BROADBAND SPECTROSCOPY WITH DUAL COMBS AND CAVITY ENHANCEMENT

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Classical FTIRs handle the task of massively parallel spectroscopic probing by interferometric detection. In contrast a frequency comb Fourier transform spectrometer (FC-FTS) retains the principle of combining two interferometer beams but uses two inputs from two independent sources. Thus we can offset their frequencies to facilitate multifrequency heterodyne signal processing. The advantages of this spectrometer compared with the classical FTIR include ease of operation (no cumbersome moving delay lines), speed of acquisition (18 μs demonstrated), collimated long-distance propagation, possibly diffraction-limited microscopic probing, and mid infrared as well as THz operation if necessary.

In a recent proof of principle experiment we have dramatically improved the sensitivity by the implementation of an enhancement cavity around the probing volume[a]. We recorded, within 18 μs, spectra of the ammonia 1.0 μm overtone bands comprising 1500 spectral elements and spanning 20 nm with 4.5 GHz resolution and a noise-equivalent-absorption at one-second-averaging of 1 $10^{-10}\mathrm{cm}^{-1}\mathrm{Hz}^{-1/2}$, thus opening a route to time-resolved spectroscopy of rapidly-evolving single-events. Since FC-FTS only needs one detector that is easily available in practically all spectral regions, it can be envisioned that cavity-enhanced FC-FTS will assume a position of dominance for the measurements of real-time ultra-sensitive spectra in the molecular fingerprint region.

[a] B. Bernhardt et. al., *Nature Photonics* **4** (55), January 2010