Notre Dame Science
Department of Physics

DIMER-BREAKING AND ELECTRONIC CORRELATION IN $ThCr_2Si_2$ STRUCTURAL COMPOUNDS

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With over 600 members, the tetragonal $ThCr_2Si_2$ structure is the most commonly observed structure among the intermetallic compounds. This AT_2X_2 structure is formed by stacking covalently bonded transition metal-metalloid T_2X_2 layers, made from edge-sharing TX_4 tetrahedra, with ionic A atoms. In certain members of this AT_2X_2 family, a molecule-like X-X dimer crosses the A atom layer, pulls the neighboring T_2X_2 layers closer together and induces a relaxation of the in-plane lattice dimension, leading to what are known as collapsed tetragonal (cT) cells. In contrast, the absence of an X-X dimer results in uncollapsed tetragonal (ucT) cells. A unique lattice collapse transition from ucT phase to cT phase, albeit noted 20 years ago, has rarely been examined until very recently.

In this talk, I will show my exploration of solid solutions between the ucT and cT phases. The continuous lattice collapse transitions can be controlled by tuning the chemical pressure or changing the electron filling in the X-X antibonding orbitals. Exotic magnetic properties, such as quantum critical point (QCP) and high temperature ferromagnetism, unexpectedly develop during the course of the dimer breaking. The use of chemical bond breaking as a tuning parameter to induce QCP opens an avenue for designing and studying novel magnetic materials.

Condensed Matter Seminar

All interested persons are cordially invited to attend.