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A Spin-Orbital Singlet and Quantum Critical Point on the Diamond Lattice: $FeSc_2S_4$ GANG CHEN, UCSB, LEON BALENTS, ANDREAS SCHNYDER, Kavli Institute for Theoretical Physics, UCSB — We present a theory of spin and orbital physics in the A-site spinel compound $FeSc_2S_4$, which experimentally exhibits a broad "spin-orbital liquid"(SOS) regime. A spin-orbital Hamiltonian is derived from a combination of microscopic consideration and symmetry analysis. We demonstrate a keen competition between spin-orbit interactions, which favor formation of a local "Spin-Orbital Singlet", and exchange, which favors magnetic and orbital ordering. Separating the SOS from the ordered state is a quantum critical point (QCP). We argue that $FeSc_2S_4$ is close to this QCP on the SOS side. The full phase diagram of the model includes a commensurate-incommensurate transition within the ordered phase. A variety of comparison to and suggestion for experiments are discussed.

Gang Chen
Physics Department, UCSB

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