Highly tunable emergent quantum phenomena in double-layer graphene

2-dimensional (2D) electron gas exposed to an external magnetic field has been a paradigm system to study the effect of electron correlation and resulting emergent quantum ground states. Physical structures available to such a system are constrained by the nature of Coulomb interaction, which is difficult to control in a single 2D confinement. In this talk, I will discuss a variety of highly tunable quantum phenomena emerging from a double-layer structure, which consists of two monolayer graphene separated by a thin insulating barrier. Coulomb interaction in a double layer structure can be controlled by continuously varying a series of experimental parameters, such as interlayer separation, magnetic field and charge carrier density, providing a multi-dimensional phase space to characterize the nature of electron correlation, and to explore novel quantum phenomena. As an example of such tunability, quantum transport measurement will be used to demonstrate a BEC to BCS crossover in the exciton condensate phase.