Dynamical effects of correlated superconducting nanostructures

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We discuss non-equilibrium effects imposed on the superconducting hybrid structures. Specifically, we consider abrupt changes (quantum quenches) which give insight into characteristic time-scales of the related (Andreev or Majorana) quasiparticles. Sudden changes of the physical conditions in bulk superconductors usually affect the complex order parameters, activating the amplitude (Higgs-type) and phase (Nambu-Goldstone) collective modes [1]. In superconducting hybrid systems there is opportunity to empirically design any perturbation at will and measure the resulting response, exploring post-quench dynamics across different phases [2]. In particular, one can drive transition from the BCS-type to the singly occupied (unpaired) configurations. Signatures of the dynamical phase transition are manifested at critical time instants by parity crossings of the in-gap bound states [3], that chould be observed by the Andreev and magnetic spectroscopies.

Study of dynamical phenomena driven of the superconducting hybrid structures is motivated by a prospect to construct the quantum bits out of the conventional (Andreev) or topological (Majorana) bound states [5]. Practical use of such qubits would require either the charge or spin manipulations [6], therfore it is of essential importance to establish how the in-gap bound states react upon applying external fields.

References:

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