



## Physical Sciences Seminar

# Quantum Dots in Bilayer Graphene

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Graphene and bilayer graphene (BLG) are attractive platforms for quantum electronics, quantum circuits and quantum information science in general. This has motivated substantial efforts in studying quantum dot (QD) devices based on graphene and BLG. The major challenge in this context is the missing band-gap in graphene, which does not allow to electrostatically confining electrons. A widely used approach to tackle this problem was to introduce a hard-wall confinement by etching the graphene sheet. However, the influence of edge disorder, turned out to be a roadblock for obtaining clean quantum devices. The problem of edge disorder can be circumvented in clean BLG, thanks to the fact that this material offers a tunable band-gap (up to 120 meV) in the presence of a perpendicularly applied electric field, a feature that allows introducing electrostatic soft confinement in BLG. Here I present gate-controlled single and double quantum dot operation in electrostatically gapped BLG. I show a remarkable degree of control of our devices, which allows the implementation of gate-defined electron-hole and electron-electron double-dot systems, where single-electron occupation becomes possible. Also in the single dot regime, the very few electron/hole regime has been reached, excited state energies have been extracted and their evolution in a parallel and perpendicular magnetic field has been investigated. I will show data on ultra-clean BLG quantum dots allowing to investigate the spin-valley coupling in bilayer graphene, the electron-hole crossover and the high symmetry between electron and hole states. Finally, I will show data on BLG quantum dots that allow to investigating the spin and valley lifetimes. Our work paves the way for the implementation of spin and valley-qubits in graphene.

**Tuesday, November 7, 2023 11:00am - 12:00pm**

Office Bldg West / Ground floor / Heinzl Seminar Room (I21.EG.101)



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