Induced Spin-Orbit Interactions in Graphene Quantum Devices

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High-quality quantum dots can be prepared in gate-defined bilayer graphene. Spin, charge and valley states have been identified and lifetimes have been measured. When bilayer graphene is van der Waals bonded with a neighboring layer of TMD (transition metal dichalcogenide) effects of spin-orbit interactions can be observed when the wavefunction in the bilayer graphene is close to the TMD. For quantum point contacts we demonstrate situations where the spin-orbit splitting is comparable to the orbital level splitting. Characteristic experimental features are observed in transport experiments that are related to exchange effects of the corresponding spin and valley states. Also quantum dots can be realized in such gate-defined structures. We also present entropy spectroscopy of graphene quantum dots as well as coupling of a superconducting resonator to the dipole moment of charge states in graphene quantum dots. Many of the techniques known for conventional quantum dots (Si, Ge, GaAs) can be applied to graphene quantum dots and give rise to unusual behavior of the level spectrum and its manipulation by gate electrodes.

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