Controlling magnetic frustration in 1T-TaS_2 via Coulomb engineered long-range interactions

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Quantum spin liquids (QSL) are exotic phases of matter featuring strong entanglement and fractional excitations. They have attracted much research interest due to their potential Majorana physics and relation to high-temperature superconductivity. A variety of materials including TaS_2 have been proposed as QSL candidates, yet finding a stable QSL regime in these materials remain a remarkable challenge. Here we propose Coulomb engineering as a versatile strategy to drive a 2D magnet to the quantum spin liquid regime. Focusing on the QSL candidate TaS_2, we show how Coulomb engineering allows controllably renormalizing the low energy flat band dispersion. We then show that the renormalized electronic structure gives rise to a screening-dependent Heisenberg model in the many-body regime. Finally, based on the screening-dependent Heisenberg model, we show how Coulomb engineered long-range interactions can give rise to stronger frustration, potentially driving the system to a QSL state.

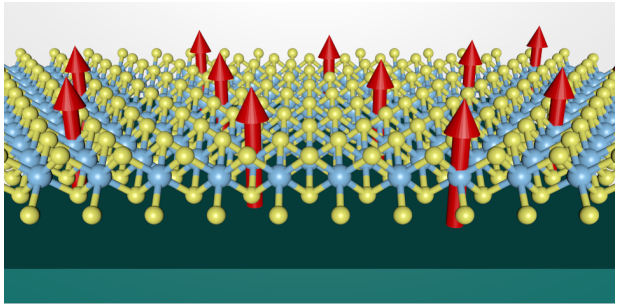
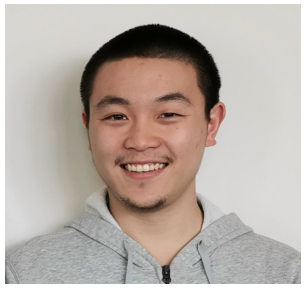


Fig.1 Sketch of the setup.



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