MAR16-2015-006895

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Design of Mott and topological phases on buckled *3d*-oxide honeycomb lattices[1]

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The honeycomb lattice, as realized e.g. in graphene, has rendered a robust platform for innovative science and potential applications. A much richer generalization of this lattice arises in (111)-oriented bilayers of perovskites, adding the complexity of the strongly correlated, multiorbital nature of electrons in transition metal oxides. Based on first principles calculations with an on-site Coulomb repulsion, here we provide trends in the evolution of ground states versus band filling in (111)-oriented $(LaXO_3)_2/(LaAlO_3)_4$ superlattices, with X spanning the entire *3d* transition metal series. The competition between local quasi-cubic and global triangular symmetry triggers unanticipated broken symmetry phases, with mechanisms ranging from Jahn-Teller distortion, to charge-, spin-, and orbital-ordering. $LaMnO_3$ and $LaCoO_3$ bilayers, where spin-orbit coupling opens a sizable gap in the Dirac-point Fermi surface, emerge as much desired oxide-based Chern insulators, the latter displaying a gap capable of supporting room-temperature applications [1] Further realizations of the honeycomb lattice and geometry patterns beyond the perovskite structure will be addressed. [1] D. Doennig, S. Baidya, W.E. Pickett and R. Pentcheva, arXiv: 1510.09177.

[1]Research supported by the DFG, SFB/TR80.