

### Aim of the project:

- > Study dust formation in SiH<sub>4</sub> plasmas with CRDS
- > Define the collective behaviour of a dust cloud
- > Prepare micro-gravity experiments for ISS\*

\*International Space Station

### Cavity Ring-Down theory:

- > A certain number of photons is trapped in an optical cavity and radiation begins to leak out of it
- > Record the exponential decrease of radiation
- > For a given wavelength  $\lambda$ , the decrease (ring-down) time  $\tau$  depends on the gas absorption coefficient  $\alpha$  and the cavity properties (mirror reflectivity R, cavity length L, broadband scatter processes)

$$\tau = \frac{L}{c} \times \frac{1}{(1-R) + \alpha L}$$

R = 0.997 ; d = 1 m →  $\tau_0 = 1$  ms  
 $\Delta\tau_{\min} < 1$  ns →  $\alpha < 10^{-6}$

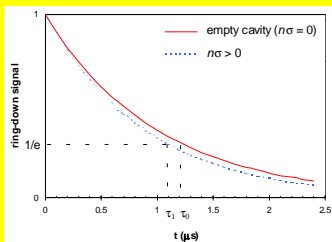
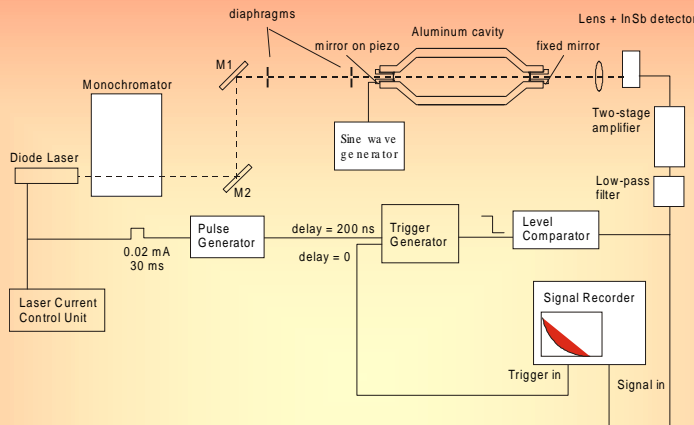


Fig. 1: Theoretical ring-down signal

### Set-up:

- > Helium cooled infrared laser diode (wide tuning range, narrow line width)
- > Plano-concave ZnSe cavity mirrors (R>97 %, radius of curvature 1 m)
- > LN<sub>2</sub> cooled InSb photodiode detector

### CRDS and infrared detection principle:



### First results :

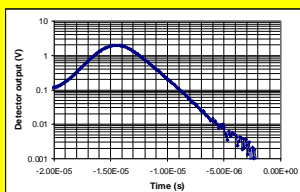


Fig. 2: Ring-down with a CO laser at 5.18 μm  
 $\tau = 1.54 \mu\text{s}$

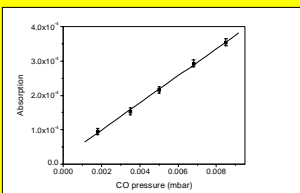


Fig. 4: Absorption as a function of CO pressure

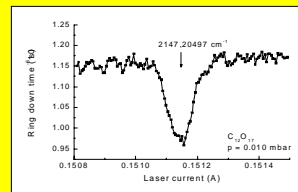


Fig. 3: Spectroscopic ring-down measurements of CO

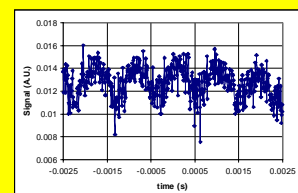


Fig. 5: Laser diode beam through the cavity

### Current fields of investigation:

- > Diode laser characteristics (beam size, active region geometry, spectral line width...)
- > Approximate vertical dimension 0.5-0.7 μm
- > Junction width of about 1.2-2 μm
- > Cavity length of about 250 μm

⇒ total laser diode diffraction angle is ≈ 112 degrees

△ Troubles with laser beam size ( $\varnothing = 35$  mm)

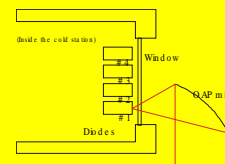


Fig. 6: Diode and OAP set-up

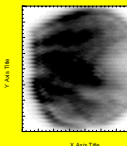


Fig. 7: Size of the laser beam at the OAP output

- > Mode selector device performances (light losses, mirror reflectivity...)

- > Mirrors not suitable for laser beam size
- > Laser power reduced by 4 at the output

△ Mode selector device needs improvement

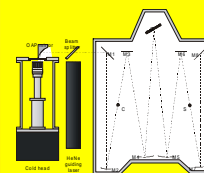


Fig. 8: Mode selector device

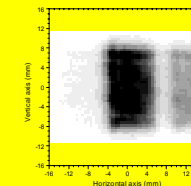


Fig. 9: Size of the laser beam at the mode selector output