MAR16-2015-020179

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Nature of the magnetic correlations in photo-doped and chemically-doped spin-orbit Mott insulator $\mathbf{Sr_2IrO_4}$[1]

MARK P. M. DEAN, Brookhaven National Laboratory

In the iridates, competition between spin-orbit coupling, crystal field, and electronic correlation has lead to the observation of several novel states. Particularly notable is the spin-orbit Mott insulating state in Sr_2IrO_4 which has close analogies to the high temperature superconducting cuprates. This talk will describe the nature of the magnetic correlations in Sr_2IrO_4 and how the magnetic correlations can be modified by two different doping schemes. I will first describe doping via photo-excitation in which we use femtosecond infrared pulses to excite carriers across the Mott gap. After excitation, we probe the resulting magnetic state as a function of time delay using the first implementation of magnetic resonant inelastic X-ray scattering at a free electron laser. We find that the non-equilibrium state 2 ps after the excitation has strongly suppressed long-range magnetic order, but hosts photo-carriers that induce strong, non-thermal magnetic correlations. The magnetism recovers its two-dimensional in-plane Néel correlations on a timescale of a few ps, while the three-dimensional long range magnetic order is restored over a far longer, fluence-dependent timescale of a few 100 ps. In the second part of the talk I will describe chemical doping via Ir-Ru substitution. In this situation, we find that with increased Ru concentration, the dispersive magnetic excitations in the parent compound become almost momentum-independent, opening a magnetic gap > 150 meV. We attribute this gap to the combined effects of disorder and Ir-Ru interactions.

[1]Work performed at Brookhaven National Laboratory was supported by the US Department of Energy, Division of Materials Science, under Contract No.DE-AC02-98CH10886.