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Band Topology, Electron Correlations and 3D Dirac Metal in Pyrochlore Iridates

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We study consequences of strong spin orbit interaction in a class of correlated systems. We discuss the possibility of novel phases such as a π axion insulator, protected by inversion, rather than time reversal symmetry and a gapless topological phase, the three dimensional Dirac semimetal. The latter phase has unusual surface states that take the form of 'Fermi Arcs', that cannot be realized in any two dimensional band structure. The pyrochlore iridates, (such as $Y_2Ir_2O_7$) according to LDA+U calculations and existing experimental data, are argued to be promising materials for realizing these states. This work was done in collaboration with Xiangang Wan (Nanjing U.), Sergey Savrasov (UC Davis) and Ari Turner (UC Berkeley).