# Valley and Spin Blockade in Graphene Quantum Dots

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The Pauli blockade effect in coupled double quantum dots, the prohibition of transitions between spin-singlet and triplet-states [1], is the foundation of successful manipulation of spin qubits [2]. Pauli spin blockade is well established for systems such as GaAs QDs, where the two-electron spin-singlet ground state is separated from the three triplet states higher in energy [1, 2, 3]. In our bilayer graphene double dots, the spin and valley states can be precisely controlled [4, 5, 6]. We demonstrate that gate and magnetic-field tuning allows switching between a spin-triplet–valley-singlet ground state with charge occupancy (2,0), where valley-blockade is observed, and a spin-singlet–valley-triplet ground state, where spin blockade is shown [7]. The observation of blockade also demonstrates the superb quality that the graphene quantum dots have reached, brought about by recent progress in fabrication technology.

## References

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## Figures

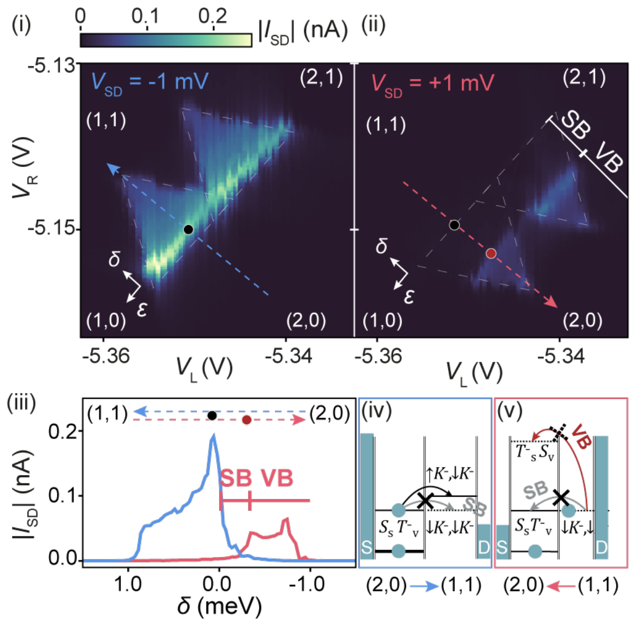


**Figure 1:** Finite-bias triangles at B=800 mT with (i) negative, and (ii) positive source–drain bias $V_{SD}$, with relevant transitions sketched for zero detuning in (iv), and (v), respectively. For negative-bias (electron transport (2,0) → (1,1)), the spin-blockaded GS–GS transition (grey) is readily circumvented by a transition very close in energy (black). For positive bias (electron transport (1,1) → (2,0)), the next available transition is higher in energy (red), and requires a valley flip. (iii) Line-cuts along the dashed arrows, where $V_{L,R}$ are converted into detuning δ. Current peaks are labelled by dots. Valley-blockade (VB) and spin-blockade (SB) effects suppress the current in the positive-bias direction.