The metal-induced gap states localization and superconducting qubit decoherence at low-dimensions

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In the present communication we report studies on the local properties of the metal-induced gap states (MIGSs) that may become localized at the low-dimensional Josephson junctions, cause magnetic flux noise and consequently lead to the decoherence of the corresponding qubit modalities. These investigations follow similar earlier bulk considerations [1, 2], toward disambiguation of the decoherence effect and the validation of its universal character. Herein, the theoretical analysis is conducted within the complex band structure method [3, 4] for an arbitrary low-dimensional junctions, to arrive with the most fundamental and general observations, respectively. Specifically, the presented communication discusses in details the behavior of the MIGSs in the momentum space, with respect to the potential fluctuations at the junctions and under moderate electron-electron interactions. Such assumption allow us to conduct our analysis in agreement with the seminal proposal of Choi et al. [1], that relates magnetic flux noise to the MIGSs localization. In what follows, this study attempts to provide direct relationship between the MIGSs behavior, known aspects of the superconducting qubit decoherence and the intrinsic properties of the low-dimensional Josephson junction. As a results, the general trends in terms of the superconducting qubit decoherence at low-dimensions are expected, to simultaneously reinforce plausibility of the previous related studies.

References:

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