Joint Quantum Information Science Seminar

Tuesday, February 26th, 2019
PHYS 242, 11:00 a.m.

Refreshments served at 10:45 am

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Unraveling and harnessing non-Abelian topological quantum matter

Developing a scalable quantum computing architecture that can withstand decoherence to the extent necessary for real-world applications poses an enormous scientific and technological undertaking. One route forward involves stabilizing exotic topological phases of quantum matter harboring emergent particles known as non-Abelian anyons. With these degrees of freedom in hand, one can in principle construct physical qubits that by themselves function as good logical qubits, thus obviating the need for large-scale error correction. Within this topological approach to quantum computation, the requisite topological phenomena could either be *intrinsic* to a material's internal dynamics or *engineered* in judiciously designed heterostructures. In this talk, I will first describe the current status of the 5/2 fractional quantum Hall plateau, a classic example of a (potentially) intrinsic non-Abelian topological phase. In light of recent thermal Hall measurements indicating a particularly surprising non-Abelian state, I will show that this many-body condensed matter problem is as enigmatic as ever from both a theoretical and numerical perspective [1]. Next, I will turn to recent efforts toward engineering a prototype topological qubit in the Majorana nanowire platform. Within this context, I will describe our recent proposals aimed at verifying topological protection in these devices via time-domain measurements designed to demonstrate (or falsify) the system's exponential insensitivity to all sources of local noise [2,3]. Finally, several directions of future research in these and related areas will be discussed.

[1] Mishmash, Mross, Alicea, and Motrunich, PRB 98, 081107(R) (2018)

[2] Aasen, Hell, Mishmash, Higginbotham et al., PRX 6, 031016 (2016)

[3] Mishmash, Bauer, von Oppen, and Alicea (in preparation)