Air-Plasma-Based Ultrabroadband Terahertz Generation, Detection, and Spectroscopy Applications

Summary: The terahertz (THz) region of the electromagnetic spectrum hosts a wealth of intriguing light-matter interactions that are vital for understanding fundamental material properties. THz time-domain spectroscopy (THz-TDS) has emerged as a powerful technique to probe these properties and dynamics. Among various ultrafast THz platforms, femtosecond (fs) laser-induced two-color air-plasma generation stands out for its ability to produce ultrashort THz pulses (tens of fs) with a continuous, gapless spectrum spanning the entire THz range (1 – 30 THz).

In this talk, I will present our recent advances in air-plasma-based THz technology. We will begin by exploring efficient THz generation strategies, including the use of long-wavelength driving lasers and third-harmonic mixing. The second part of the talk will focus on ultra-broadband coherent detection. High dynamic range (DR) and signal-to-noise ratio (SNR), crucial for spectroscopy applications, can be achieved with an air-plasma-based THz spectrometer. Innovative detection schemes, such as solid-state biased coherent detection (SSBCD) and single-shot detection, will be discussed. Finally, I will showcase key spectroscopy applications that leverage the platform's unique advantages, demonstrating its promise across diverse research domains.

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