Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

From J_{eff} =1/2 insulator to p-wave superconductor in single-crystal $Sr_2Ir_{1-x}Ru_xO_4$ ($0 \leq x \leq 1$)[1] SHUJUAN YUAN, SAICHARAN ASWARTHAM, JASMINKA TERZIC, HAO ZHENG, HENGDI ZHAO, Center for Advanced Materials, Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506, USA, PEDRO SCHLOTTMANN, Physics Department, Florida State University, Tallahassee, FL 32306, USA, GANG CAO, Center for Advanced Materials, Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506, USA — Sr_2IrO_4 is a magnetic insulator assisted by strong spin-orbit coupling (SOC) whereas the Sr_2RuO_4 is a p-wave superconductor. Our investigation of structural, transport, and magnetic properties reveals that substituting 4d Ru^{4+} ($4d^4$) ions for 5d Ir^{4+}($5d^5$) ions in Sr_2IrO_4 directly adds holes to the t_{2g} bands, reduces the SOC and thus rebalances the competing energies in single-crystal $Sr_2Ir_{1-x}Ru_xO_4$. A profound effect of Ru doping driving a rich phase diagram is a structural phase transition from a distorted $I4_1/acd$ to a more ideal $I4/mmm$ tetragonal structure near x=0.50 that accompanies a phase transition from an antiferromagnetic-insulating state to a paramagnetic-metal state. We also make a comparison drawn with Rh doped Sr_2IrO_4, highlighting important similarities and differences.

[1]This work was supported by the National Science Foundation via Grant No. DMR-1265162 and by Department of Energy (BES) through grant No. DE-FG02-98ER45707 (PS).

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Date submitted: 05 Nov 2015 Electronic form version 1.4