MAR13-2012-020430

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Tuning the Spin-Orbit Coupled Ground State of Iridates with Pressure

DANIEL HASKEL, Argonne National Laboratory

The electronic ground state of the novel magnetic insulators $BaIrO_3$ [1] and Sr_2IrO_4 [2] is probed at ambient and high-pressure conditions using x-ray absorption and magnetic circular dichroism measurements. A spin-only description of the magnetic ground state is ruled out, spin-orbit entanglement in $5d$states resulting in comparable orbital (L_z) and spin (S_z) contributions to the localized magnetic moments despite the presence of strong crystal fields and band effects in Ir $5d$ states. Pressures of $\sim$ 5 GPa and 20 GPa quench the "weak" ferromagnetic ordering in $BaIrO_3$ and Sr_2IrO_4, respectively, despite robust local moments and insulating behavior remaining at these pressures, confirming the Mott character of the insulating gap. The expectation value of the angular part of the S-O interaction, $<\mathbf{L}\bullet\mathbf{S}>$, extrapolates to zero at 80–90 GPa in Sr_2IrO_4 where an increased bandwidth strongly mixes J_{eff} =1/2, 3/2 states and S-O interactions no longer dominate the electronic ground state. The likely appearance of a single, metallic band at a pressure of $\sim$ 1 Mbar (100 GPa) provides an exciting backdrop for searches of superconductivity at high pressures [3]. Work at Argonne is supported by the U.S. Department of Energy (DOE), Office of Science, Office of Basic Energy Sciences, under Contract No. DE-AC-02-06CH11357.

[1] M. A. Laguna Marco *et al.*, *Phys. Rev. Lett.* **105**, 216407 (2010).
[2] D. Haskel *et al., Phys. Rev. Lett.* **109**, 027204 (2012).
[3] F. Wang and T. Senthil, *Phys. Rev. Lett.* **106**, 136402 (2011).