Fractionalized excitations in Quantum Spin Liquids and their Detection

(Plenary Talk)

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The 2022 Nobel prize celebrates the detection of entanglement between two photons. Quantum spin liquids (QSLs) are long-range entangled states of matter of billions of interacting qubits or spins that develop in a Mott insulator. The fate of the interacting spins can progress along two paths as the temperature is lowered: the spins can undergo long range ordering, spontaneously breaking the continuous symmetries, leading to a magnetic phase; or the spins can remain disordered but get quantum mechanically entangled with long range patterns of many-body entanglement in the resultant QSL. The possibility of obtaining QSL phases is enhanced by having a low spin and enhanced quantum fluctuations, and frustration arising from the lattice geometry and/or competing spin-spin interactions. Remarkably QSLs harbor fractionalized excitations rather than the conventional spin waves of ordered magnets that carry integer units of angular momentum. In my talk I will identify detectable signatures of these fractionalized excitations in experiments using light and neutrons. These fractionalized excitations are promising candidates to create logical qubits for quantum computation.

In collaboration with Shi Feng, Adhip Agarwala, Subhro Bhattacharjee, Kang Wang, Penghao Zhu, Tao Xiang, Xu Yang, Ryan Buechele

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