SINGLE MODE CAVITY RING-DOWN SPECTROSCOPY WITH PULSED LASERS

J. T. HODGES, J. P. LOONEY, and R. D. van ZEE, *Chemical Science and Technology Laboratory, National Institute of Standards and Technology, Gaithersburg, MD 20899*.

The conventional implementation of cavity ring-down spectroscopy (CRDS) is based on the use of pulsed lasers and relatively long (i.e., round-trip time > pulse duration) unstabilized cavities. For this case, the highest frequency resolution that can be achieved is limited by the bandwidth of the probe laser, and is typically no better than 100 MHz. However, the frequency resolution of CRDS can be significantly enhanced by the selective excitation of a single cavity mode through the use of relatively short (i.e., round-trip time < pulse duration) and degenerate cavities. In this unconventional implementation of CRDS, the frequency resolution may be ultimately limited by the ring-down cavity mode width. To illustrate, we report single mode CRDS lineshape measurements of the oxygen A-band at nearly Doppler-broadened conditions. In these experiments, a resolution of about 10 MHz was achieved, using a laser source with a bandwidth of more than 100 MHz and a length-stabilized and degenerate ring-down cavity 10 cm in length. As expected, this approach led to signals exhibiting negligible longitudinal and transverse mode beating. Finally, it was found that the ring-down signals could be precisely fit by a single exponential decay, which is a property making single mode CRDS highly attractive for quantitative and sensitive absorption measurements.