Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Majorana Box Qubits & Surface Code"

Stephan Plugge, University of Düsseldorf

Abstract: An attractive feature of quantum information stored in topological degrees of freedom are protected gates generated through, e.g., the braiding of Majorana bound states. However, braiding requires branched structures which have inherent difficulties in the semiconductor superconductor heterostructures now believed to host Majorana bound states. In the talk I will discuss quantum bits taking advantage of the topological protection and non-local properties of Majorana bound states in a network of parallel wires. The elementary unit is made from three topological wires, two wires coupled by a trivial superconductor and the third acting as an interference arm. Coulomb blockade of the combined wires spawns a fractionalized spin, non-locally addressable by quantum dots used for single-qubit readout, initialization, and manipulation. The same tools allow for measurement-based protected implementation of the Clifford gates, in total making the architecture universal. Proof-of-principle demonstration of topologically protected qubits using existing techniques is therefore within reach.

If time permits, I will discuss how this could pave the way towards large-scale fault-tolerant quantum computation, e.g., using Majorana surface code architectures and/or hybrid strategies.

References:
Plugge, Rasmussen, Egger, & Flensberg, Majorana box qubits, arXiv:1609.01697
Plugge, Landau, Sela, Altland, Flensberg, & Egger, Roadmap to Majorana surface codes, arXiv:1606.08408
Landau, Plugge, Sela, Altland, Albrecht, & Egger, Towards realistic implementations of a Majorana surface code, PRL 116, 050501 (2016)

12:00pm
Thursday, October 13, 2016
Duboc Room (4-331)

Host: Liang Fu