Tunnelling transport in bilayer graphene nanostructures with quantum dots

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Quantum nanostructures, e.g., quantum wires and quantum dots, are needed for applications in quantum information processing devices, such as transistors or qubits. In gapped bilayer graphene, one can confine charge carriers purely electrostatically, inducing smooth confinement potentials and limiting edge-induced perturbances while allowing a high degree of gate-defined control over the confined structure. I will discuss charge transport in bilayer graphene nanostructures with electrostatically confined quantum dots. We investigated both theoretically [1,2] and in collaboration with experiments [3,4,5] how the bilayer graphene dots' highly degenerate single- and two-electron spin and valley multiplets, which depend on, e.g., the displacement field and the electron-electron interactions, manifest in tunnelling transport. Different contributing tunnelling processes depend on the states' orbital composition and the dot's spin and valley configuration. By studying the tunnelling current, we gain information about the dots' single- and two-particle spectra (e.g., valley g-factors and orbital splittings) and microscopic material parameters of bilayer graphene, such as the coupling constants of the dominant short-range interactions. Our insights open the field for using the dots' rich spin and valley multiplets for quantum information storage and processing..

References

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