On Ising's Model of Ferromagnetism

Dr. N. Peter Armitage

Johns Hopkins University

Friday, December 5, 2025, 3:30pm

Abstract: The 1D Ising model is a classical model of great historical significance for both classical and quantum statistical mechanics. Developments in the understanding of the Ising model have fundamentally impacted our knowledge of thermodynamics, critical phenomena, magnetism, conformal quantum field theories, particle physics, and emergence in many-body systems. Despite the theoretical impact of the Ising model there have been very few good 1D realizations of it in actual real material systems. However, it has been pointed out recently, that the material $CoNb_2O_6$, has a number of features that may make it the most ideal realization we have of the Ising model in one dimension. In this talk I will discuss the surprisingly complex physics resulting in this simple model and review the history of "Ising's model" from both a scientific and human perspective. In the modern context I will review recent experiments by my group and others on $CoNb_2O_6$. In particular, I will show how low frequency light in the THz range gives unique insight into the tremendous zoo of phenomena arising in this simple model system.

Bio: Prof. N. Peter Armitage has been at Johns Hopkins University since 2006. He received his B.S. in Physics from Rutgers University in 1994 and his PhD from Stanford University in 2002. He is a physicist whose research centers on material systems which exhibit coherent quantum effects at low temperatures, like superconductors and "quantum" magnetism. Dr. Armitage's principal scientific interest is understanding how is it that large ensembles of strongly interacting, but fundamentally simple particles like electrons in solids act collectively to exhibit complex emergent quantum phenomena. He is exploiting (and developing) recent technical breakthroughs using very low frequency microwave and THz range radiation to probe these systems at their natural frequency scales. The material systems of interest require novel measurement techniques as their relevant frequencies typically fall between the range of usual optical and electronic methods. He has been the recipient of a DARPA Young Faculty Award, an NSF Career Award, a Sloan Research Fellowship, was a three-time Kavli Frontiers Fellow, the Spicer Award from the Stanford Synchrotron Radiation Laboratory, the McMillan Award from the University of Illinois and 2016 Genzel Prize. He was also the co-chair of the 2014 Gordon Research Conference in Correlated Electron Systems. Professor Peter Armitage received a 2023 Brown Investigator Award from the Brown Science Foundation. The elite award recognized curiosity-driven research in chemistry and physics. Armitage was one of only seven recipients in 2023.