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Coherent dynamics of Andreev levels in Josephson weak links

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In this talk, I will present measurements of the coherent dynamics of Andreev levels in two types of superconducting phase-biased weak links: single-atom contacts and semiconducting nanowire junctions. In the former, the weak link is typically characterized by a single well transmitted channel hosting a pair of Andreev bound states which can be populated with zero, one or two quasiparticles, leading to three many body states $|g\rangle$, $|o\rangle$ and $|e\rangle$, where the odd state $|o\rangle$ is two-fold degenerate due to spin. In the latter, spin-orbit interaction lifts this degeneracy and the Andreev spectrum is much richer. Using circuit QED-techniques, we perform relaxation, Ramsey, and echo experiments and analyze the time evolution of the populations of the different many-body states for different weak link configurations. I will discuss the evolution of the extracted rates as a function of the superconducting phase and gate bias and the possible mechanisms at play.