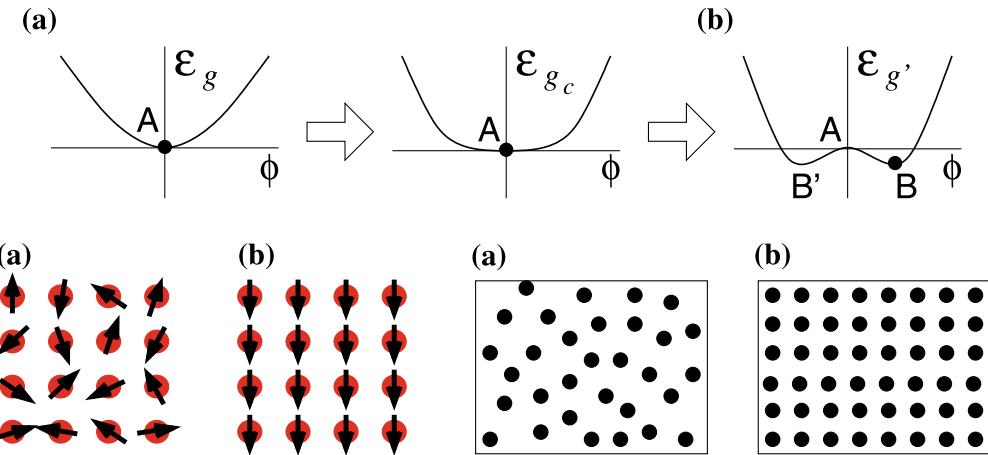
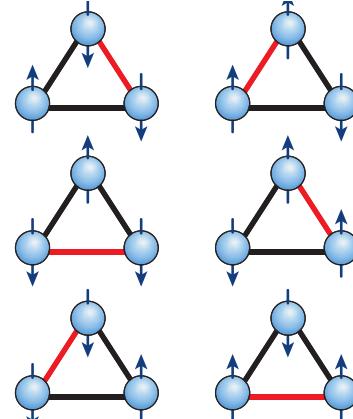
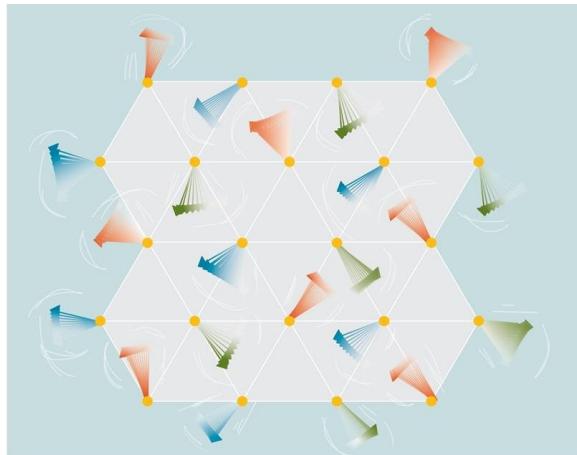


Quantum Spin Liquids

Phases without order

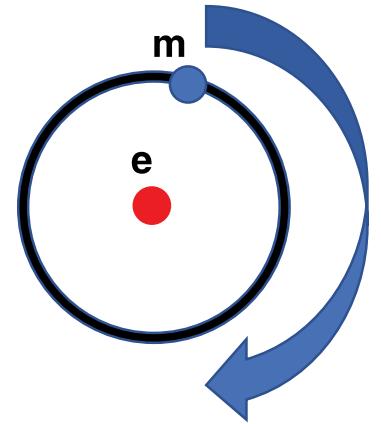
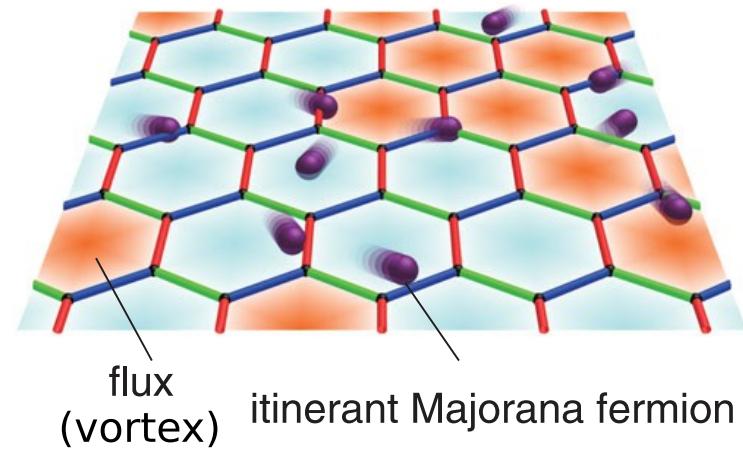


Landau's paradigm: ordering at low T



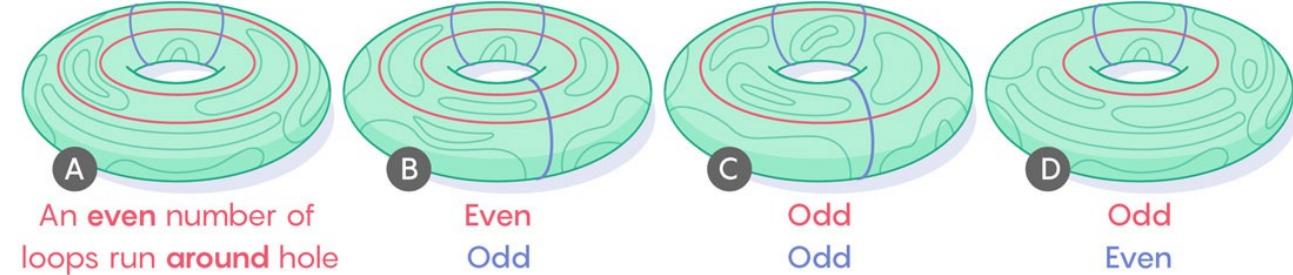
Quantum spin liquid and geometric frustration.
No broken symmetry nor order even at zero T

Fractionalized particles



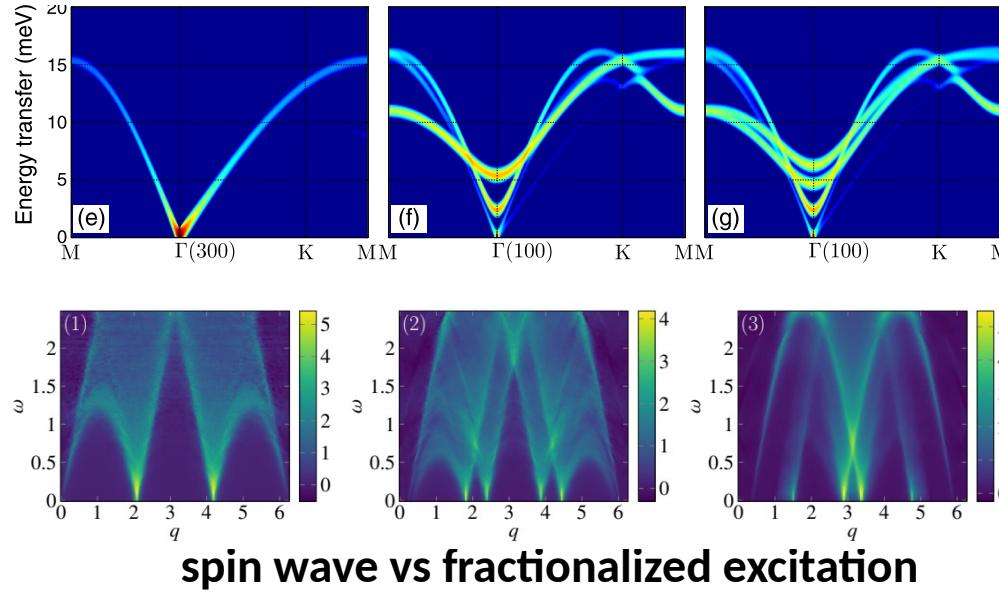
Emergent Majorana fermions with fractional statistics

Topological order



Topological order reflected in the ground state
degeneracy and long-range entanglement

Fractionalization

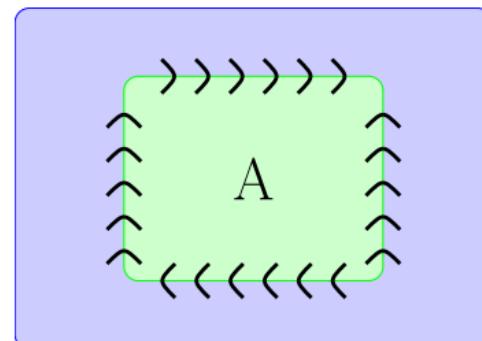


by density matrix renormalization group (DMRG)

S. Feng, G. Alvarez, N. Trivedi, arXiv:2012.00700

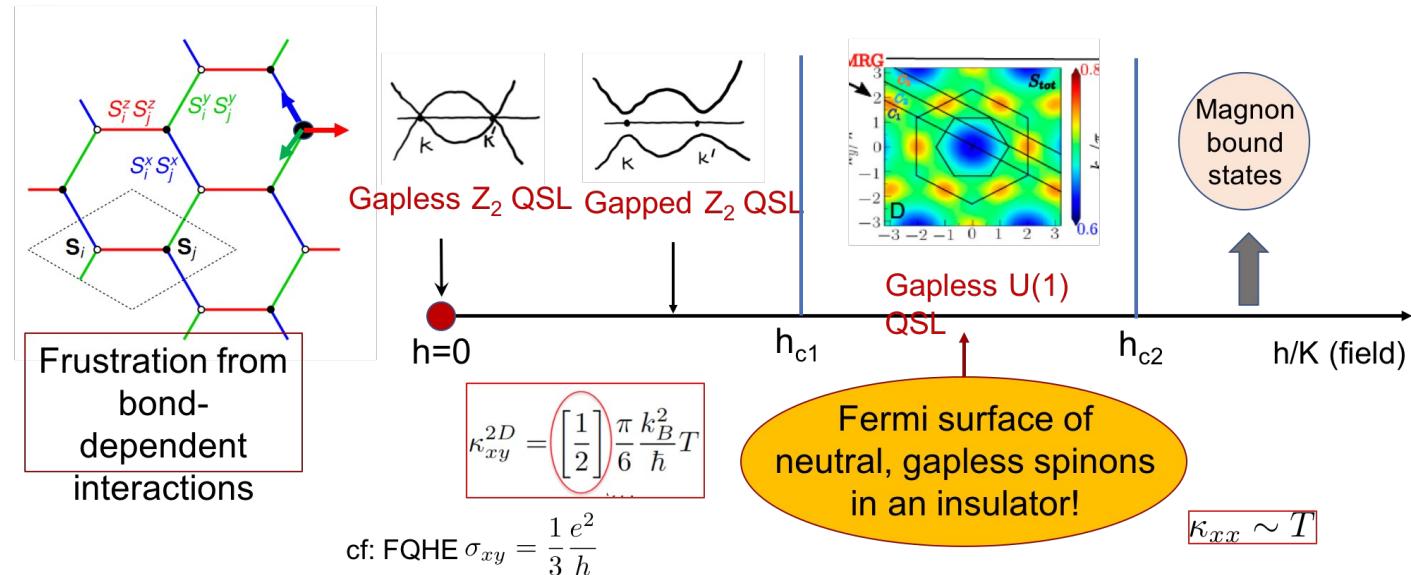
S. Feng, et al, Phys. Rev. B 101, 155112 (2020)

Future Work

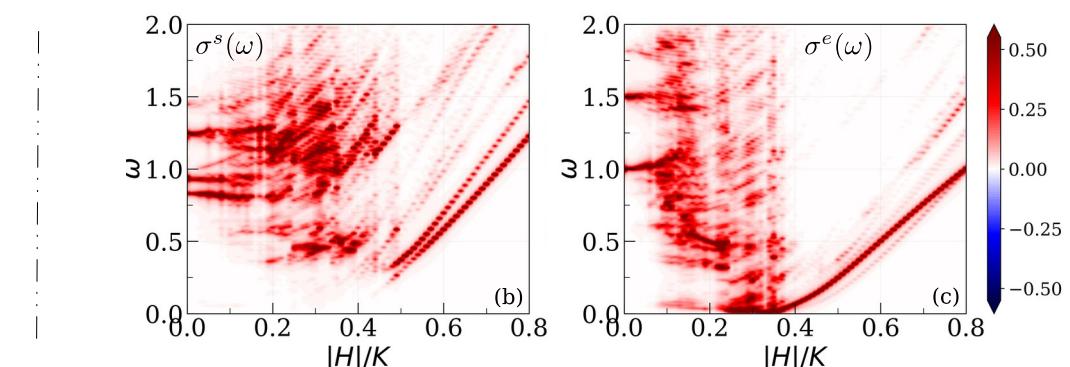


Entanglement in QSL

Kitaev spin liquids



S. Pradhan, et al, Phys. Rev. B 101, 180401(R) (2020), ibid 99, 140413(R) (2019)
N. D. Patel, N. Trivedi, Proc. Natl. Acad. Sci (PNAS) 116, 12199 (2019)



Transport in QSL (spin and energy conductivities)