Spin liquids from Majorana Zero Modes in a network of Cooper Boxes

Yuval Oreg

Spin liquid phases are insulating states of matter with unique properties. In certain cases the phase hosts edge modes, end modes, and emergent non-abelian quasiparticles. The latter is a key element in several suggestions for topological quantum computation. In this talk, I'll describe a proposal to construct a platform for creating effective spin models using semiconductor nanowires. The wires are tuned to the topological regime; with Majorana zero modes on each end. We group them into three-wires building blocks called hexons, each containing six Majorana zero modes. In the presence of a strong charging energy, the hexon becomes a Cooper box that is equivalent to two spin- 1/2 degrees of freedom. This structure enables a flexible control (using local gates only) of the couplings between the Majorana zero modes, This tuning of the Hamiltonian governing the low energy effective spins, provides us with a path of simulating interacting spin-models in one- and two-dimensions. I'll describe several examples including realizations of different phases of 1/2 Heisenberg spin chains, topological spin phases on a two dimensional Fisher lattice and their experimental signature.