Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Strong Electronic Correlations in Manganese Pnictide Compounds

By

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Electron-electron interactions must be considered to understand the electronic ground states of many crystalline solids. The work presented here addresses the effects of electronic correlation in several manganese pnictide compounds. These results contribute to our understanding of the conditions under which high temperature superconductivity and spin liquid behavior can occur.

First, we find that the intra-atomic Hund's coupling between electrons is crucial for the stabilization of an insulating ground state in LaMnPO [1] and $BaMn_2As_2$ [2], which are isostructural to the parent compounds of the high temperature iron-based superconductors. Second, we find that competing inter-atomic exchange interactions frustrate the long range magnetic order in the corrugated honeycomb lattice compound $CaMn_2Sb_2$ [3]. Finally, we find signatures of an orbitally selective Mott phase in $LaMn_xSb_2$.

To arrive at these results, we performed and analyzed inelastic neutron scattering, x-ray and neutron diffraction, transport, specific heat and magnetization measurements on bulk single crystals and powders that we synthesized. We also collaborated extensively with groups that performed optical spectroscopy measurements on single crystals that we provided and electronic structure calculations on input crystal structures that we provided.

[1] D.E. McNally et al., "Origin of the charge gap in LaMnPO" Phys. Rev. B 90, 180403(R) (2014).

[2] D.E. McNally et al., "From Hund's insulator to Fermi liquid: Optical spectroscopy study of K doping in $BaMn_2As_2$", Phys. Rev. B 92, 115142 (2015).

[3] D.E. McNally et al., "$CaMn_2Sb_2$: Spin waves on a frustrated antiferromagnetic honeycomb lattice", Phys. Rev B 91, 180407 (2015).

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