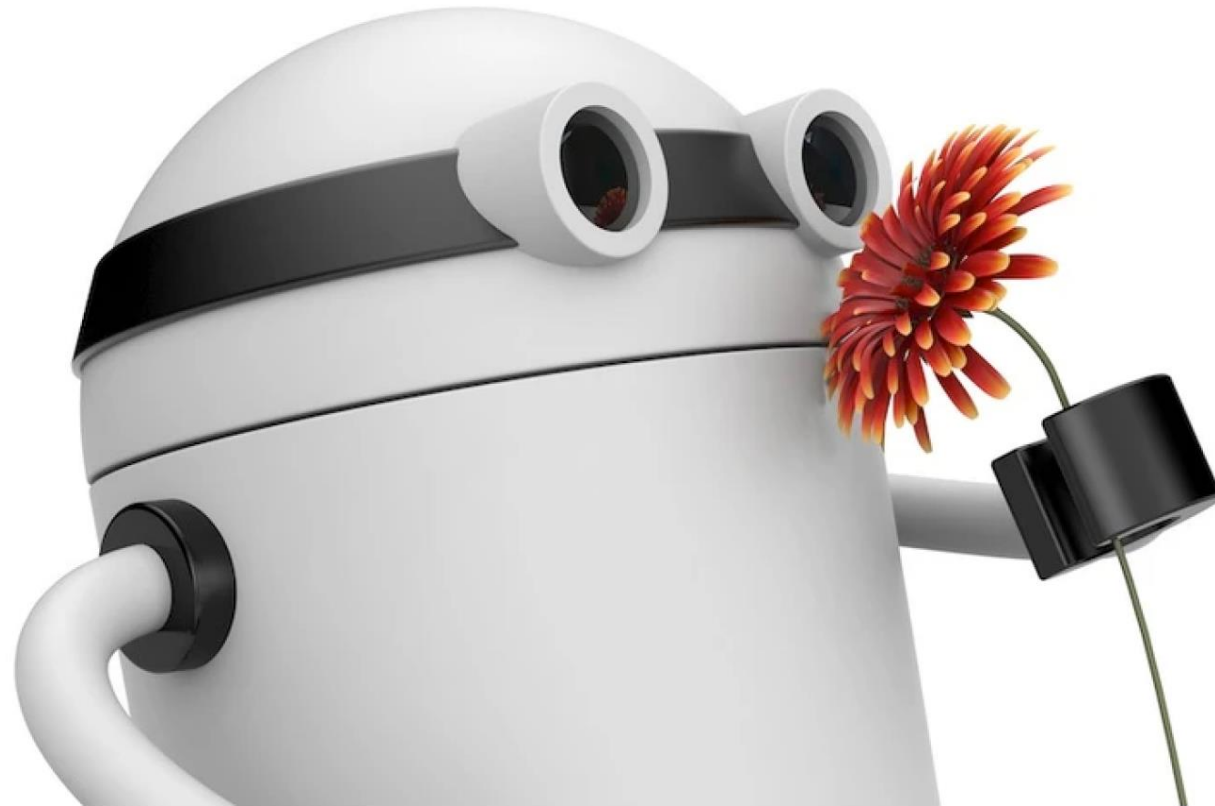


OPTICAL NOSE



Master's Thesis UHCL

RICE UNIVERSITY



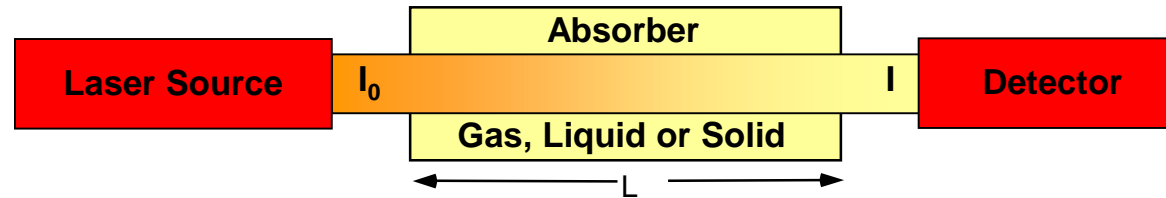
**NOVEL LASER-BASED GAS SENSORS FOR TRACE GAS
DETECTION IN A SPACECRAFT HABITAT
BY**

DARRIN PAUL LELEUX

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



Direct Laser Absorption Spectroscopy



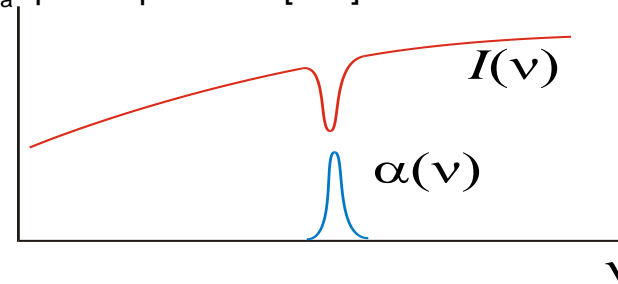
Beer-Lambert's Law of Linear Absorption

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

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

ν - frequency [cm^{-1}]; P_a - partial pressure [atm]

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



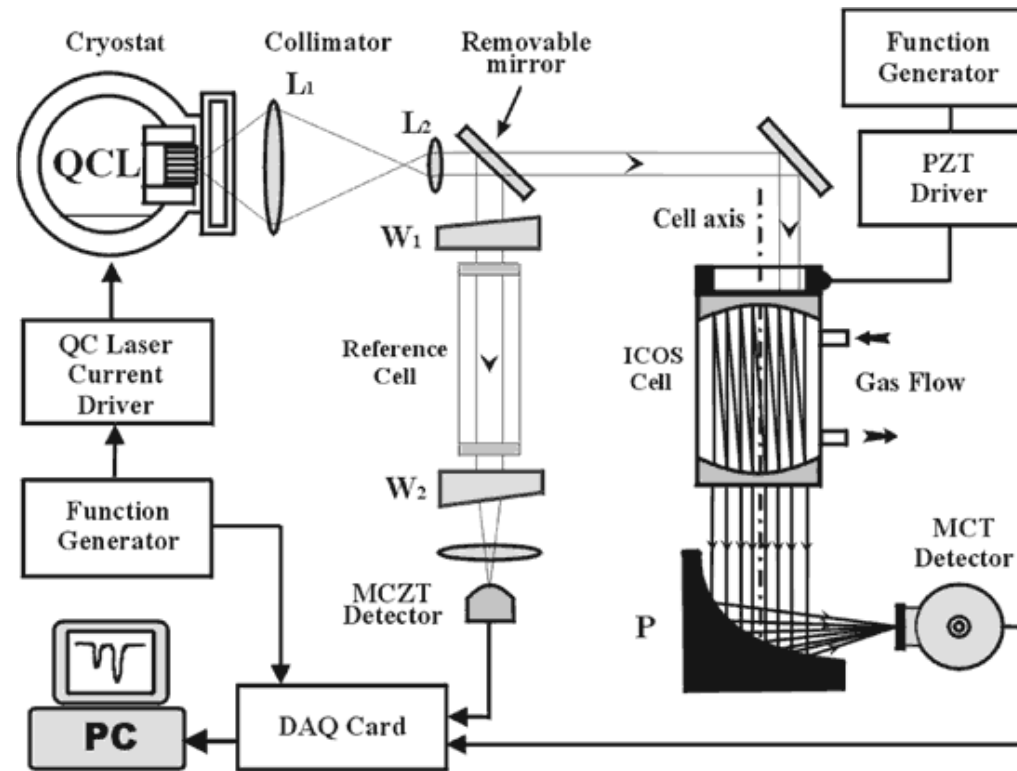
C - total number of molecules of absorbing gas/atm/ cm^3 [$\text{molecule} \cdot \text{cm}^{-3} \cdot \text{atm}^{-1}$]

S - molecular line intensity [$\text{cm} \cdot \text{molecule}^{-1}$]

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



EXPERIMENTAL SETUP



Target Gases – 1

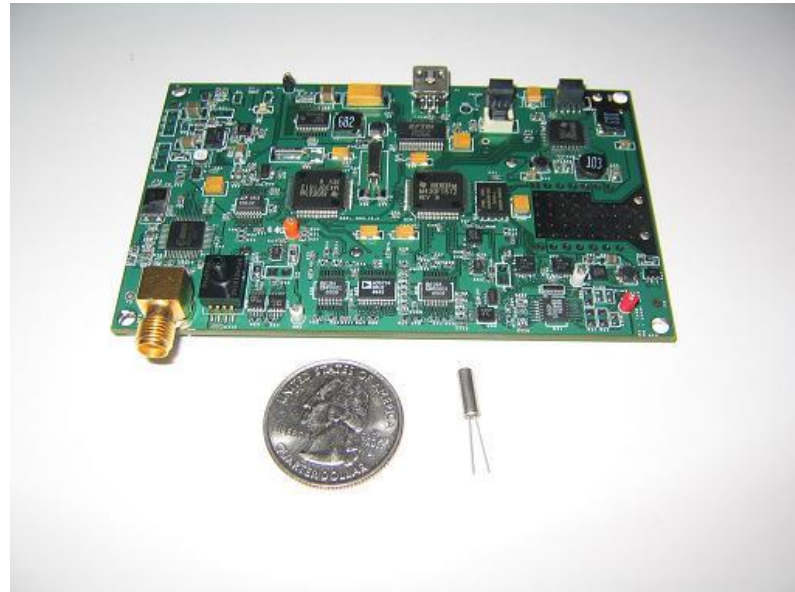
Molecule	Formula	Trace Concentration in Breath (ppb)	Biological/Pathology Indication
Nitric Oxide	NO	6 - 100	Inflammatory and immune responses (e.g., asthma) and vascular smooth muscle response
Carbon Monoxide	CO	400 - 3000	Smoking response, CO poisoning, vascular smooth muscle response, platelet aggregation
Hydrogen Peroxide	H ₂ O 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



Rice System 2002



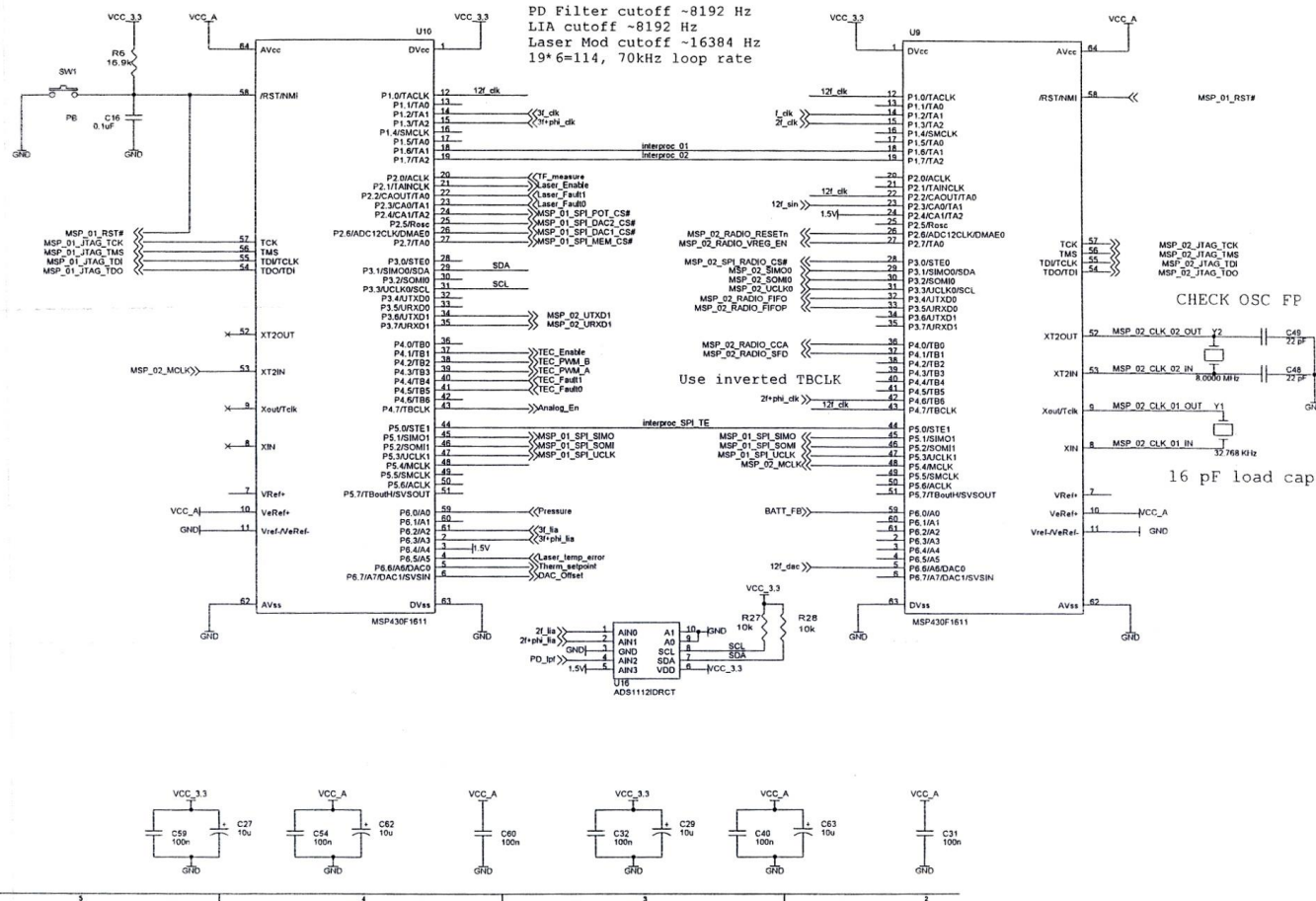
New Circuit Board 2008 with Stephen So



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!



MSP430F1611 Processor (MSP 02)

