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Twisted Hubbard Model for Sr_2IrO_4: Magnetism and Possible High Temperature Superconductivity

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Sr_2IrO_4 has been suggested as a Mott insulator from a single $J_{eff} = 1/2$ band, similar to the cuprates. However this picture is complicated by the measured large magnetic anisotropy and ferromagnetism. Based on a careful mapping to the $J_{eff} = 1/2$ (pseudospin-1/2) space, we propose that the low energy electronic structure of Sr_2IrO_4 can indeed be described by a SU(2) invariant pseudospin-1/2 Hubbard model very similar to that of the cuprates, but with a "twisted" coupling to external magnetic field (a g-tensor with a staggered antisymmetric component). This perspective naturally explains the magnetic properties of Sr_2IrO_4. We also derive several simple facts based on this mapping and the known results about the Hubbard model and the cuprates, which may be tested in future experiments on Sr_2IrO_4. In particular we propose that (electron-)doping Sr_2IrO_4 can potentially realize high-temperature superconductivity.