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Ultrafast Nonlinear Opto-Electronic Spectroscopy
SHAWN M. PERDUE, JOONHEE LEE, ALEJANDRO RODRIGUEZ PEREZ, V. ARA APKARIAN, Department of Chemistry, University of California, Irvine — Using a single color of light and rf beam tagging, parametric nonlinear optical mixing processes can be read not just in photons, but also in electrons. The scheme allows ultrafast time-resolved opto-electronics, which we demonstrate at a tunneling junction. Acousto-optic modulators are used to frequency tag ultrashort laser pulse trains, whereby carrier beats generated in nonlinear mixing processes are down shifted by sampling at the repetition rate of the laser (80 MHz). The method down converts optical carrier frequencies (PHz) to baseband (kHz), where direct current readout is possible with single electron sensitivity. Various parametric processes can be identified through their one-to-one map in baseband. Illustrative implementations that will be presented include the determination of the temporal profile of field-emitted ultrashort electron packets and characterization of the highly nonlinear dynamics involved in light-induced tunneling emission.

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