We use self-consistent Hartree-Fock[1] and exact diagonalization[2] methods to shed light on the recently discovered[3,4] correlated insulator states in magic-angle twisted bilayer graphene (TBG)[5]. Our calculations are performed in the full pi-band Hilbert space. Surprisingly we find that because of rotations that occur in the full pi-band Hilbert space as interactions strengthen near the magic angle, gaps can open between the flat conduction and flat valence bands without breaking the system's valley projected C2T symmetry, which seemingly protects Dirac-point band crossings between conduction and valence bands(See Figure 1). Broken spin/valley flavor symmetries then enable gapped states to form not only at neutrality but also at total moiré band filling n= ±p/4 with integer p = 1,2,3. Because the gapped states do not necessarily break C2T symmetry, the magic-angle TBG insulating states at n=±1/4 and n=±3/4 need not exhibit a quantized anomalous Hall effect. The dependence of the electron spectral function, obtained from ED on fractional moiré band filling demonstrates that interactions totally dominate band-structure effects within the flat bands in a manner reminiscent of the fractional quantum Hall effect.

References
