

Femtosecond Fieldoscopy

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Femtosecond Fieldoscopy provides direct access to the electric field of light in ambient air, offering near-petahertz detection bandwidth together with exceptional sensitivity and a broad dynamic range. When applied to spectro-microscopy, the technique achieves attosecond temporal resolution and spatial resolution beyond the diffraction limit.

In this approach, ultrashort excitation pulses impulsively drive resonant molecular modes in a sample, initiating vibrational coherences that decay on a timescale determined by molecular dephasing. As a result, the transmitted electric field contains contributions from the excitation pulse itself, the sample's delayed molecular response lasting several picoseconds, and a long-lived response from atmospheric gases that persists for up to hundreds of nanoseconds. By isolating and analyzing the decaying molecular field in the time domain, Femtosecond Fieldoscopy enables highly sensitive spectroscopic measurements with an exceptional dynamic range. The method has successfully resolved overtone, Raman, and combination bands in liquid samples, and recent developments have enabled super-resolution imaging well below the diffraction limit of the excitation pulses, paving the way toward non-perturbative, label-free imaging. In this talk, I will present an overview of these advances demonstrated by my group.

References:

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