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Competing electronic instabilities in the bilayer spin-orbit Mott insulator $Sr_3Ir_2O_7$[1]

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Destabilizing the spin-orbit Mott state is central to unveiling many of the unconventional electronic states predicted to reside in close proximity, ranging from correlated topological states to high-temperature superconductivity. In particular, carrier substitution into the spin-orbit Mott states manifest in Ruddlesden-Popper (R.P.) strontium iridates is predicted to parallel doping their more strongly correlated cuprate cousins, potentially revealing rich phase diagrams featuring an interplay of competing charge density wave, pseudogap, and superconducting states. Cleanly doping the more strongly insulating R.P. iridates however has proven challenging due to both to the larger carrier densities required to globally quench the Mott state and the limited chemical solubility of traditional dopants. In contrast, the weakly insulating phase of the bilayer R.P. system $Sr_3Ir_2O_7$ resides close the limit of the spin-orbit Mott state's stability and can be driven into a homogenous metallic state via electron (La) doping, providing an ideal platform for searching for competing instabilities. In this talk, I will present our recent work exploring the magnetic and coupled electronic/structural responses of $(Sr_{1-x}La_x)_3Ir_2O_7$ to electron-doping. Data consistent with the formation of spin dimer and charge density wave states coincident with the emergence of the metallic phase will be presented. These features, when combined with the observation of a pseudogap-like state in this compound, provide an intriguing parallel to the canonical phase diagrams of the cuprates and demonstrate an equally rich electronic phase space in correlated R.P. iridates.

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