# Massachusetts Institute of Technology
# Department of Physics

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# Condensed Matter Theory Seminar

## "Numerical investigation of gapped edge states in fractional quantum Hall-superconductor heterostructures"

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**Abstract:** The possibility of realizing anyons -- quasiparticles with fractional exchange statistics -- is an exciting prospect in the field of interacting topological phases. Non-abelian anyons, whose exchange is characterized by a matrix rather than a simple phase, are of the most exotic kind. They are highly sought after as they could be used as qubits for quantum computation intrinsically immune to decoherence. While non-abelian anyons are expected to appear in the fractional quantum Hall effect, engineering systems that purposefully favor their emergence might be a better strategy to probe their properties. Progress in creating quantum devices with Majorana bound states represents an important achievement in this direction. Realizing the even more elusive parafermions, which unlike Majoranas could support universal quantum computation, would be an exciting next step.

Parafermion states have been envisioned to occur in heterostructures using fractional quantum Hall (FQH) states and superconductors. Existing theoretical studies of these systems have been entirely based on effective theories of fractional quantum Hall edge states which cannot offer any quantitative analysis of competing energy scales, correlation lengths etc. To fill this gap, we propose and implement a numerical setup for studying edge states of FQH droplets with a superconducting instability. Using exact diagonalization, we report the first observation in a fully microscopic model of gapped FQH edge modes with topological degrees of freedom. The topological nature of these modes is probed through fractional Josephson effect and flux insertion, and evidence the cooper pairing of fractionalized quasiparticles.

## 12:00pm noon
## Tuesday, February 13, 2018
## Duboc Room (4-331)

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**Host: Itamar Kimchi**