MAR12-2011-004916

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Spin orbit coupling, electron correlations and exotic magnetism in 5d complex Ir oxides

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In 5d Iridium oxides, a large spin-orbit coupling of $\sim$ 0.5 eV, inherent to heavy 5d elements, is not small as compared with the width of d bands and often modifies the landscape of the electronic structure substantially. This is distinct from those of 3d transition metal oxides and gives rise to a variety of novel electronic phases. Layered Ir^{4+} perovskite Sr_2IrO_4 is recently revealed to be a novel J_{eff}=1/2 Mott insulator [1,2], where even a moderate Coulomb U can open up a correlation gap because of the large spin-orbit coupling. In the three dimensional analogue of Sr_2IrO_4, $SrIrO_3$, the large spin-orbit coupling manifests itself in a contrasted way, where the interplay of strong spin-orbit coupling and lattice distortions brings the system almost to a band insulator. $SrIrO_3$ is in fact a very low carrier density semimetal with unusual transport and magnetic properties. If J_{eff}=1/2 Ir^{4+} is placed on a honeycomb lattice or a geometrically frustrated lattice such as pyrochlore lattice, even more exotic states might be anticipated, including a correlated topological insulator [3] and a Kiteav magnet [4]. Our attempt to explore such spin-orbit coupling induced states will be reported.

Work done in collaboration with T. Takayama, B.J.Kim, S.Fujiyama, K.Ohashi, J.Matsuno, H.Osumi and T.Arima.

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