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A New Spin on Superconductivity

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Nearly a hundred years after its discovery, superconductivity remains one of the most intriguing phases of matter. In 1957 Bardeen, Cooper and Schrieffer (BCS) presented their theory of superconductivity describing this state in terms of pairs of electrons arranged in a spatially isotropic wave function with no net momentum and a spin singlet configuration. Immediately thereafter, a search began to find materials with unconventional superconductivity where pairing deviates from conventional BCS theory. One particular class of unconventional superconductors involves pairs arranged in triplet rather than singlet configurations. Such superconductors may enable dissipationless transport of spin and may also give rise to elementary excitations that do not obey the conventional Fermi or Bose statistics but rather have non-Abelian statistics where the exchange of two particles transforms the state of the system into a new quantum mechanical state.

In this talk I will describe some of our recent collaboration with Bert that explores the proximity effect between a conventional superconductor and a semiconductor with strong spin-orbit interaction. Using supercurrent interference, we show that we can tune the induced superconductivity continuously from conventional to unconventional that is from singlet to triplet. Our results open up new possibilities for exploring unconventional superconductivity as well as new ways for detecting unconventional pairing in known materials.