Automation and measurement geometry of stimulated-polariton-scattering based THz spectrometric systems

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Electromagnetic radiation at THz frequencies transmits through various packaging materials, but is strongly absorbed by water and organic compounds including a variety of illicit substances. As such a number of THz generation techniques became relatively common and several have been incorporated into spectrometer devices. Ultrafast pulsed systems, such as THz time domain spectroscopy (TDS) and photoconductive antennas [1], utilize mature Ti:sapphire laser technology and offer fast acquisition times in a desktop system. They have broad spectral coverage (0.1-8 THz using new materials [2]), however, as they generate, and also measure, simultaneously over the whole bandwidth, their spectral power is low and thus measurements of thick or highly absorptive samples can be problematic. THz lasers based on stimulated-polariton-scattering (SPS) on the other hand generate narrowband (~GHz) but tunable output, typically from 0.5 to 6 THz [3] (output up to 13.5 THz has been observed in a KTP crystal [4]), which allows for high-power spectroscopic measurements. Although a SPS tunable THz laser is commercially available [5] it is not yet implemented in a spectrometer setup.

In this paper we show how a frequency tunable SPS laser can be automated and implemented into a scanning spectrometer setup (see Fig. 1). A two-detector scheme is used for automatic background and laser power fluctuation compensation, thereby increasing data acquisition speed and accuracy. The setup is controlled by a LabVIEW interface and utilizes a lock-in detection scheme resulting in a peak signal-to-noise ratio of 24.5 dB.

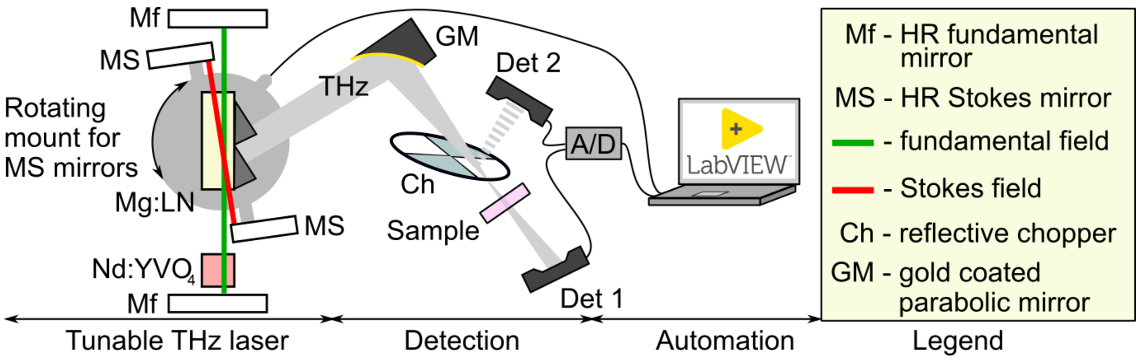

Fig. 1. Schematic of scanning THz spectrometer implementation.

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[3] A. J. Lee, D. J. Spence, H. M. Pask, *Prog. Quantum Electron*. **71**, (2020).

[4] C. Yan, Y. Wang, D. Xu, et al., *Appl. Phys. Lett.* **108**, 011107 (2016).

[5] https://www.m2lasers.com/firefly-thz.html (26-Jul-2022).