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Interlayer Exciton Optoelectronics in a 2D Heterostructure p-n Junction PASQUAL RIVERA, Univ of Washington, JASON ROSS, JOHN SCHAIBLEY, ERIC LEE-WONG, University of Washington, HONGYI YU, University of Hong Kong, TAKASHI TANIGUCHI, KENJI WATANABE, National Institute for Materials Science, Japan, JIAQIANG YAN, DAVID MANDRUS, Oak Ridge National Laboratory & University of Tennessee, DAVID COBDEN, University of Washington, WANG YAO, University of Hong Kong, XIAODONG XU, University of Washington — Semiconductor heterostructures are backbones for solid state based optoelectronic devices, which are now being engineered at the atomically thin limit using 2D semiconductors heterojunctions. In monolayer WSe_2-$MoSe_2$ heterobilayers, the type II band alignment causes the formation of interlayer excitons – with electron and hole confined to different layers – which have shown promising properties for novel excitonic devices. Here, we demonstrate interlayer exciton optoelectronics in an electrostatically defined p-n junction, which uses tunneling contacts to preferentially inject electrons and holes directly into the n and p type monolayers of the heterobilayer. Wavelength dependent photocurrent measurements provide the first direct observation of resonant optical excitation of the interlayer exciton, which allows estimation of its oscillator strength compared to that of intralayer excitons. Furthermore, comparison of the photocurrent, electroluminescence, and photoluminescence spectra provides evidence for the predicted finite center of velocity light cones in the interlayer exciton dispersion.

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