The Power of Strong Spin-Orbit Interactions: Electrical Control of Structural and Physical Properties of Novel Mott Insulators

Wednesday, November 1, 2017
4:00 PM
F.W. Olin Hall Room 105
2190 E. Iliff Avenue

Reception at 3:30PM in the Olin Rotunda

Presented by

Dr. Gang Cao
Department of Physics, University of Colorado at Boulder

Effects of spin-orbit interactions in condensed matter are an important and rapidly evolving topic. Strong competition between spin-orbit, on-site Coulomb and crystalline electric field interactions in iridates drives exotic quantum states that are unique to this group of materials. In this talk, we briefly review current experimental studies of iridates, and then present results of our recent study on electrical-current controlled behavior in iridates. Electrical control of structural and physical properties is a long-sought, but elusive goal of contemporary science and technology. We demonstrate that a combination of strong spin-orbit interactions (SOI) and a canted antiferromagnetic (AFM) Mott state is sufficient to attain that goal. The AFM insulator Sr$_2$IrO$_4$ provides a model system in which strong SOI lock canted Ir magnetic moments to IrO$_6$-octahedra, causing them to rigidly rotate together. A novel coupling between an applied electrical current and the canting angle reduces the Néel temperature and drives a large, non-linear lattice expansion that closely tracks the magnetization, increases the electron mobility, and precipitates a unique resistive switching effect. These observations open new avenues for understanding fundamental physics driven by strong SOI in condensed matter, and provide a new paradigm for functional materials and devices.