NONLINEAR ABSORPTION IN JET-COOLED NO_2 BY COMBINING THE CRDS AND LIF TECHNIQUES

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By combining the capabilities of a high-Q optical cavity with the ones of a supersonic jet (nozzle) expansion, we can get a powerful tool for probing weak absorbing molecular transitions or traces of contaminants $(\alpha \sim 5.10^{-10}\ /\mathrm{cm})$. Moreover, sensitive high resolution spectroscopy is obtained by combining the Cavity Ring Down Spectroscopy (CRDS) technique with single mode CW laser sources. In the red energy range, Ring Down times greater than 100 μs can be easily obtained with an intracavity power which can reach 100 W near 800 nm. In such conditions, the usual Beer-Lambert law can be readily violated, revealing nonlinear absorptions (saturations) when the electrical dipolar transition momentum is high enough (like for the hot vibrational bands of the $\mathrm{NO_2}$ radical) *i.e.*, non exponential decays are observed.[a] Furthermore, Lamb dips are observable if the intensity of the electromagnetic field trapped inside the cavity is large enough. Additionally, 2-photons absorption transitions are detected by observing the LIF signal accompanying the absorption. Two kinds of 2-photon transitions are observed: i) sharp sub-Doppler (laser limited) transitions corresponding to resonant absorption and appearing only when the energy of the 2-photon transition is lower than the dissociation threshold, ii) Doppler limited transitions corresponding to non resonant transitions and appearing without energy threshold conditions revealing a continuum of absorption.

[a] D. Romanini, P. Dupré and R. Jost, in Vibrational Spectroscopy 19, 93 (1999)