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Observation of biexciton states in monolayer WSe_2 YUMENG YOU, XIAOXIAO ZHANG, Department of Physics, Columbia University, TIMOTHY BERKELBACH, Department of Chemistry, Columbia University, MARK HYBERTSEN, Center for Functional Nanomaterials, Brookhaven National Laboratory, DAVID REICHMAN, Department of Chemistry, Columbia University, TONY HEINZ, Department of Physics and Electrical Engineering, Columbia University —
We report the identification of strongly-bound biexcitonic states in monolayer crystals of WSe_2. The presence of biexcitons was identified by the emergence of a new photoluminescence feature at the high exciton density. From the spectral shift of the biexciton emission, we infer a biexciton binding energy of about 50 meV. We also present results on the thermal stability and ultrafast dynamics of the biexciton states. In comparison with the behavior in conventional quantum-well structures, the biexciton binding energy in monolayer WSe_2 is enhanced by more than an order of magnitude. A variational calculation of the biexciton state reveals that the high binding energy arises not only from strong carrier confinement in two dimensions, but also from the reduced and nonlocal dielectric screening in this atomically thin material.

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