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Optical detection of a chiral spin liquid in transition metal dichalcogenide moiré bilayers

Johannes Motruk[1] and Louk Rademaker[2]

[1] *Department of Theoretical Physics, University of Geneva*
[2] *Department of Quantum Matter Physics, University of Geneva*

The first valence or conduction band of many moiré bilayers consisting of transition metal dichalcogenide (TMD) sheets can be effectively described by an extended Hubbard model on the triangular lattice. Since the standard Hubbard model on this lattice at half filling has been theoretically predicted to host a chiral spin liquid (CSL) ground state at intermediate interaction strength, TMD moiré bilayers, given their remarkable tunability, represent a promising candidate to experimentally realize this elusive state of matter. However, the identification of such a state in an experiment remains challenging. Based on the possibility of optical manipulation and readout of the spin in TMDs, we propose a pump-probe protocol to detect the characteristic spin Hall conductivity of the CSL. We calculate the spin dynamics within a parton picture benchmarked by matrix product state simulations for small system sizes and discuss under which circumstances the quantization of the spin Hall conductivity can be detected.