Contents

1 Document history

Modification	Author	Verified	Approved	Date
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Modification				

2 Object

This document reports tests carried out by Alpes Lasers to characterize tuning and find appropriate parameters for NO spectroscopy with Quantum Cascade Laser (QCL) sbcw5353 in intermittent continuous-wave (ICW) operation.

3 Application domain

This document is meant for Alpes Lasers's customers who are considering using intermittent CW QCLs for their spectroscpic measurements and for customers who are starting to implement this method.

4 Optical set up description

QCL #sbcw5353, encapsulated in a HHL package, was operated in ICW mode using Alpes Lasers' ICWQCL driver. Diver settings used in the measurements are listed in Section 7. The pulse width was 720 µs. The laser temperature was maintained at 41ºC.

Light intensity was detected using a thermoelectrically-cooled multi-junction mercury-cadmium-telluride (MCT) detector (Vigo System, model PVMI-2TE-10.6) with an AC-coupled preamplifier (Vigo System, model VPAC-1000). The detector contains an integrated microlens (diameter = 1 mm). No additional optics was used.

5 Tuning calibration using a Ge etalon

Spectral position of the laser as function of time during the pulse was measured by counting fringes of a Ge etalon with a free spectral range FSR = 0.048 cm^{-1}. Oscilloscope traces of a laser pulse with the etalon in the optical path are shown in Fig. 2. Calculated relative tuning curve is shown in Fig. 1. The very fast tuning occuring during the 1st microsecond of the pulse was not included in the data shown in Fig. 1. The measured total tuning range is 1.5 cm^{-1}.

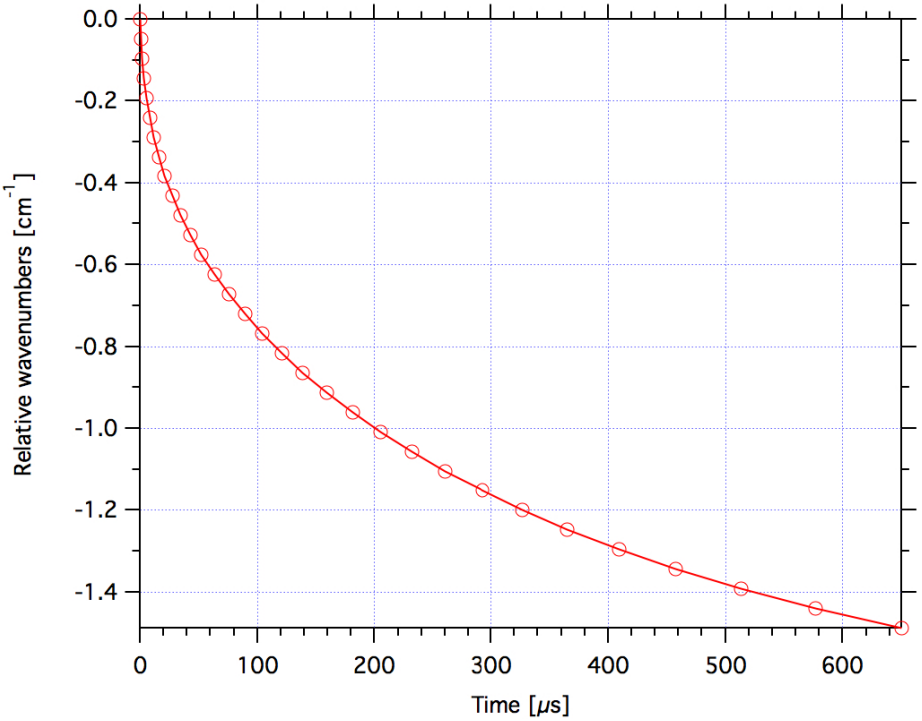


Figure 1: Relative wavenumbers as function of time measured using a Ge etalon.

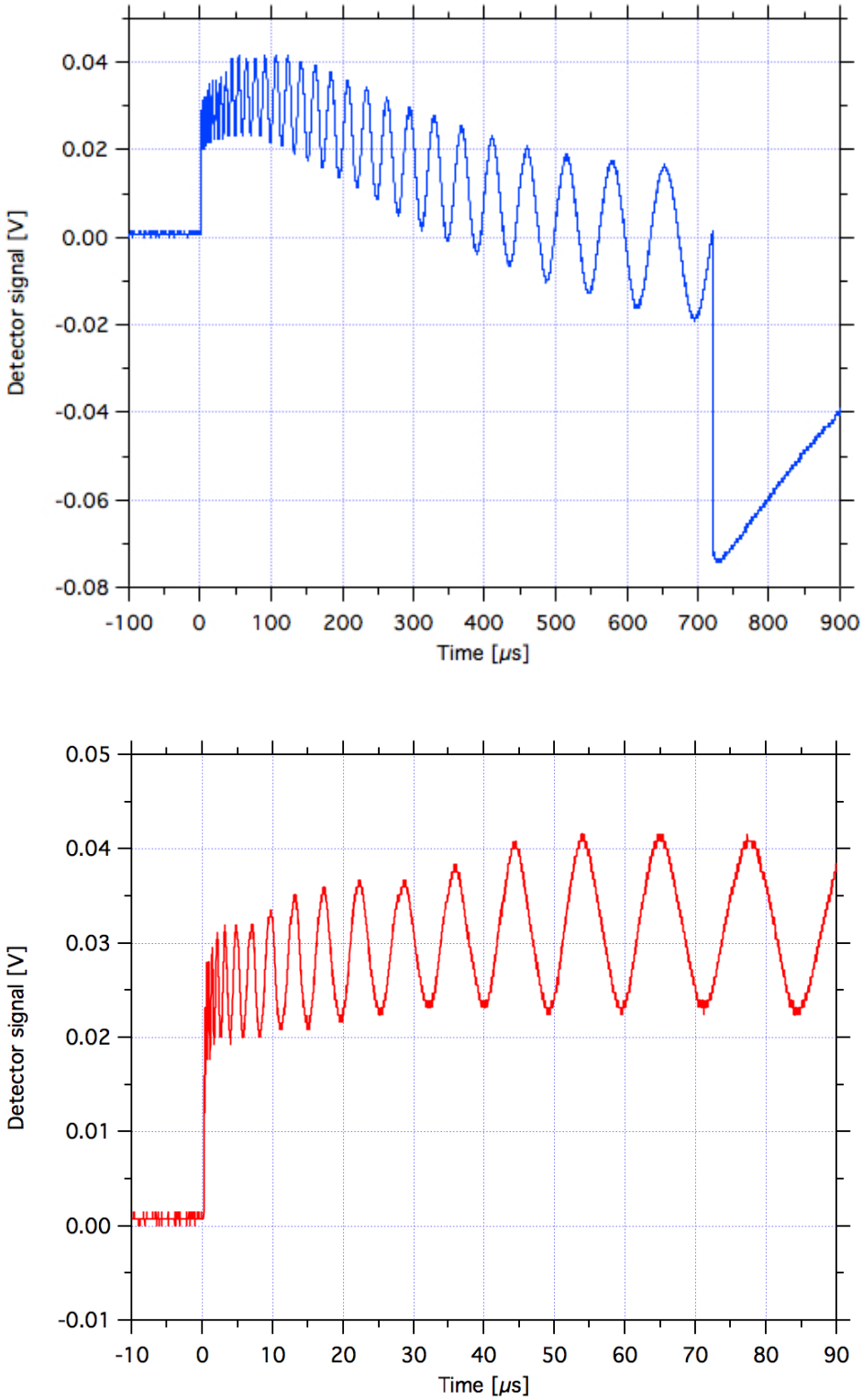


Figure 2: Oscilloscope traces of the detector signal with a Ge etalon in the optical path. Top: Entire pulse. Bottom: Zoom on the first 90 µs.

6 NO spectroscopy

A NO gas cell with sapphire windows was placed between the laser and the detector. Oscilloscope traces of the detector signal with and without the cell present are shown in Fig. 3. The absorption of the NO doublet spanning about 1900 cm^{-1} to 1900.5 cm^{-1} is clearly seen between ~250 µs and 350 µs.

Note: because our detector is AC coupled, absorption in the cell cannot simply be obtained by substracting the 2 curves.

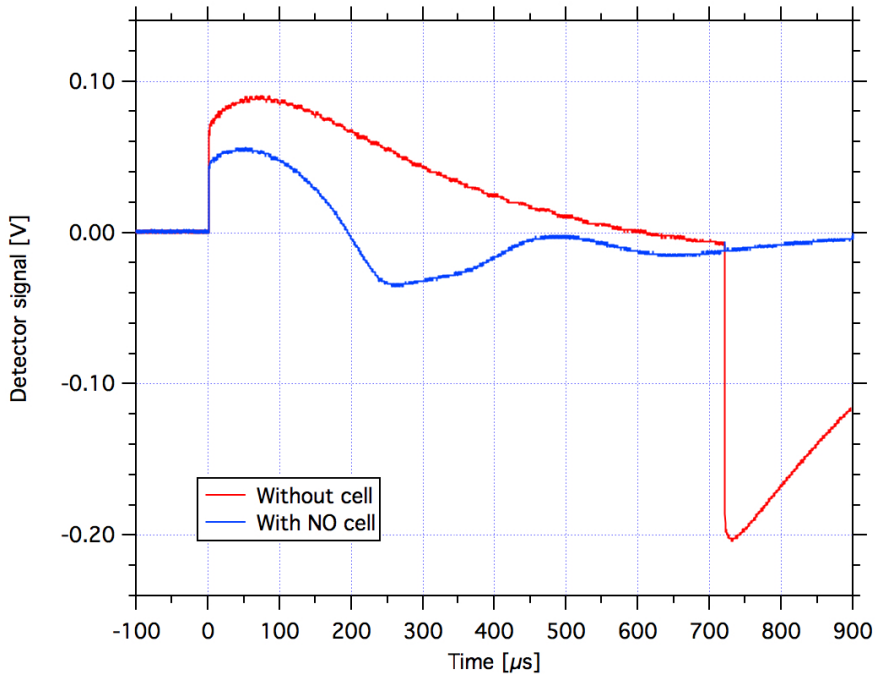
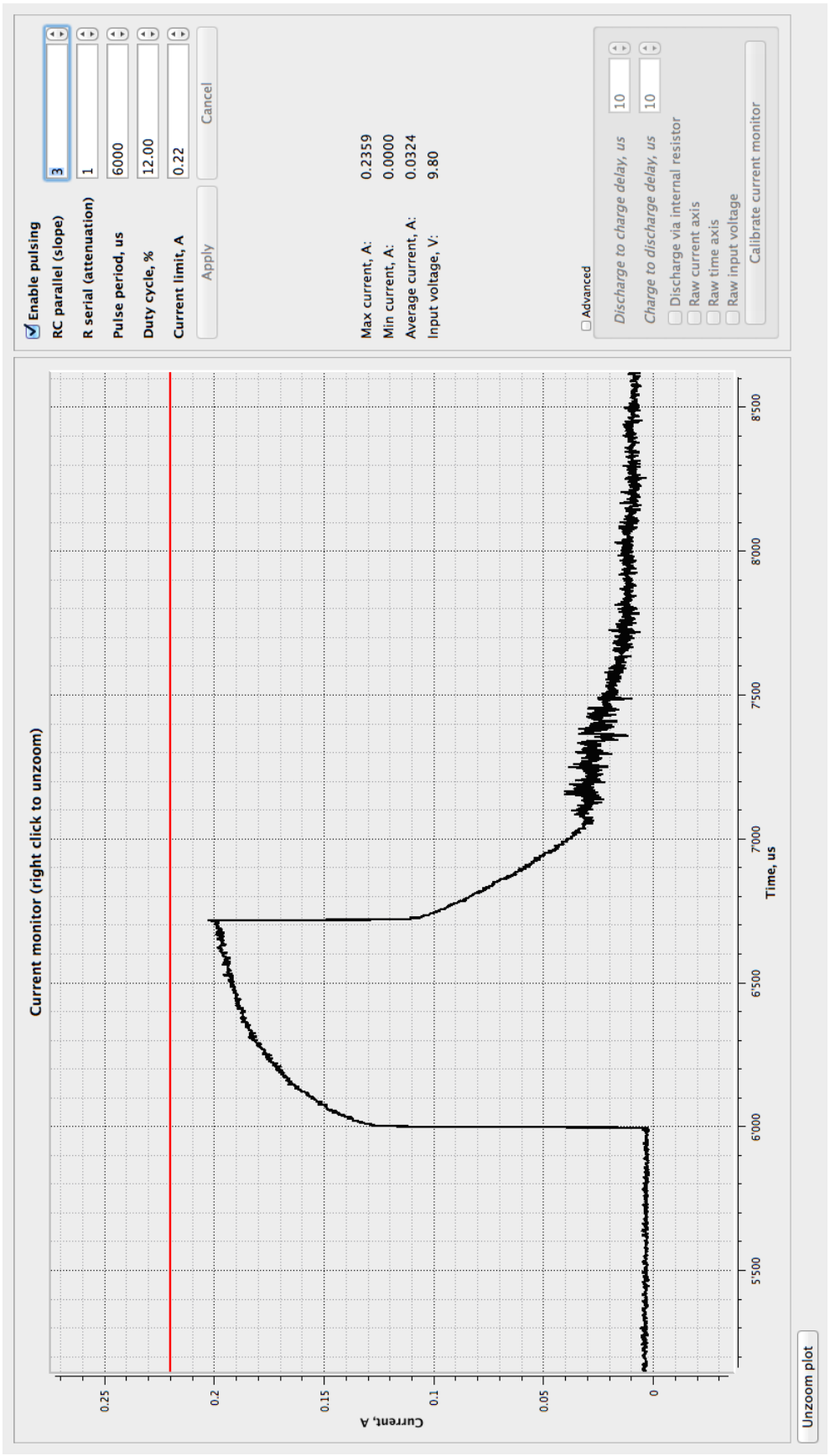


Figure 3: Measured absorption of NO gas cell with sapphire windows.

7 Driver settings



8 Temperature tuning

To calibrate spectral position as function of laser temperature, FTIR spectra were measured at various temperatures between 10 and 50ºC (see Fig. 4). The average value measured by the FTIR correponds approximately to the spectral position at 300 µs after the begining of the pulse.

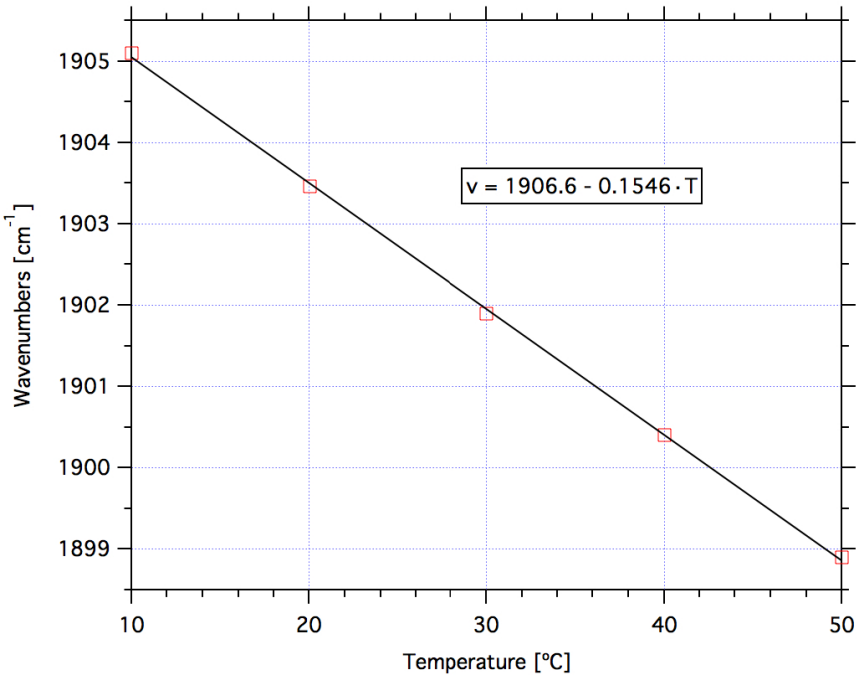


Figure 4: Wavenumbers as a function of laser temperature measured using an FTIR.