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CENTER FOR THEORETICAL PHYSICS



# Sommerfeld Theory Colloquium

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## How to detect Majorana fermions in topological insulators

Majorana fermions are spatially localized superpositions of electron and hole excitations in the middle of a superconducting energy gap. These unusual particles have been predicted to occur at the interface between a magnetic and superconducting electrode, in contact with a topological insulator (such as a Bi crystal or a HgTe quantum well). A single qubit can be encoded nonlocally in a pair of spatially separated Majorana fermions. Such Majorana qubits are in demand as building blocks of a topological quantum computer, but direct experimental tests of the nonlocality remain elusive.

We propose a method to probe the nonlocality by means of crossed Andreev reflection, which is the injection of an electron into one bound state followed by the emission of a hole by the other bound state. The resulting splitting of a Cooper pair by the Majorana qubit produces a pair of excitations that are maximally entangled in the momentum (rather than the spin) degree of freedom, and might be used as "flying qubits" in quantum information processing.

Wednesday, 4<sup>th</sup> November 09, 10:30 h, Room 348 / 349, Theresienstr. 37 / III