PROBING BUFFER-GAS COOLED MOLECULES WITH DIRECT FREQUENCY COMB SPECTROSCOPY IN THE MID-INFRRARED

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We present the first demonstration of cavity-enhanced direct frequency comb spectroscopy[a] on buffer-gas cooled molecules[b]. By coupling a mid-infrared frequency comb to a high-finesse cavity surrounding a helium buffer-gas chamber, we can gather rotationally resolved absorption spectra with high sensitivity over a broad wavelength region. The measured $\sim$10 K rotational and translational temperatures of buffer-gas cooled molecules drastically simplify the observed spectra, compared to those of room temperature molecules, and allow for high spectral resolution limited only by Doppler broadening (10-100 MHz). Our system allows for the extension of high-resolution spectroscopy to larger molecules, enabling detailed analysis of molecular structure and dynamics, while taking full advantage of the powerful optical properties of frequency combs.

[a] A. Foltynowicz *et al*. Cavity-enhanced optical frequency comb spectroscopy in the mid-infrared application to trace detection of hydrogen peroxide. Applied Physics B, vol. 110, pp. 163–175, 2013.

[b] D. Patterson and J. M. Doyle. Cooling molecules in a cell for FTMW spectroscopy. Molecular Physics 110, 1757–1766, 2012.