# Preserving Coulomb blockade in transport spectroscopy of quantum dots by dynamical tunnel barrier compensation

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Surface-gated quantum dots (QDs) in semiconductor heterostructures represent a highly attractive platform for quantum computation and simulation. However, in this implementation, the barriers through which the QD is tunnel-coupled to source and drain reservoirs (or neighboring QDs) are usually non-rigid and capacitively influenced by the plunger-gate voltage ($V_P$) [1][2]. In transport spectroscopy measurements, this leads to suppression of current and lifting of the Coulomb blockade [3] for increasing negative and positive values of $V_P$, respectively. Consequently, the charge-occupancy of the QD can be tuned over a rather small range of $V_P$.

By dynamically tuning the tunnel barriers to compensate for the capacitive effect of $V_P$, we demonstrate a protocol that allows Coulomb blockade to be preserved over a remarkably large span of charge-occupancies, as demonstrated by clean Coulomb diamonds and well-resolved excited state features. The protocol will be highly beneficial for automated tuning [4] and identification of the gate voltage space for optimal operation of QDs in large arrays required for a scalable spin quantum computing architecture.

V. Jangir, **D. Shah**, et al.; Appl. Phys. Lett. 23 December 2024; 125 (26): 263503.

References

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Figures

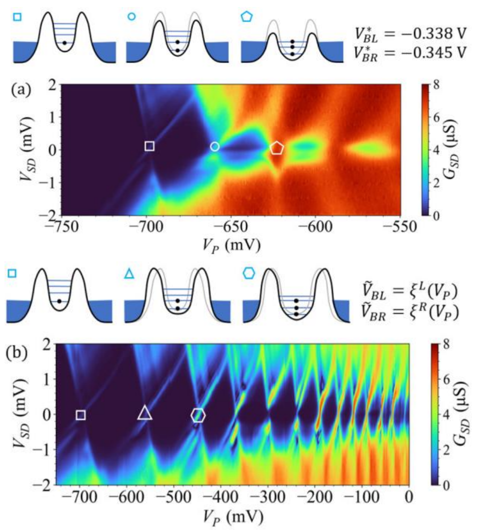


**Figure 1:** Coulomb Blockade Spectroscopy (CBS): Conductance color-map obtained using (a) the conventional and (b) the compensated techniques of recording CBS data. The schematics on top depict how the plunger-gate voltage affects the tunnel barriers in either case. In the case of the compensated data, dynamical tuning of barrier-gate voltages allows the barrier transparencies to be maintained approximately constant. Both measurements have identical barrier-gate voltages when $V_P$ = -700 mV