3:30 pm • Friday November 30, 2012 • 2241 Chamberlin Hall • Coffee at 4:30 pm

Natalia Perkins

UW-Madison

Emergent phases of correlated electrons in materials with spin-orbit coupling and magnetic frustration

Department of Physics Colloquium

WISCONSIN

Recently spin-orbit coupling (SOC) effects have become a subject of intensive research across many different disciplines in condensed matter physics. In particular, SOC has been appreciated in correlated electron systems with orbital degrees of freedom for its role in creating a new class of electronic states that allow crossed-responses of the electrons to electric and magnetic fields. The effects of SOC are especially pronounced in 4d and 5d transition-metal compounds, which have large intrinsic atomic SOC due to their high atomic weight. In these materials electrons are more delocalized than in the 3d systems, the Coulomb interaction is effectively screened, and SOC often becomes a dominant interaction, which makes the hierarchy of energy scales very unusual. This unusual hierarchy of interactions and strong entanglement between spin and orbital degrees of freedom in 5d-systems lead to a variety of interesting ground states but also to novel types of elementary excitations which carry both spin and orbital characteristics and also strongly depend on lattice and bonding geometries. Because of these properties 5dsystems might be considered as promising materials for the realization of various emergent quantum phases, such as spin liquids, topological insulators, Weyl semimetals, and novel magnetically ordered Mott insulators. 3d transition metals may also exhibit important SOC if competing interactions such as crystal fields and exchange interactions are suppressed by geometrical frustration of the underlying crystal structures. Examples of this type have been observed in various 3d-based spinels, in which the SOC is responsible for the orthogonal magnetic structure in the V-based spinel MnV_2O_4, multiferroic behavior of FeV_2O_4, and the spin-orbital liquid state in the Fe-based spinel $FeSc_2S_4$.

Please Post