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Exploring the correlated phase behavior and electronic properties of parent and doped spin-orbit Mott phases[1]

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An unusual manifestation of Mott physics dependent on strong spin-orbit interactions has recently been identified in a growing number of classes of 5d transition metal oxides built from Ir^{4+} ions. Instead of the naively expected increased itinerancy of these iridates due to the larger orbital extent of their 5d valence electrons, the interplay between the amplified relativistic spin-orbit interaction (intrinsic to large Z iridium cations) and their residual on-site Coulomb interaction U, conspires to stabilize a novel class of spin-orbit assisted Mott insulators with a proposed J_{eff} =1/2 ground state wavefunction. The identification of this novel spin-orbit Mott state has been the focus of recent interest due to its potential of hosting a variety of new phases driven by correlated electron phenomena (such as high temperature superconductivity or enhanced ferroic behavior) in a strongly spin-orbit coupled setting. Currently, however, there remains very little understanding of how spin-orbit Mott phases respond to carrier doping and, more specifically, how relevant U remains for the charge carriers of a spin-orbit Mott phase once the bandwidth is increased. Here I will present our group's recent experimental work exploring carrier doping and the resulting electronic phase behavior in one such spin-orbit driven Mott material, $Sr_3Ir_2O_7$, with the ultimate goal of determining the relevance of U and electron correlation effects within the doped system's ground state. Our results reveal the stabilization of an electronically phase separated ground state in B-site doped $Sr_3Ir_2O_7$, suggestive of an extended regime of localization of in-plane doped carriers within the spin-orbit Mott phase. This results in a percolative metal-to-insulator transition with a novel, global, antiferromagnetic order. The electronic response of B-site doping in $Sr_3Ir_2O_7$ will then be compared with recent results exploring A-site doping if time permits.

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