

# Condensed Matter Theory Center Seminar



Tuesday, February 25th  
11:00 am to 12:30 pm, 2205 Physics Building

## Junhua Zhang

William and Mary

### “Novel Electronic States in Graphene-based Heterostructures ”

I will present our recent progress in the search for, and understanding of, novel electronic states in graphene-based heterostructures. First, I will show that in heterostructures formed by one sheet of single layer graphene (SLG) and one sheet of bilayer graphene (BLG) the ground state is a chiral p-wave superfluid state coexisting with a s-wave superfluid state. I will then show that due to the chiral nature of the p-wave state SLG-BLG heterostructures support a topologically protected midgap state analogous to the Majorana fermion of a chiral p-wave superconductor. We find that the coexistence of the two superfluid states and the chirality of the p-wave state is due to the difference between the chirality of the quasiparticles in SLG and the ones in BLG, and is therefore a robust effect, not affected, for example, by the presence of disorder. I will show how, on the other hand, for isolated BLG the influence of disorder gives rise to an interesting crossover behavior between the proposed competing ordered states, the fully gapped state and the nematic one, and provide a simple and natural scenario to resolve the discrepancy between the recent experimental observations. Next, I will discuss the proximity effect in graphene-topological insulator heterostructures both in the case of commensurate and incommensurate stacking. I will show that the induced spin and pseudospin textures in this combination of two Dirac materials are highly nontrivial.

(All are welcome to attend)

