PAP Seminar Announcement

Date: 4 November 2016, Friday  
Time: 11am – 12.30pm  
Venue: Hilbert Space (PAP-02-02)  
Host: Asst Prof Justin Song

Singapore Quantum Materials Series

Speaker: Dr. Derek Ho *(Shaffique Adam group, NUS)*  
Seminar title: Effective Medium Theory for Coulomb Drag in Graphene

Abstract

When two semiconductor sheets are held close together and a current driven through one of them, a small current gets pulled along in the other due to the Coulomb force coupling the charges in the two layers. This effect is known as the Coulomb drag and is a direct transport manifestation of electron-electron interactions. Such experiments now have a history of almost three decades. The last four years in particular have seen a sustained interest in Coulomb drag between graphene sheets both theoretically and experimentally for both fundamental science and applications-oriented reasons. Here, I report on our recent theoretical work on graphene Coulomb drag. It is known that in a single graphene sheet at low density, charge inhomogeneities play an important role in carrier transport. The effects of such inhomogeneity on measurements have previously been successfully understood using effective medium theory (EMT), a framework for predicting transport in single spatially inhomogeneous layers of material. Up till now however, there has been a conspicuous lack of an EMT in the literature for multi-layer transport problems such as Coulomb drag. We remedy this and extend the EMT for the first time to the double layer drag problem. We show that this new EMT resolves a glaring contradiction between existing (homogeneous) theory and experiments and also makes new predictions for future experiments at higher temperatures.

Speaker: Dr. Ivan Verzhbitskiy *(Goki Eda group, NUS)*  
Seminar title: Superconductivity in Li-intercalated MoS<sub>2</sub>

Abstract

Interest in the superconducting properties of layered transition metal dichalcogenides has been recently renewed by several key discoveries such as electric-field-induced superconductivity and the role of spin-valley locking in MoS<sub>2</sub>. Superconductivity in intercalation compounds of TMDs has been studied since the ’60s but its connection to the recently observed electric-field-driven superconductivity remains elusive. We present a thorough experimental study of superconducting transition in Li<sub>x</sub>MoS<sub>2</sub> grown by chemical vapor transport. We observe multiple transition temperatures ranging from 3 to 7 K. Interestingly, resistivity was found to show insulator-like temperature dependence above the transition temperature in contrast to typical superconducting materials including electrostatically doped MoS<sub>2</sub>. This change in the sign of temperature coefficient near superconducting transition and its magnetic-field dependence are consistent with a superconductor-to-insulator transition driven by induced localization of Cooper pairs.