MAS20-2020-000151

Abstract for an Invited Paper
for the MAS20 Meeting of
the American Physical Society

Duality and domain wall dynamics in a twisted Kitaev chain

N. PETER ARMITAGE, The Johns Hopkins University

The Ising chain in transverse field is a paradigmatic model for a host of physical phenomena, including spontaneous symmetry breaking, topological defects, quantum criticality, and duality. Although the quasi-1D ferromagnet $CoNb_2O_6$ has been put forward as the best material example of the transverse field Ising model, it exhibits significant deviations from ideality. Through a combination of THz spectroscopy and theory, we show that $CoNb_2O_6$ in fact is well described by a different model with strong bond dependent interactions, which we dub the *twisted Kitaev chain*, as these interactions share a close resemblance to a one-dimensional version of the intensely studied honeycomb Kitaev model. In this model the ferromagnetic ground state of $CoNb_2O_6$ arises from the compromise between two distinct alternating axes rather than a single easy axis. Due to this frustration, even at zero applied field domain-wall excitations have quantum motion that is described by the celebrated Su-Schriefer-Heeger model of polyacetylene. This leads to rich behavior as a function of field. Despite the anomalous domain wall dynamics, close to a critical transverse field the twisted Kitaev chain enters a universal regime in the Ising universality class. This is reflected by the observation that the excitation gap in $CoNb_2O_6$ in the ferromagnetic regime closes at a rate precisely twice that of the paramagnet. This originates in the duality between domain walls and spin-flips and the topological conservation of domain wall parity. We measure this universal ratio '2' to high accuracy – the first direct evidence for the Kramers-Wannier duality in nature.