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Pulsed neutrons, fractional excitations, and quantum spin liquids

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Sixty years ago, Canadian Physicist Bertram Brockhouse pioneered inelastic neutron scattering. His invention, the triple axis spectrometer, enabled direct measurements of phonons, magnons, and other collective elementary excitations in materials. In more recent times the practice of inelastic neutron scattering has been revolutionized by pulsed neutron time-of-flight spectroscopy, enabled in part by the vast increase in available computational power. This has allowed detailed investigations of exotic phenomena including fractionalized magnetic excitations. This talk will begin by surveying some relevant developments in neutron instrumentation, primarily at the accelerator-based Spallation Neutron Source at Oak Ridge. The focus will then shift to the physics of quantum magnets and fractionalized excitations, showing how these are probed by neutron scattering. Next will be a look at the exactly solvable model on a honeycomb lattice proposed by Alexei Kitaev, that exhibits a quantum spin liquid ground state. The talk will conclude with an examination of recent experiments on materials that exhibit mutually competing interactions like those postulated by Kitaev, showing evidence for fractional excitations associated with his eponymous quantum spin liquid.

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