Unveiling Spin Triplet Superconductivity in Noncentrosymmetric NbRe films

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Non-centrosymmetric superconductors (NCSs) represent a fascinating class of materials showing several unconventional physical properties. In particular, due to the lack of an inversion symmetry centre in their crystal structure, NCSs can host an unconventional superconducting order parameter featuring a mixture of spin-singlet and spin-triplet components [1]. This property can be useful for an efficient generation and control of spin polarized supercurrents, which is one of the main objectives of superconducting spintronics [2].

The talk provides evidence of intrinsic equal-spin triplet superconductivity in noncentrosymmetric Nb0.18Re0.82 films, addressing a long-standing open question in its unconventional superconductivity [3]. The focus will be on NbRe-based NCS/Ferromagnetic (F) hybrids. The idea is to use the ferromagnetic layer as a spin filter for triplet correlations to obtain evidence of the unconventional nature of the superconducting state. In particular, a very slow monotonic decay of the superconducting critical temperature (Tc) on the thickness of the F layer was observed in NbRe/F bilayers. These results, obtained by using different ferromagnetic materials, were interpreted in terms of a long-range proximity effect supported by the spin-triplet pairs in the NbRe film [4]. Further support for this interpretation is provided by experiments on Py/NbRe/Py superconducting spin valves (SVs), which exhibit an inverse spin-valve effect [5]. Specifically, the systems show a suppressed Tc when the ferromagnetic layers are aligned in the antiparallel (AP) configuration compared to the parallel (P) one. This behavior is widely recognized as a characteristic indication of equal-spin triplet Cooper pairs, providing a direct manifestation of spin-triplet superconducting correlations.

Finally, some ongoing experiments of both single NbRe films and NbRe/F heterostructures will be briefly illustrated.

References

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