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Probing spinon nodal structures in Kitaev spin liquids

The quantum spin liquid (QSL) is a state of matter which is very difficult to detect experimentally because it lacks a local order parameter to which common probes couple directly. The three defining characteristics of a QSL are topological ground-state degeneracy, long-range entanglement, and fractionalization of the fundamental spin degrees of freedom. While the first two are not easily accessible by experiment, fractionalized excitations can be detected by means of thermodynamic and dynamical scattering measurements. Here we propose that resonant inelastic X-ray scattering (RIXS) is an effective probe of the fractionalized excitations in 2D and 3D

Kitaev spin liquids, which are quintessential examples of the QSL state [1,2]. We find that RIXS channels, the spin-conserving and non-spin-conserving RIXS channels do not interfere and give completely different responses. The spin-conserving channel picks up exclusively the Majorana sector with a pronounced momentum dispersion. The non-spin-conserving RIXS channels additionally create immobile fluxes, and the response becomes only weakly momentum dependent. We compute the RIXS response at finite temperature and show how the momentum-energy map of fractionalization varies with temperature [3].

[1] G. Halasz, N.B. Perkins, J. van den Brink, PRL 117, 127203 (2016).
[2] G. Halasz, B. Perreault, N.B. Perkins, PRL 119, 097202 (2017).
[3] G. Halasz, S. Kourtis, J. Knolle and N.B. Perkins, in preparation.