Bound states in the continuum and Majorana zero modes in a parallel double quantum dot: Ghost-Fano-Majorana effect

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Abstract

In the present work, we study a system formed by a parallel double quantum dot (DQD) structure coupled to two normal leads, with each quantum dot independently connected to a topological superconductor nanowire (TSCN) hosting Majorana zero modes (MZM) at its ends. We focus on the linear conductance through the DQD, the density of states, and the Majorana spectral functions, which are calculated employing Green's functions (GFs) formalism. In addition, we focus on identifying signatures of quantum interference phenomena, MZMs leakage into the QDs-BICs, and the interplay between MZM and the so-called Bound states in the continuum (BICs) by direct control of the magnetic flux over all the bound states of our setup. Our results show that both MZMs and BICs appear in high-symmetry configurations, i.e., depending on the QD-MZM coupling strength and the length of the TSCN. Also, we find a transport suppression anomaly in the linear conductance as a function of the magnetic flux. This phenomenon appears for the same symmetric configurations mentioned above. We also find that the magnetic flux can control both the MZMs leaking into the QDs and the BICs, suggesting that this external parameter will suffice for manipulating the above states.

References

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Figures

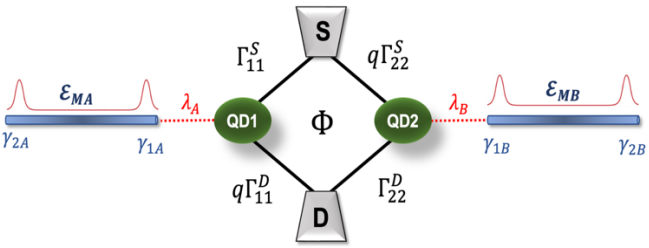

Figure 1: Schematic view of the system under study: TSCN-DQD-TSCN. Each QD (green) is coupled to a TSCN (blue tones). The TSCN A(B) is connected to the QD1(2) The DQD is coupled to two normal leads, labelled as S and D (solid gray), and an external magnetic flux Φ across the interferometer is considered.