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Spin-Polarized Current in a Superconductor[1]

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Superconductivity is one of the most intriguing phenomena in nature. A certain metal becomes a superconductor below its critical temperature TC, loses electrical resistance, enables persistent current, and repels magnetic flux. Superconductivity occurs because electrons form Cooper pairs, which undergo Bose-Einstein condensation at TC. The binding of electrons into Cooper pairs causes a finite energy gap, which decreases with increasing temperatures and vanishes at TC. The intricate physics of superconductivity lies in the pairing mechanism and the symmetry of the energy gap. Most SCs are s-wave SCs with an isotropic superconducting gap. The high TC cuprates, due to an intriguing and still elusive pairing mechanism, are d-wave SCs with an anisotropic gap structure with nodes. The recent Fe p-nidtide SCs, not d-wave as first suspected, but s-wave albeit with an unconventional spairing. The p-wave SCs, which were predicted in the BCS theory more than half a century ago, have proven to be very difficult for experimental confirmation. Superfluid He3 is the only known p-wave pairing in nature. The crucial feature of a p-wave SC is that the electrons in a Cooper pair can have the same spin orientation. This is very different from that of an s- or d-wave SC where electrons must have opposite spins in a Cooper pair. Thus a spin-polarized current can be injected into a p-wave SC but not an s- or d-wave SC. Using this technique, we first show that the Fe-superconductors, which have been predicted to be p-wave, are singlet SCs. Instead, I will show you another strong p-wave candidate.

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