POTENTIAL-CONTROLLED FILTERING IN QUANTUM STAR GRAPHS

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We study the scattering in a quantum star graph with a Fulop–Tsutsui coupling in its vertex and with external potentials on the lines. We find certain special couplings for which the probability of the transmission between two given lines of the graph is strongly influenced by the potential applied on another line. On the basis of this phenomenon we design a tunable quantum band-pass spectral filter. The transmission from the input to the output line is governed by a potential added on the controlling line. The strength of the potential directly determines the passband position, which allows to control the filter in a macroscopic manner. Generalization of this concept to quantum devices with multiple controlling lines proves possible. It enables the construction of spectral filters with more controllable parameters or with more operation modes. In particular, we design a band-pass filter with independently adjustable multiple passbands. We also address the problem of the physical realization of Fulop–Tsutsui couplings and demonstrate that the couplings needed for the construction of the proposed quantum devices can be approximated by simple graphs carrying only δ potentials.