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The NO₂ spectrum in the 12500-16100 cm⁻¹ energy range obtained by intracavity laser absorption spectroscopy

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We present spectroscopic results obtained on NO₂ molecules with the IntraCavity Laser Absorption Spectroscopy (ICLAS) technique in which the gas sample is rotationally cooled in a supersonic slit jet.

Our goal is to observe the vibronic levels of NO₂ from 10000 to 16500 cm⁻¹ in order to study the transition from the regular to the chaotic behavior. The high sensitivity of the ICLAS technique is well adapted to the study of the NO₂ absorption spectrum which is very weak in the near I.R.. Moreover the rotational congestion observed at room temperature forbids rotational analysis. This spectral congestion can be overcome by using the cooling effect of a supersonic expansion. The geometry of a slit jet (instead of a pinhole jet) is well adapted to absorption experiment : the expansion of a mixture of NO₂ (1%) and argon through a slit jet (thickness : 10 microns, length : 24 cm) reduces the rotational temperature down to about 10 K. So we have combined the high sensitivity of the ICLAS technique with the rotational cooling obtained by a supersonic slit jet.

The high sensitivity of the ICLAS technique is governed by the generation time, time during which the mode competition occurs in the laser. A typical generation time of 100 μsec corresponds to an equivalent pathlength of 7 km. The resolution, limited by a two meters monochromator, is 0.05 cm⁻¹.

We have studied with a dye laser the 12500-16100 cm⁻¹ energy range in which 156 cold bands have been observed. They represent about 65 % of the total number of bands predicted by using a 24 parameters Dunham expansion. These 24 parameters have been determined by a fit of about 300 levels observed by LIDFS in the 0-12000 cm⁻¹ energy range.

We will access to the 10000-13000 cm⁻¹ energy range with ICLAS technique using a new Titanium-Sapphire (Ti : Al₂O₃) laser developed by A. Charvat and presented in a joint poster.