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High-order sideband generation: colliding quasiparticles, probing Berry curvature, and generating tunable frequency combs in semiconductors[1]

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High-order sideband generation (HSG) is a recollision phenomenon that is closely related to high-order harmonic generation (HHG). A weak laser, tuned near the band gap of a semiconductor, resonantly injects pairs of quasiparticles (electrons and holes) while the semiconductor is driven by a strong terahertz-frequency electric field. The terahertz field accelerates the photo-injected electrons and holes first away from, then back towards each other. If the electrons and holes recombine, a high-order sideband is emitted. The sidebands form a frequency comb with teeth spaced by twice the terahertz frequency, and anchored by the frequency of the laser that generates the electron-hole pairs. Recently, we have observed HSG spectra containing sidebands up to 90th order and spanning over 12 percent of the laser wavelength, which is near 800 nm. As the electrons and holes are accelerated through the band structure of GaAs quantum wells, the holes experience significant Berry curvature, which leaves its imprint on the polarizations of the high-order sidebands.

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