THE APPLICATION OF HIGH-REPETITION-RATE CAVITY RINGDOWN TECHNIQUES TO INFRARED SPECTROSCOPY

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Our group has been applying continuous-wave cavity ringdown spectroscopy to systems of supersonic jets, plasmas, and ion beams using diode, difference frequency, and quantum cascade lasers. We use these techniques to take spectra of molecular ions and large neutral molecules, such as C_{60}, at wavelengths in the near- and mid-IR. Our traditional method of collecting ringdowns, which involves sweeping the cavity length over several free spectral ranges and diverting the laser when buildup events are observed, has allowed us to achieve a repetition rate of tens of ringdowns per second with a minimum detectable absorbance of 2×10^{-9} cm^{-1}.[a]

In an effort to increase our sensitivity, we have embarked on a program to implement high-repetition-rate ringdown, in a setup similar to that of the Halonen Group.[b] This change requires locking the laser frequency to the cavity length using the Pound-Drever-Hall method. Since the laser and the cavity are always in resonance, the ringdown collection rate can be improved to thousands per second. We will present our progress, including the generation of error signals, the construction of the locking electronics, the data acquisition process, and our experimental results.

[a] S. L. Widicus Weaver, M. B. Wiczer, B. Negru, J. P. DiGangi, B. A. Tom and B. J. McCall, J. Mol. Spec., 249, 14-22 (2008).
[b] R. Z. Martínez, M. Metsälä, O. Vaittinen, T. Lantta, and L. Halonen, J. Opt. Soc. Am. B., 23, 727-740 (2006).