PHASE SHIFT CAVITY RING DOWN SPECTROSCOPY USED TO DETERMINE ABSOLUTE ABSORPTION CROSS SECTIONS

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The cavity ring down (CRD) absorption technique is nowadays widely used for measuring electronic and vibrational transitions in gases, plasmas and even solids. In most CRD schemes, a pulsed laser is used. In this contribution, we show the results of a study of the use of a continuous wave CRD scheme, i.e. phase shift cavity ring down (PSCRD), to determine absolute absorption cross sections.
In the PSCRD technique, a narrow band continuous wave (cw) diode laser is used in combination with a high-finesse optical cavity to perform sensitive high-resolution, direct absorption spectroscopy in a simple experimental setup using ideas from the field of cavity ring down spectroscopy[a]. In the case of PSCRD, a chopper (3-20 kHz) modulates the intensity of the continuous laser beam that is coupled into the cavity. The absorption spectrum is obtained by measuring the magnitude of the phase shift the light beam experiences upon passing through an optical cavity. The performance of the setup and the possibility to extract absolute cross sections over a large dynamic range is demonstrated on the forbidden transitions in the $\mathrm{b}(\mathrm{v}'=0) \leftarrow \mathrm{X}(\mathrm{v}''=0)$-band of $^{16}\mathrm{O}_2$ and $^{16}\mathrm{O}^{18}\mathrm{O}$ around 769 nm. We will present results that show that the absorption cross sections determined with PSCRD are in good agreement with literature values. Furthermore, absolute agreement is obtained by fitting the lines with known Doppler and Lorentz broadening parameters. Absorptions down to 10^{-8} cm^{-1} can be recorded. The effect of the amplified spontaneous emission on the measured phase shift and the possible saturation of the detector due to the *irregular* in-coupling of the laser light into the optical cavity has been investigated.

[a] R. Engeln, G. von Helden, G. Berden, G. Meijer, *Chem. Phys. Lett.* **262** (1996) 105