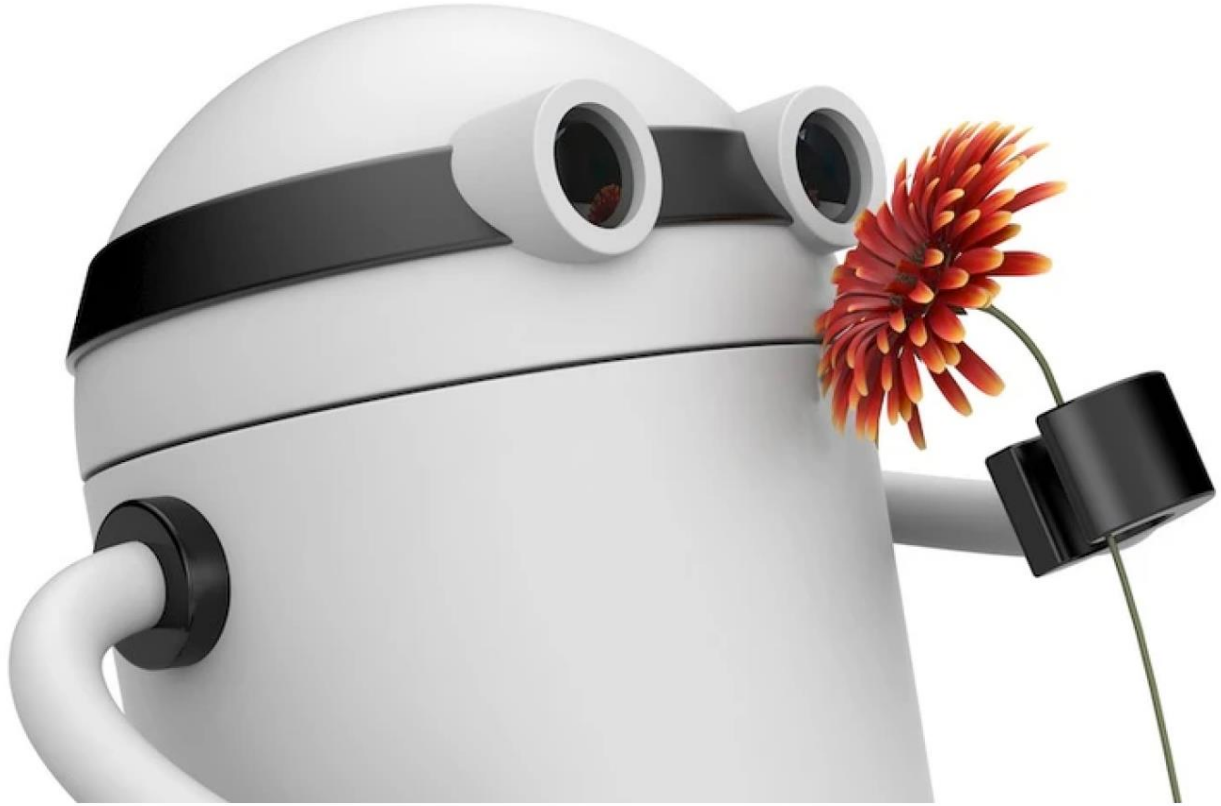
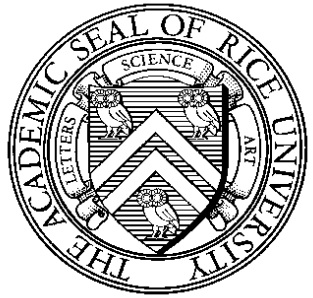
# OPTICAL NOSE



Master’s Thesis UHCL



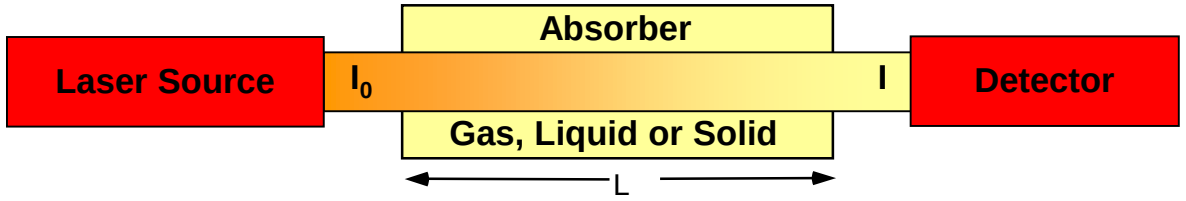

**RICE UNIVERSITY**

**NOVEL LASER-BASED GAS SENSORS FOR TRACE GAS DETECTION IN A SPACECRAFT HABITAT**
**BY**

**DARRIN PAUL LELEUX**

**DOCTOR OF PHILOSOPHY**
**HOUSTON, TX**
**APRIL, 2002**

# Direct Laser Absorption Spectroscopy



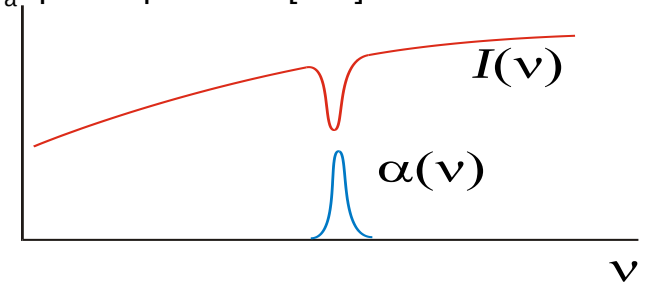

**Beer-Lambert's Law of Linear Absorption**

$$I(\nu) = I_0 \cdot e^{-\alpha(\nu) \cdot P_a L}$$

$\alpha(\nu)$ - absorption coefficient [$cm^{-1}$ $atm^{-1}$]; L – path length [cm]

$\nu$ - frequency [$cm^{-1}$]; $P_a$ - partial pressure [atm]

$$\alpha(\nu) = C \cdot S(T) \cdot g(\nu - \nu_0)$$




C - total number of molecules of absorbing gas/atm/$cm^3$ [molecule·$cm^{-3}$ ·$atm^1$]

S - molecular line intensity [cm ·$molecule^{-1}$]

$g(\nu - \nu_0)$ - normalized lineshape function [cm], (Gaussian, Lorentzian, Voigt)

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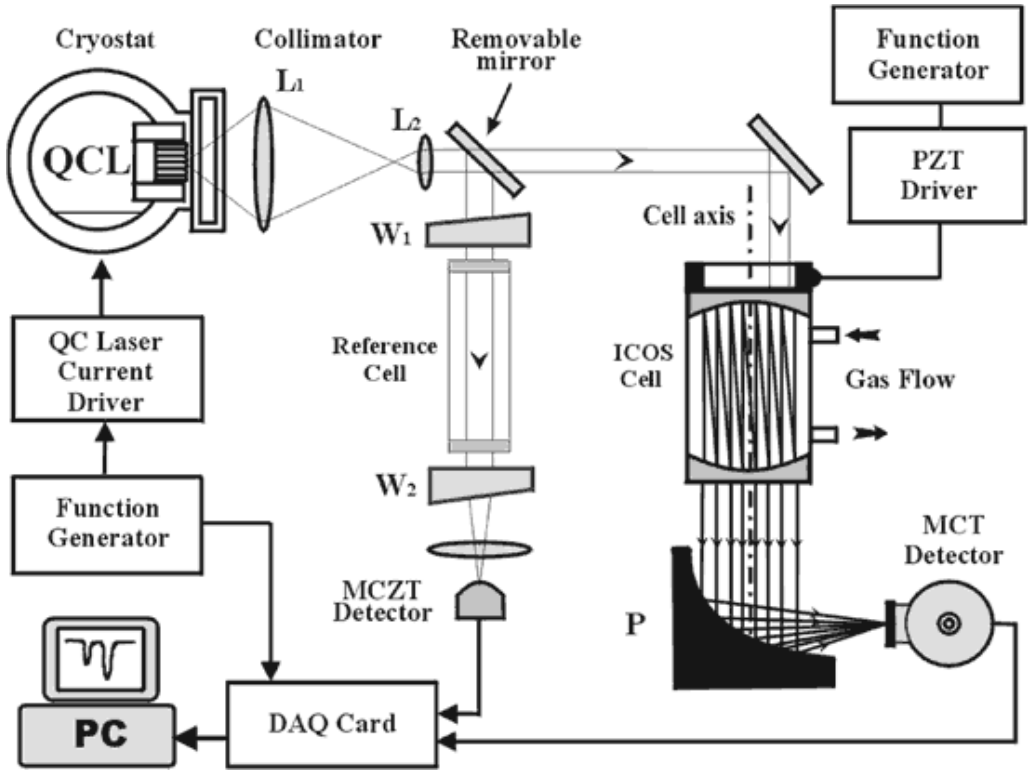
# EXPERIMENT AL SETUP



# Target Gases – 1

| Molecule | Formula | Trace Concentration in Breath (ppb) | Biological/Pathology Indication |
|---|---|---|---|
| Nitric Oxide | NO | 6 - 100 | Inflammatory and immune responses (e.g., asthma) and vascular smooth muscle response |
| Carbon Monoxide | CO | 400 - 3000 | Smoking response, CO poisoning, vascular smooth muscle response, platelet aggregation |
| Hydrogen Peroxide | $H_2O_2$ | 1 - 5 | Airway Inflammation, Oxidative stress |
| Carbonyl Sulfide | OCS | 100 – 1000 | Liver disease and acute allograft rejection in lung transplant recipients |
| Formaldehyde | HCHO | 400 - 1500 | Cancerous tumors, breast cancer |

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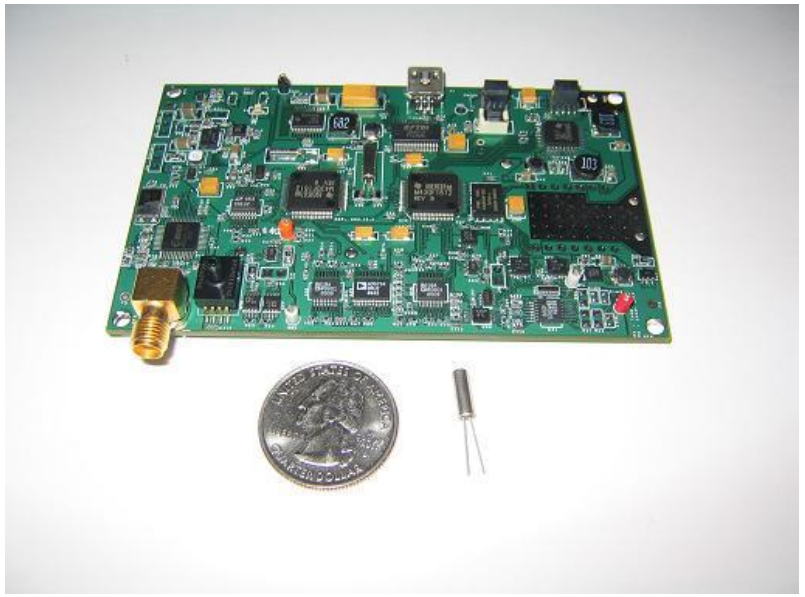
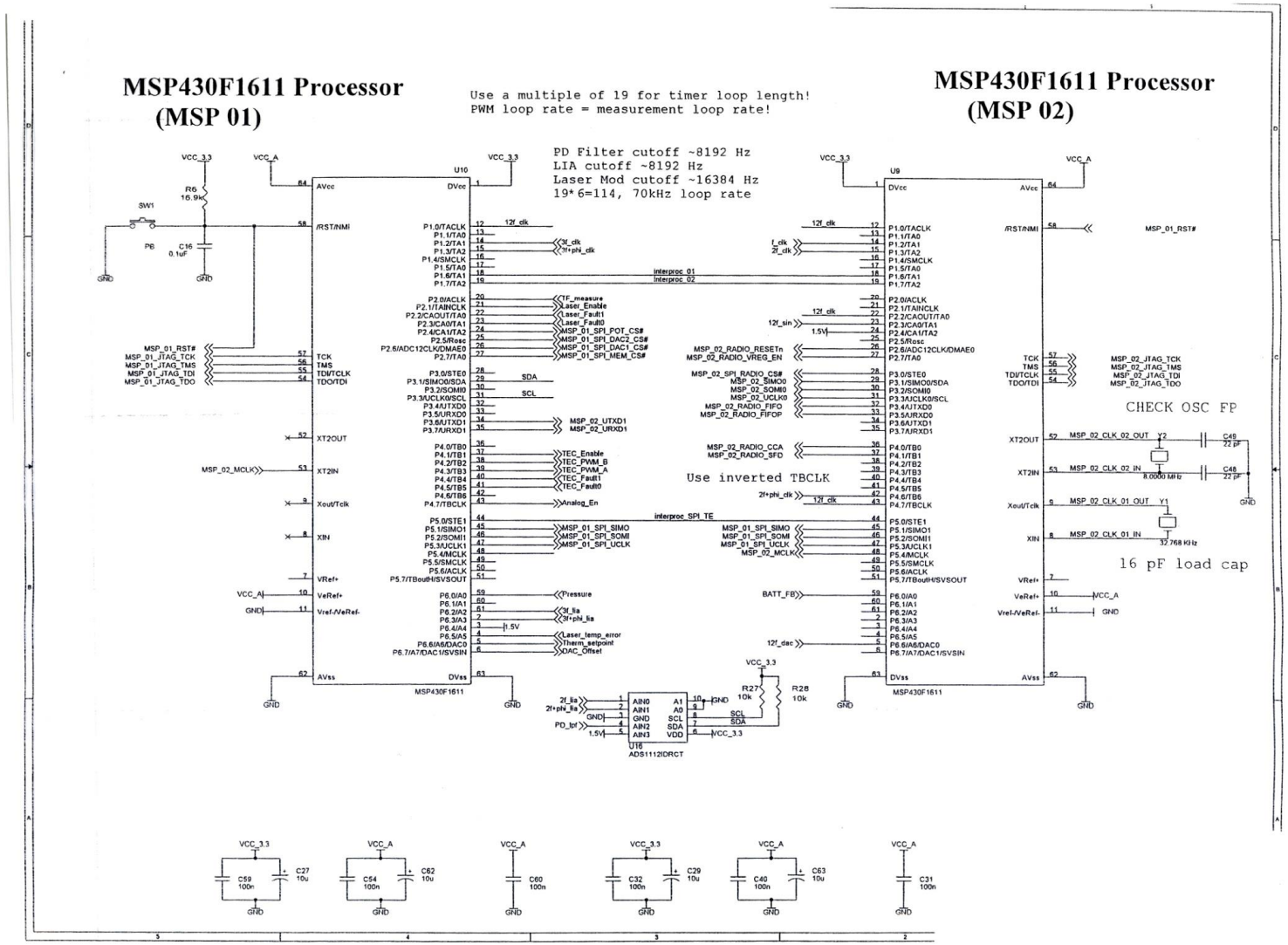
# Rice System 2002

# New Circuit Board 2008 with Stephen So



Design at Rice for handheld spectrometer


MSP430F1611 Processor
(MSP 01)
Use a multiple of 19 for timer loop length!
PWM loop rate = measurement loop rate!
PD Filter cutoff ~8192 Hz
LIA cutoff ~8192 Hz
Laser Mod cutoff ~16384 Hz
19*6=114, 70kHz loop rate
MSP430F1611 Processor
(MSP 02)
Use inverted TBCLK
CHECK OSC FP
16 pF load cap