A FOURIER TRANSFORM CAVITY RING DOWN SPECTROMETER

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A novel multiplex absorption spectrometer will be presented, in which the sensitivity of the Cavity Ring Down absorption detection technique is combined with the multiplex advantage of a Fourier Transform spectrometer [a]. A description of the Fourier Transform – Cavity Ring Down (FT-CRD) spectrometer, substantiated with first experimental results on the atmospheric band of molecular oxygen, will be given. The molecular oxygen spectrum, has a noise-equivalent absorption detection limit of 2.5 10^{-7} cm^{-1}, corresponding to an $1/e$ absorption length of 40 km, for the present experimental setup. This absorption detection limit even compares favourably to the detection limit that can be obtained using standard continuous FT spectroscopy in a long path-length absorption cell, although then digitizers with a higher dynamic range are used. If interfaced to pulsed, repetitive sources many orders of magnitude are gained in absorption detection sensitivity with the FT-CRD technique compared to presently available FT spectroscopic techniques.

It is demostrated that as in the case of 'normal' CRD spectroscopy, in a FT-CRD spectrometer the absorption information is deduced from the temporal shape of the ring down transient, and therefore only the spectral shape of the light source has to be known and has to be constant during the measurement, whereas the intensity of the light source is allowed to fluctuate. Since one does not need to know the absolute intensity of the interferograms, less stringent restrictions are posed on the vertical resolution of the digitizer.

Full advantage of the multiplex approach to spectroscopy is obtained in the (near)-IR spectral region where the intrinsic noise level of the light detectors is higher than in the visible and near-UV range. As also the Michelson interferometers work better for longer wavelengths, it is anticipated the the FT-CRD technique that will be presented, is ideal for exploration in the spectroscopically valuable IR region of the spectrum.

[a] Richard Engeln and Gerard Meijer, submitted to Rev. Sci. Instrum.