# *The emergence of superconducting spintronics*

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It is generally accepted that the semiconductor electronics scaling road-map will reach its physical limits within the next decade. Different alternative technologies are under active development, in particular the superconducting spintronics, which may be generally described as follows.The Cooper pairs of electrons which carry the current in conventional superconductors consist of electrons with antiparallel spins and so a standard supercurrent is a pure charge current with no spin component. However, these "singlet" pairs can be transformed by a suitable magnetic structure into "triplet" pairs in which the spins are parallel. Recently it has demonstrated that triplet pairs can penetrate significant distances in ferromagnets and evidence has been reported that triplet pairs can flow from ferromagnets into non-magnetic metals. Since triplet pairs are spin-aligned it is possible for them to carry spin without Ohmic dissipation. I will review the main mechanisms of the interplay between magnetism and superconductivity and the coexistence between these two different long ranged orders in the bulk magnetic superconductors and superconductor-ferromagnetheterostructures. Special attention will be devoted to the superconductor/ferromagnet/superconductor Josephson junctions. There the noncollinear magnetization of the ferromagnetic layer provides the conditions necessary to generate the triplet superconducting correlations. It leads to the long-range induced magnetic moment, emerging in the superconducting layers and depending on the Josephson phase. By tuning the Josephson current, one may manipulate the long-range induced magnetic moment. The induced magnetic moment controlled by the Josephson current may be used in spintronics devices instead of the spin-torque effect. The proposed mechanism seems to be attractive for superconducting spintronic devices with low dissipation because it provides a direct coupling between the superconducting current and magnetization.