry Department at CSU, and will be joining the Physics faculty in the fall.