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Giant Photocurrent Generation at Topological Singularities in Graphene Superlattices SANFENG WU, University of Washington, LEI WANG, Columbia University, YOU LAI, NHMFL, WENYU SHAN, Carnegie Mellon University, GRANT AIVAZIAN, University of Washington, XIAN ZHANG, Columbia University, TAKASHI TANIGUCHI, KENJI WATANABE, NIMS, DI XIAO, Carnegie Mellon University, CORY DEAN, JAMES HONE, Columbia University, ZHIQIANG LI, NHMFL, XIAODONG XU, University of Washington — The energy spectrum of graphene away from the Dirac point contains topological critical points where Van Hove singularities (VHSs) appear and are predicted to host fascinating phenomena. However, the required extreme doping has prevented the experimental access to these VHSs. Alternatively, the formation of Moiré superlattices in twisted graphene bilayers or graphene on hexagonal boron-nitride (hBN) heterostructures generates electronic mini-bands that mimic graphene's energy spectrum but with reduced energy scale, providing a remarkable opportunity to study a variety of physics previously inaccessible. Here we reveal that the formation of saddle point VHSs in the mini-bands of graphene/hBN superlattice enables anomalously enhanced photocurrent generation through a photo-Nernst effect at low magnetic fields. We establish that this enhancement is unambiguously linked to the electronic topological transition at VHSs. The obtained zero-bias photocurrent is giant, with a photoresponsivity as high as about 0.3 ampere per watt, corresponding to an external quantum efficiency exceeding 50%.

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