Radio-Frequency Charge Detection on Gate-Defined Bilayer Graphene Quantum Dots

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Bilayer graphene (BLG) emerges as a promising platform for 2D-material-based quantum technologies due to its low disorder, high electrical tunability, and rich spectra of single and two-particle states endowed by the spin and valley degrees of freedom.
Additionally, BLG allows for the realization of electron-hole double-quantum dots (DQDs) [1], where the tunnelling across the inter-dot charge transition line has to obey particle-hole symmetry, leading to a protected spin-valley blockade, which could be leveraged in the future to realize a robust qubit read-out scheme [2].
This work highlights the fabrication and investigation of gate-defined BLG DQDs implementing an advanced design, utilizing radio-frequency (RF) reflectometry on a closely located quantum point contact (QPC) for fast charge readout, achieving a signal-to-noise ratio (SNR) of up to 160.
The advanced device architecture enables high-contrast differences between different charge states in the electron-hole DQD regime (see Figure below) and the detection of time-resolved single tunnelling events across the inter-dot transition, making an essential step in realizing a qubit in this unique system.

References

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Figures

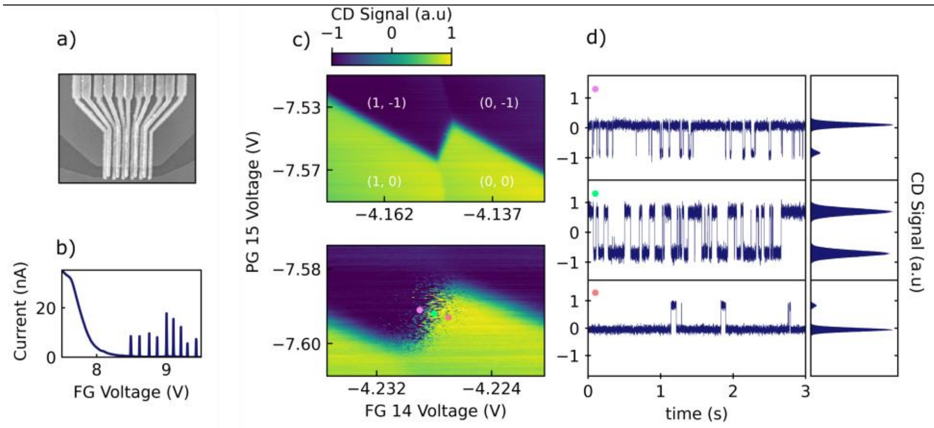

Figure 1: a) Examplary SEM image of a QD sample with finger gate (FG) and piano gate (PG) layers. b) Coulomb peaks of the first few electrons of a BLG QD. C) Charge stability diagram in the electron-hole regime, obtained via RF reflectometry at 0 Tesla (upper plot) and 1.5 Tesla (lower plot). d) Time traces at selected points marked in the lower plot in c) together with their histograms showing the typical random telegraph signal signature.