Title:

Superconducting Van der Waals Heterostructures As a Quantum Information Platform

Abstract:

The field of Quantum Information Systems (QIS) represents the current scientific and technological frontier, which promises to harness the quantum notions of coherence and entanglement and to revolutionize the world of computing and communications. There are several solid-state platforms used for the study and applications of quantum systems. Most of them rely on low dimensional nano-materials, often coupled with superconductors, which naturally support quantum coherence and entanglement. Several of these systems aim to realize novel topological excitations, such as Majorana fermions, which in turn will bring topological quantum computation closer to reality. I discuss the use of hybrid devices made of superconductors and graphene as a platform for supporting and generating unique quantum states. Starting with graphene-based Josephson junctions, we explore the governing parameters of the platform. Ballistic graphene allows for superconducting coupling between several superconducting electrodes, and enables paradoxical scenarios, in which e.g. superconducting and dissipative currents coexist in the same physical space. Finally we combine superconductivity with the Quantum Hall effect. Such combination results in unique “Andreev edge states”. We discuss the generation and coupling between these states and their relation to the predicted Majorana fermion and parafermion excitations.

Biography:

Ivan Borzenets holds B.S. in Engineering Physics from U.C. Berkeley. He obtained M.S. in Electrical and Computer Engineering, and Ph.D. in Physics from Duke University. Prior to becoming a faculty at the City University of Hong Kong, Ivan Borzenets has worked as a postdoctoral fellow at the University of Tokyo, the lab of Prof. Seigo Tarucha. Currently he is an assistant professor at Texas A&M. His newly established laboratory focuses on measuring quantum properties of nanoscale devices at milli-Kelvin temperatures. Ivan’s immediate research interest are hybrid nanoscale devices, in which naturally incompatible quantum states are artificially brought together. The examples include superconductors, quantum Hall, and various spin systems, combing which promises to realize exotic ground states and excitations.