BROADBAND CAVITY-ENHANCED MOLECULAR ABSORPTION AND DISPERSION SPECTROSCOPY WITH A FREQUENCY COMB-BASED VIPA SPECTROMETER

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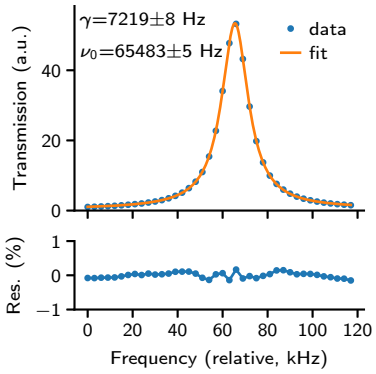
Cavity mode-width spectroscopy (CMWS) [1] and cavity mode-dispersion spectroscopy (CMDS) [2] techniques provide a way to simultaneously determine absorption and dispersion of a sample in an optical cavity. It was shown recently that CMDS can also be efficiently combined with optical frequency combs (OFCs) [3] to perform dispersion measurements in a broad spectral range. In this work, we utilize a near-infrared frequency comb and a VIPA spectrometer to retrieve absorption and dispersion of an atmospheric pressure CO-N_2 sample in a high-finesse cavity, by measuring shapes and positions of 7-kHz-wide cavity modes at Hz-level precision. A Pound-Drever-Hall lock of a CW laser to the cavity and a phase-lock of the OFC to the CW laser allow for arbitrary detuning between comb and cavity modes, while cavity length stabilization to a Rb frequency standard provides absolute frequency scale. The signal-to-noise ratios for CMWS and CMDS spectra were, respectively, 190 and 380.



To the best of our knowledge, the 7-kHz-wide cavity resonances shown in this work are the narrowest spectral features measured directly with a frequency comb. The presented technique is capable of fast acquisition and ultrahigh resolution in a broad spectral range, which makes it particularly suitable for spectroscopy of cold molecules or monitoring of chemical kinetics.

[1] A. Cygan *et al*, Opt. Express 21, 29744 (2013).
[2] A. Cygan *et al*, Opt. Express 23, 14472 (2015).
[3] L. Rutkowski *et al*, Opt. Express 25, 21711–21718 (2017).