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Scaling laws of van Hove singularities in twisted bilayer graphene[1]

JEIL JUNG, National University of Singapore, ASHLEY DASILVA, University of Texas at Austin, YANG WANG, DILLON WONG, MICHAEL CROMMIE, University of Carlifornia at Berkeley, SHAFFIQUE ADAM, Yale-NUS College and National University of Singapore, ALLAN H. MACDONALD, University of Texas at Austin — Van Hove singularities (vHS) appear in twisted coupled bilayer graphene at saddle points in the band structure. The lowest energy vHS can be associated with the overlap between the displaced Dirac cones of the top and bottom layers, resulting in an approximately linear increase of its position in energy with increasing twist angle. This picture, which is applicable in the perturbative regime for moderately large twist angles, sees departures in the small angle limit due to non-perturbative coupling between the layers. Using a theory for twisted bilayer graphene [1] that incorporates all the relevant interlayer coupling compatible with momentum conservation of k-vectors of the top and bottom layers we explore the scaling laws of the vHS for sufficiently small twist angles and long period moire superlattices. We analyze the localization properties of their wave functions through their local density of states (LDOS) paying particular attention to the behavior of the states corresponding to higher energy van Hove singularities. We comment on our results in light of the experimental DOS and LDOS maps obtained through scanning tunneling microscopy. [1] R. Bistritzer and A. H. MacDonald, PNAS 108 (30), 12233 (2011)

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