# Nature of the quantum spin liquid phase in the moiré TMD superlattice

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Twisted hetero-bilayers of transition metal dichalcogenides are promising platforms for studying strongly correlated phases of matter [1]. The mismatch between the top and bottom lattice constants and additional twisting causes new periodicity in the system. The moiré pattern acts effectively as a strongly localizing potential, forming an array of quantum dots on the triangular lattice. The ground-state properties of such a complex system can be described by spin Hamiltonian with a four-spin ring exchange term [2, 3].

Structures we study can host intriguing ground states like valence bond solid (VBS), stripe phase, or quantum spin liquid (QSL). Especially the QSL phase and its ambiguous nature have recently attracted a lot of attention from the condensed matter community. The QSL ground state is characterized by the absence of long-range order, conservation of all lattice symmetries, and large entanglement [4].

In our work, using the DMRG algorithm, we analyze various properties of the moiré TMD superlattice properties, including spin correlations, entanglement, and static spin susceptibility, to obtain the phase diagram of those structures. We are able to distinguish three phases, which differ in correlation functions and entanglement entropy. One of our goals is to settle the nature of the QSL ground state as a topological gapped [5] or gapless one with a spinon Fermi surface [6].

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