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Electrical Control of Exciton-Enhanced Second-Harmonic Generation in Monolayer WSe2 KYLE SEYLER, JOHN SCHAIBLEY, University of Washington, PU GONG, University of Hong Kong, PASQUAL RIVERA, AARON JONES, SANFENG WU, University of Washington, JIAQIANG YAN, DAVID MANDRUS, Oak Ridge National Laboratory, WANG YAO, University of Hong Kong, XIAODONG XU, University of Washington — Nonlinear optical frequency conversion, in which optical fields interact with a nonlinear medium to produce new field frequencies, is ubiquitous in modern photonic systems. However, the nonlinear electric susceptibilities that give rise to such phenomena are often challenging to tune in a given material, and so far, dynamical control of optical nonlinearities remains confined to research labs. In this talk, we report a new mechanism to electrically control second-order optical nonlinearities in monolayer WSe2. We show that the intensity of second-harmonic generation (SHG) at its lowest exciton resonance is widely tunable through electrostatic doping in a field-effect transistor device. Such remarkable tunability arises from the strong exciton charging effects in monolayer semiconductors, which allow for exceptional control over the exciton and trion oscillator strengths. Our study paves the way for a new platform of chip-scale, electrically tunable nonlinear optical devices based on two-dimensional semiconductors.

Kyle Seyler
University of Washington

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