Are odd-parity states in Andreev Quantum Dots always a nuisance?

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Abstract

An Andreev quantum dot (AQD) is a phase-biased superconducting weak link in which discrete Andreev bound states develop. In particular, a single-channel AQD accommodates one Andreev state that can be occupied by either zero, one or two quasiparticles. In a recent cQED experiment on one-atom weak links we demonstrated the coherent manipulation of the two-level system formed by the even states [1]. Moreover, as a common feature to other superconducting devices, the single-occupied state of the AQD was also observed. We have focused on the role of the odd state in the dynamics of the AQD and I will present our results on the time-domain study of the parity jumps observed due to quasiparticle poisoning. Although the odd states are spin-degenerate, the fact that they are long-lived states makes them appealing for a qubit. I will present our recent progress in the realization of a spin-AQD using a gated InAs-nanowire where degeneracy can be lifted by the combination of strong spin-orbit coupling and a Zeeman field. We show that quasi-ballistic weak links can be obtained, an important requirement to achieve single-spin manipulation.
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