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Probing Andreev bound states in one-atom superconducting contacts

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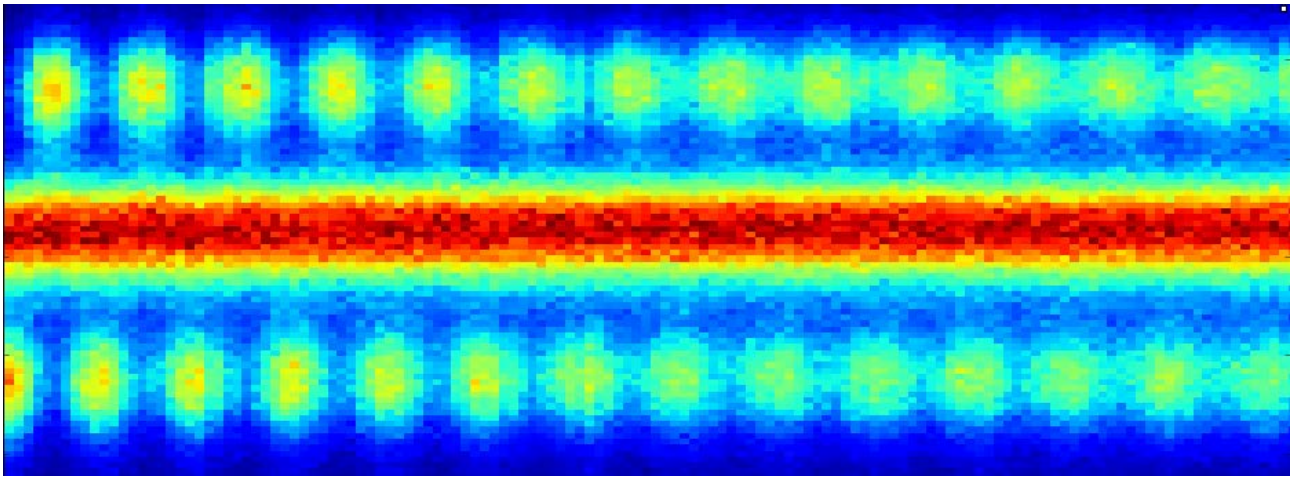
Superconductors are characterized by a dissipationless current. Since the work of Josephson 50 years ago, it is known that a supercurrent can even flow through tunnel junctions between superconductors. This Josephson effect also occurs through any type of "weak links" between superconductors : non-superconducting materials, constrictions, ... A unified understanding of the Josephson effect has emerged from a mesoscopic description of weak links. It relies on the existence of doublets of localized states that have energies below the superconducting gap: the Andreev bound states. I will present experiments performed on the simplest conductor possible, a single-atom contact between superconductors, that illustrate these concepts. The most recent work demonstrates time-domain manipulation of quantum superpositions of Andreev bound states.



Rabi oscillations measured on Andreev Bound States. The bottom spots show the occupation of the ground Andreev state, the top dots of the excited Andreev state. X-axis is the duration of the drive excitation, from 0 to 270ns