Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Investigations in the crystal growth and neutron scattering of superconductors and a relaxor ferroelectric

By

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In this dissertation, I present research on four materials with properties that are not well understood. First, we investigated materials synthesis and annealing conditions of the proposed topological superconductor Cu₉Bi₂Se₃, finding that quenching above a minimum temperature was essential for superconductivity. Due to the inhomogeneity of Cu₉Bi₂Se₃, we suggest that a metastable secondary phase may be responsible for the superconductivity. Second, we performed neutron scattering measurements on samples in the Fe₁₋ₓTeₓSe family of iron-based superconductors, focusing on the anomalous phonon mode recently discovered near Bragg peaks forbidden by symmetry and at high-symmetry wavevectors where the mode’s neutron scattering intensity is expected to be zero. We characterize this mode and propose that disorder may explain its existence. Third, a superconducting crystal of the bilayer cuprate La₉Ca₉Cu₄O₆₋ₓ is synthesized and measured by neutron scattering. Though the magnetic excitations near (0.5,0.5) in reciprocal space resemble those of undoped or lightly hole-doped non-superconducting cuprates, changes in spectral weight with temperature suggest the presence of a superconducting resonance. Fourth, the relaxor ferroelectric Pb(Mg₁/₃Nb₂/₃)₀.₉₈Ti₀.₃₂O₃ was measured with neutron scattering while subjected to an electric field. From differences in neutron scattering intensity with and without electric field, we find a possible coupling between short-range polar correlations and transversely-polarized phonons near certain Brillouin zone centers.

Date: August 8, 2016
Time: 2:00 pm
Place: Physics Room P-119
Program: Physics
Dissertation Advisor: Genda Gu