Speaker: Bruno Uchoa, Oklahoma University

Title: “Massive Dirac fermions: Localization gap and superconductivity”

Abstract: In this talk, I will address the issue of mass generation in graphene. I will show that when graphene is supported on a Boron Nitride substrate, which shares a similar honeycomb structure as graphene, but has a different lattice spacing and a large intrinsic gap due to a broken $\mathbb{Z}_2$ sublattice symmetry between B and N lattice sites, quantum interference between graphene and its lattice mismatched substrate gives rise to local potentials in the form of mass terms in the Dirac Hamiltonian, which modulate with the period of the Moire pattern supercell. Those potentials can give rise to a remarkable real space network of zero energy modes in the form of quantum rings, containing nearly flat bands separated by energy gaps. I will show that the size of those gaps can be tuned with an electric field effect and can reach the order of magnitude needed to confine electrons at room temperature. In the second part of my talk, I will address the theory of superconductivity in flat band! I will explicitly describe the problem of Dirac fermion superconductivity in the presence of time reversal symmetric Landau levels, which can be generated by strain in graphene. I will show that this is probably the most promising route towards the observation of intrinsic superconductivity in graphene.