“Are there Upper Bounds on the Superconducting Tc?”

I will first describe exact upper bounds on the BKT Tc in 2D superconductors that are independent of pairing mechanism or strength. These general results are obtained by optical spectral weight bounds on the superfluid stiffness for arbitrary multi-band superconductors, with the only assumption that the vector potential couples to the kinetic energy and not the interactions. I will show that these bounds are particularly useful for strongly correlated and low-density superconductors where mean field theory fails and discuss applications to a range of problems including the BCS-BEC crossover in 2D Fermi gases, Li:ZrNCl, and monolayer FeSe/STO. Motivated by magic angle twisted bilayer graphene, I will describe how one needs to generalize these exact results to topological flat-band models. I will present bounds on the low-energy optical spectral weight related to the quantum geometry of flat band wavefunctions. I will also describe recent experimental progress in estimating the superfluid stiffness of twisted bilayer graphene. Finally, I will discuss the challenges in obtaining general bounds on Tc in 3D, which remains an open question.