Tunneling-current signatures of phonon effects in quantum dot-Majorana nanowire junctions

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We propose a realistic nanodevice formed by embedding of a quantum dot between two conducting leads via symmetrical tunnel junctions in the presence of electron-phonon interaction. The quantum dot is coupled to one of the ends of a Majorana nanowire, which leads to probe Majorana bound states under conditions where the influence of an environmental bath, modeled here by a single long-wave optical phonon mode, on the tunneling current characteristics is considered. To analyze the transport characteristics of the nanojunction, a combination of the nonequilibrium Green's function technique with a canonical transformation has been employed. The corresponding retarded Green's functions have been determined by applying the equation of motion method. The behavior of the current vs. gate voltage, the current vs. bias voltage and the current vs. quantum dot-Majorana coupling characteristics is studied for an experimentally relevant parameter range. We demonstrate that the tunneling current is sensitive to, and depends non-trivially on the parameters of the dot-Majorana setup, in the regime of low voltages combined with low temperatures. The current-bias voltage curves present a step-like structure in the presence of electron-phonon coupling due to the phonon-assisted tunneling through the dot. We hope that our quantum dot-based setup can serve as a possible platform for future Majorana detection experiments [1].

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