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Electro-optic and Many-body Effects on Optical Absorption of Twisted Bilayer Graphene KAN-HENG LEE, LUJIE HUANG, CHEOL-JOO KIM, JIWOONG PARK, Cornell University — In twisted bilayer graphene (tBLG), the interlayer rotation angle between the two graphene layers induces additional angle-dependent van Hove singularities (vHSs) in its band structure where the two Dirac cones from each layer intersect. These vHSs introduce extra angle-dependent absorption peaks in the optical absorption spectra of tBLG. Here, we experimentally investigate the effects of the overall doping and the interlayer potential on these interlayer absorption features at various angles. We independently tune the doping concentration of each layer with a newly-developed, optically transparent, dual-gate transistor geometry to perform simultaneous optical and electrical measurements. Our data show strong electro-optic phenomena in the optical absorption of tBLG: the peak energy and width of the interlayer resonance feature sensitively depends on the overall doping and interlayer potential. We explain our observation using a simple band picture as well as many-body effects. Our study provides a powerful experimental platform for studying more complicated structures such as rotated tri- and multi-layer graphene systems in the future. Moreover, the understanding of electro-optic and many-body effects in these materials opens up a way for novel electrochromic devices.

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