Topological Phases in Correlated Iridium Pyrochlores

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We discuss the phase diagram of the pyrochlore iridium oxides $A_2Ir_2O_7$, (where A=Y or a rare earth element) as correlations (U) are tuned. From electronic structure calculations (LDA+U method) and effective low energy theory, the system is found to evolve from a metal to a Mott insulator on raising U. For intermediate correlation strengths, a novel Dirac semi-metal phase is found, that coexists with magnetic order. This Dirac phase, a three dimensional analog of graphene, is proposed as the ground state of $Y_2Ir_2O_7$ and related compounds. An interesting aspect of this phase is that it exhibits topological properties - manifested by unconventional surface states in the form of Fermi arcs, that connect the bulk Dirac points. A narrow window of magnetic `axion' insulator, with magnetoelectric parameter $\boldsymbol{\theta=\pi}$, may also be present at intermediate U. Inversion symmetry plays a key role in constraining the phase diagram. Competing ferromagnetic phases, and comparison with existing experimental data will be discussed *(arXiv:1007.0016).*

Time permitting I will also discuss a recent theoretical proposal of anomalous Aharonov-Bohm effect, in topological insulator nanowires *(arXiv:1005.3542),* which could provide a smoking gun transport signature of band topology.