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Spin-Dependent Transport Signatures of Bound States: From Finger to Top Gates

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Abstract : Spin-orbit gap feature in energy dispersion of one-dimensional devices is revealed via strong spin-orbit interaction (SOI) effects under Zeeman field. We describe the utilization of a finger-gate or a top-gate to control the spin-dependent transport characteristics in the SOI-Zeeman influenced split-gate devices by means of a generalized spin-mixed propagation matrix method. For the finger-gate system, we find a bound state in continuum for incident electrons within the ultra-low energy regime. For the top-gate system, we observe more bound-state features in conductance associated with the formation of spin-associated hole-like or electron-like quasi-bound states around band thresholds, as well as hole bound states around the reverse point of the energy dispersion. We demonstrate that the spin-dependent transport behavior of a top-gate system is similar to that of a finger-gate system only if the top-gate length is less than the effective Fermi wavelength.

Keywords : spin-orbit, zeeman, top-gate, finger-gate, bound state
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