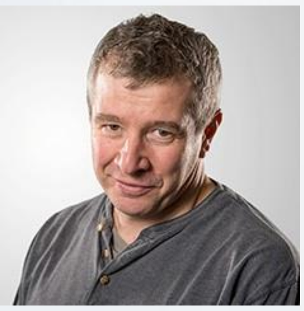
Department of Physics
THE UNIVERSITY OF HONG KONG

Physics Colloquium

Ionic Gating of 2D Semiconductors

Date: November 10, 2021 (Wednesday)
Time: 5:00 p.m.
Zoom Online Lecture: https://bit.ly/30DKiDF
Meeting ID: 980 1013 8189
Password: 2859



Prof. Alberto Morpurgo
University of Geneva

Abstract:
Ionic gating is a technique to implement electrostatic gating in electronic devices by using electrolytes to transfer very efficiently the electrostatic potential from a metallic electrode –the gate– to the surface of a semiconductor. The first mention of ionic gating can be found already in Bardeen's Nobel lecture discussing the development of the transistor, but the technique actually started to be systematically developed approximately 15 years ago. After an initial period plagued by difficulties associated to problems of irreproducibility and incompatibility with different classes of materials, ionic gating has developed into a powerful technique, enabling experiments beyond what had been initially envisioned.

In my talk I will discuss different classes of experiments performed in my group, in which we apply ionic gating to 2D semiconductors, and most notably to many different 2D semiconducting transition metal dichalcogenides. After a general introduction, I will briefly touch upon gate induced superconductivity, showing that the use of van der Waals structures and the combination with different experimental probes allows sophisticated experiments to measure the density of states and to gain important information about electron-phonon coupling. I will then discuss in detail how ionic gating can be used as a precise quantitative spectroscopic technique, to measure band gaps of 2D semiconductors, as well as band offsets between different atomically thin materials. As a last topic, I will discuss very recent experiments in which we succeeded to realize double gated ionic transistors, providing independent control of the accumulated charge density and of the applied perpendicular electric field. I will show that these devices allow an electric field to be applied perpendicularly to atomically thin 2D semiconductors that is so large (in excess of 2 V/nm) to completely quench the 1.6 eV band gap of trilayer WSe_2. Our measurements show that, in the presence of such a large field, the conductance and valence band overlap, transforming the semiconductors in a semimetal (and possibly –according to theory– in a quantum spin Hall system).

Biography:
Alberto Morpurgo is a condensed matter physicist, with a broad interest in the electronic properties of materials and devices. After receiving a Master in Physics from the University of Genova (Italy), he moved first to the Scuola Normale in Pisa and then to the University of Groningen (the Netherlands), where he did experimental work on mesoscopic physics and received a PhD degree in 1998. In 1998-99, Dr. Morpurgo was postdoctoral fellow at Stanford University, working on carbon nanotubes. At the end of 1999, he moved back Delft University, the Netherlands, where he stayed until 2008 and became associate professor. In Delft, Dr. Morpurgo extended his work on mesoscopic physics, developed research on organic semiconductors using single-crystal field-effect transistors, and started working on graphene immediately after its discovery. In 2008, Dr. Morpurgo moved to University of Geneva, Switzerland, as full professor. There he gradually focused his research entirely in the field of 2D materials and van der Waals interfaces, working on a variety of materials and techniques (e.g., ionic liquid gating, optoelectronics of transition metal dichacogenides, magnetic 2D materials etc.). Dr. Morpurgo is the deputy leader of the Work Package of Enabling Science and Technology of the EU Graphene Flagship project. He received the Midema price 2000 for the best Ducth PhD thesis on condensed matter physics during the period 1998-99. Dr. Morpurgo has authored more than 160 papers, cited more than 18'000 times according to Web of Science (h=62) or more than 25'000 times according to Google Scholar (h=71).

Anyone interested is welcome to attend!

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