Josephson current of split nonlocal Cooper pairs

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Quantum entanglement is a basic property necessary for applications in both quantum computation and communication. One attractive proposal for a solid-state entangled electron source utilizes a superconductor as a natural reservoir for spin entangled Cooper pairs of electrons, which could be extracted and separated on-demand. Recently, Andreev entanglers based on two quantum dots connected in parallel to two superconducting electrodes, has been used to adiabatically split and separate electrons of Cooper pairs, as confirmed by measurements of the Josephson current [1]. We demonstrate theoretically that the evidence for this non-local transport can be confirmed through study of the Josephson supercurrent while tuning independently the dots with local electrical gates. Depending on the occupation parity the Josephson current of nonlocal Cooper pairs can experience a negative amplitude - so called π-junction. We also show that the Josephson current of nonlocal Cooper pairs can be controlled by the spin-active Rashba interaction without any time reversal symmetry breaking.

References:

[1] R. S. Deacon, A. Oiwa, J. Sailer, S. Baba, Y. Kanai, K. Shibata, K. Hirakawa, and S. Tarucha, Nature Communications **(**6), 7446 (2015)