THE INFLUENCE OF FREE-RUNNING FP-QCL FREQUENCY JITTER ON CAVITY RINGDOWN SPECTROSCOPY OF C_{60}

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Our group is engaged in an effort to acquire a high-resolution gas phase spectrum of buckminsterfullerene in the mid-IR. To achieve this goal, we have constructed a continuous-wave cavity ringdown spectrometer (cw-CRDS) using a Fabry-Perot quantum cascade laser (FP-QCL) as the principal light source. The cw-CRDS technique has the beneficial aspects of both high sensitivity and high resolution. When aligning the high finesse cavity of the spectrometer a light source with a stable narrow linewidth is preferable as this leads to a regular occurrence of build-up events correlated to the sweep of the piezoelectric transducer. The regular interval during the sweep of the cavity resonances over the frequency of the laser source can be a useful aid by providing insight into the quality of the mode-matching. The instantaneous linewidth of a free-running quantum cascade laser operating in cw mode is sub-MHz, but frequency jitter from mechanical, optical, and/or electrical perturbations evidently yields a time averaged effective linewidth that is substantially broader. This frequency jitter, and the resulting time averaged linewidth, will therefore have an impact on the cw-CRDS system we are using for C_{60} spectroscopy. To characterize the effective linewidth, we have conducted self-pressure broadening studies of select SO_2 rovibrational lines in the ν_1 vibrational band via direct absorption spectroscopy using FP-QCLs intended for C_{60} spectroscopy, and have measured a time-averaged effective linewidth of $\sim$120 MHz. We will discuss the self-pressure broadening coefficients measured for select rovibrational lines of SO_2 between 1194-1198 cm^{-1}, the implications of the measured frequency jitter of our laser source on cw-CRDS data collection, and a progress report on our C_{60} spectroscopy project.