MAR13-2012-020084

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Spin-Orbit Coupling in Mott Insulators: Unusual Interactions and Possible Exotic Phases

GEORGE JACKELI, Max Planck Institute for Solid State Research, Stuttgart, Germany

Over the last few years, there has been an upsurge of interest in materials in which exotic states may emerge as the result of relativistic spin-orbit interactions. We will discuss insulating iridium oxides from this perspective. We show that the strong spin-orbit coupling, through the entanglement of spin and orbital spaces, leads to a variety of interesting Hamiltonians ranging from the Heisenberg model to the Kitaev or quantum compass models, for different lattice geometries [1]. Based on these effective Hamiltonians, we present a comprehensive theoretical study [1-3] of the rich phase behavior and dynamics observed in layered iridium oxides such as tetragonal Sr_2IrO_4 and $Sr_3Ir_2O_7$ and hexagonal A_2IrO_3 (A=Na, Li). We suggest that the hexagonal iridates might be close to the Kitaev spin-liquid state. We also discuss the layered tetragonal vanadate Sr_2VO_4 and argue that magnetically-hidden octupolar order, driven by spin-orbit coupling, is realized in this compound [4].

[1] G. Jackeli and G. Khaliullin, Phys. Rev. Lett. **102**, 017205 (2009).
[2] J. Chaloupka, G. Jackeli, and G. Khaliullin, Phys. Rev. Lett. **105**, 027204 (2010).
[3] J. Chaloupka, G. Jackeli, and G. Khaliullin, arXiv:1209.5100.
[4] G. Jackeli and G. Khaliullin, Phys. Rev. Lett. **103**, 067205 (2009).