# Massachusetts Institute of Technology
# Department of Physics

## Condensed Matter Theory Seminar

"Hierarchical Majoranas in a Programmable Nanowire Network"

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**Abstract:** We propose a hierarchical architecture for building "logical" Majorana zero modes using "physical" Majorana zero modes at the Y-junctions of a hexagonal network of semiconductor nanowires. Each Y-junction contains three "physical" Majoranas, which hybridize when placed in close proximity, yielding a single effective Majorana mode near zero energy. The hybridization of effective Majorana modes on neighboring Y-junctions is controlled by applied gate voltages on the links of the honeycomb network. This gives rise to a tunable tight-binding model of effective Majorana modes. We show that selecting the gate voltages that generate a Kekule vortex pattern in the set of hybridization amplitudes yields an emergent "logical" Majorana zero mode bound to the vortex core. The position of a logical Majorana can be tuned adiabatically, without moving any of the "physical" Majoranas or closing any energy gaps, by programming the values of the gate voltages to change as functions of time. A nanowire network supporting multiple such "logical" Majorana zero modes provides a physical platform for performing adiabatic non-Abelian braiding operations in a fully controllable manner. In the broader context of emergence, our scheme is a form of engineered emergence, where one can, by design, create novel excitations starting from simple building blocks.

**12:00pm noon**
**Wednesday, October 24, 2018**
**Low Room (6C-333)**

Host: Liang Fu