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Non-local Andreev Reflection as a Source of Entangled Electrons[1]

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Cooper pairs in conventional superconductors form a robust reservoir of spin-entangled singlet "particles". This has led to many theoretical proposals for the realization of "entangler" devices –i.e. devices capable of sourcing currents carried by entangled pairs into nanoelectronic circuits- that are of fundamental interest in the field of quantum information. These proposals rely on the possibility to "split" Cooper pairs by injecting the two constituent electrons into two spatially separated normal metal leads attached to a superconductors. It has been shown theoretically that such a Cooper-pair "splitting" process is equivalent to the process of non-local Andreev reflection, in which an electron (hole) injected from a metallic electrode connected to a superconductor is transmitted into a hole (electron) into a second, spatially separated electrode. In this talk I will discuss recent experiments[1] performed in Delft that demonstrate the occurrence of non-local Andreev reflection as a quantum mechanically phase coherent process. [1] S. Russo *et al.*, Phys. Rev. Lett. **95**, 027002 (2005)

[1]Work done in collaboration with S.Russo, M.Kroug, and T.M. Klapwijk