Aircraft Fire Sensing based on Optical Detection of Key Species

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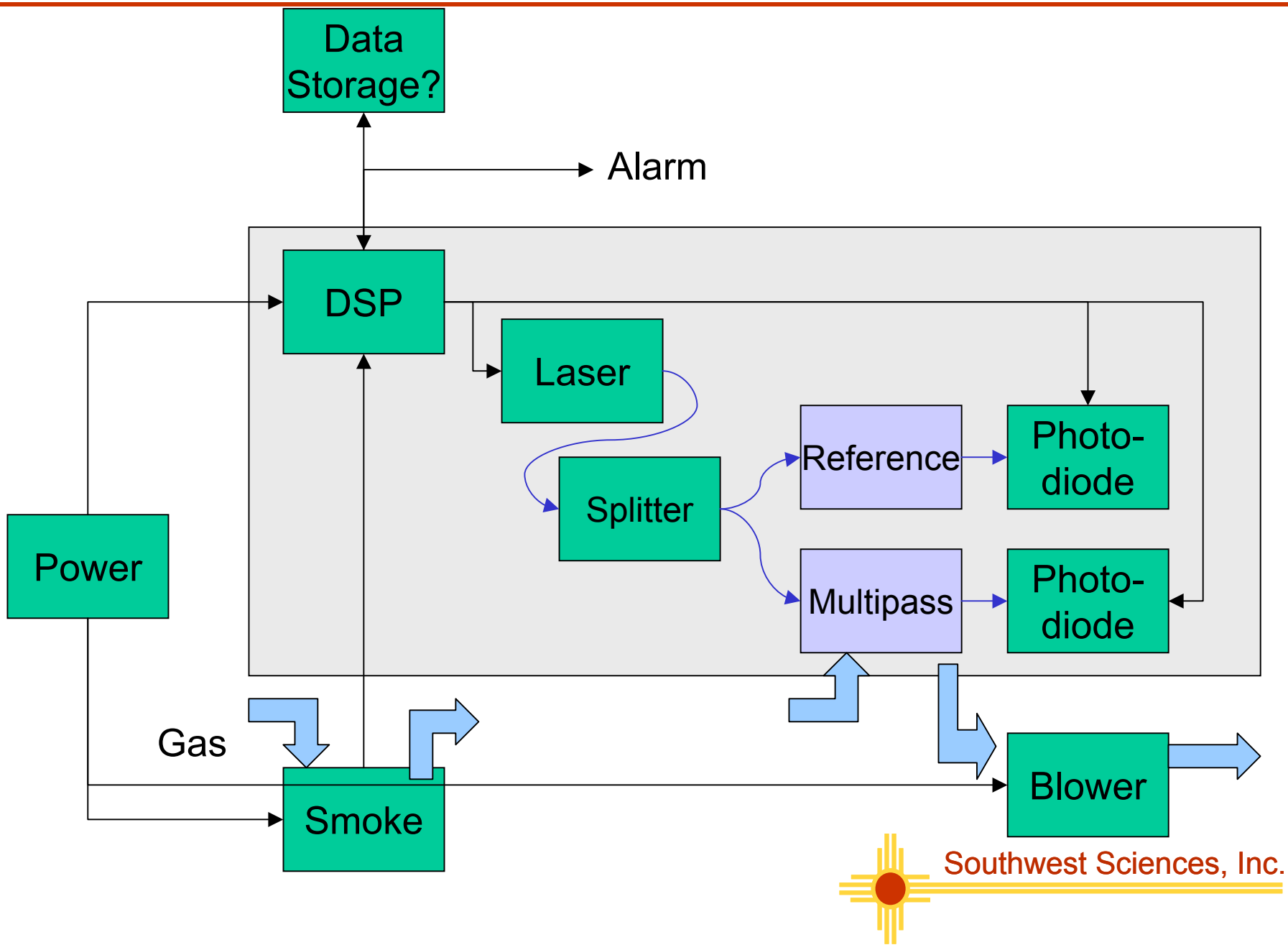
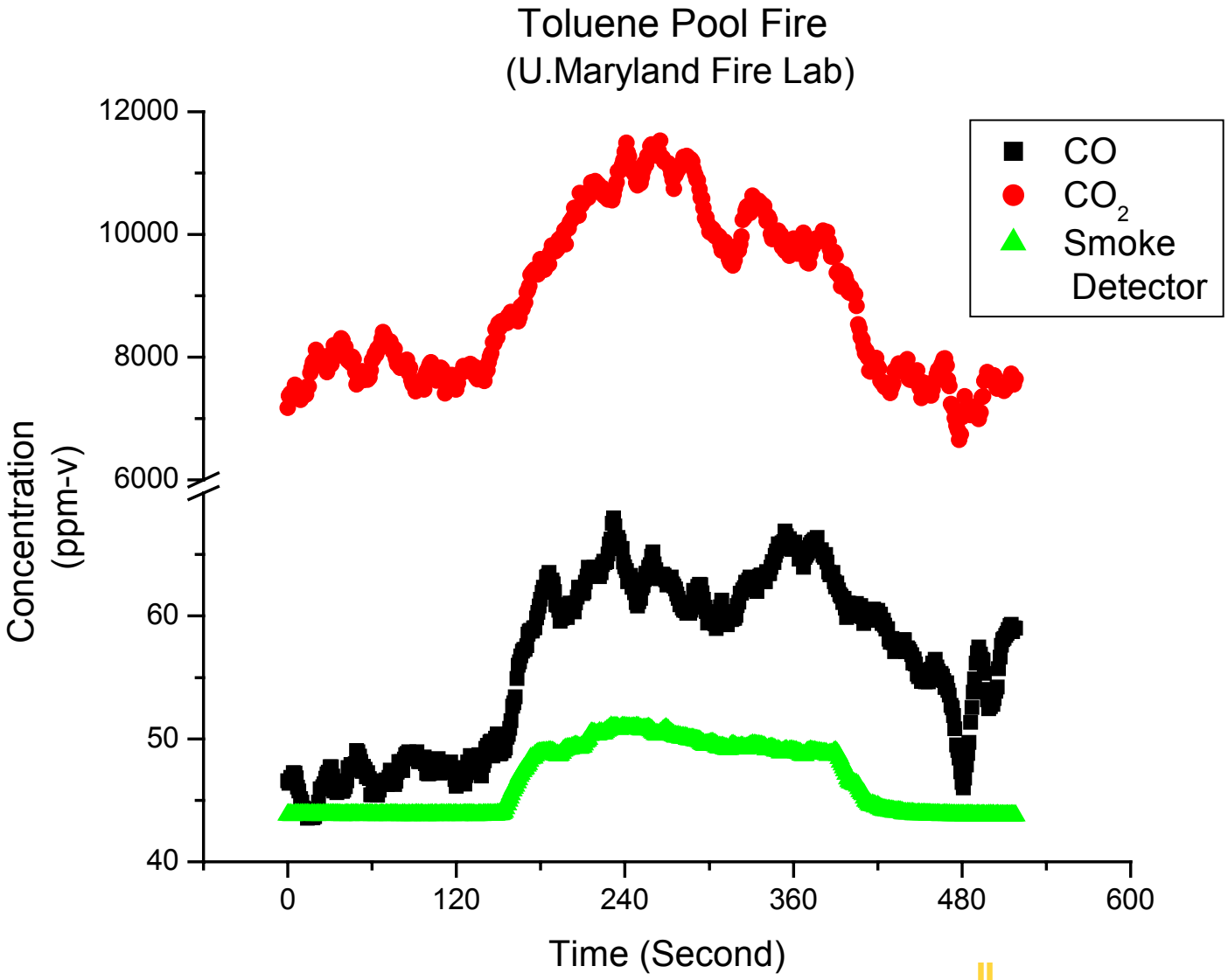
Our Approach

- Reduce False-Positive Smoke Alarms (~200:1)
  - Detect CO & CO_2 with Optical Absorption
  - Add Other Species (acetylene & HCN) if Warranted
  - Built-In Algorithm to Validate Smoke Alarm to Fire
- Validate Measurement & Algorithm
  - Tested at U. of Maryland Fire Lab w/ Different Fuels
  - Algorithm Testing Planned at U. Maryland
  - (Hope to) Piggyback at FAA Fire Testing Lab

Prototype Fire Sensor



Prototype Test Data



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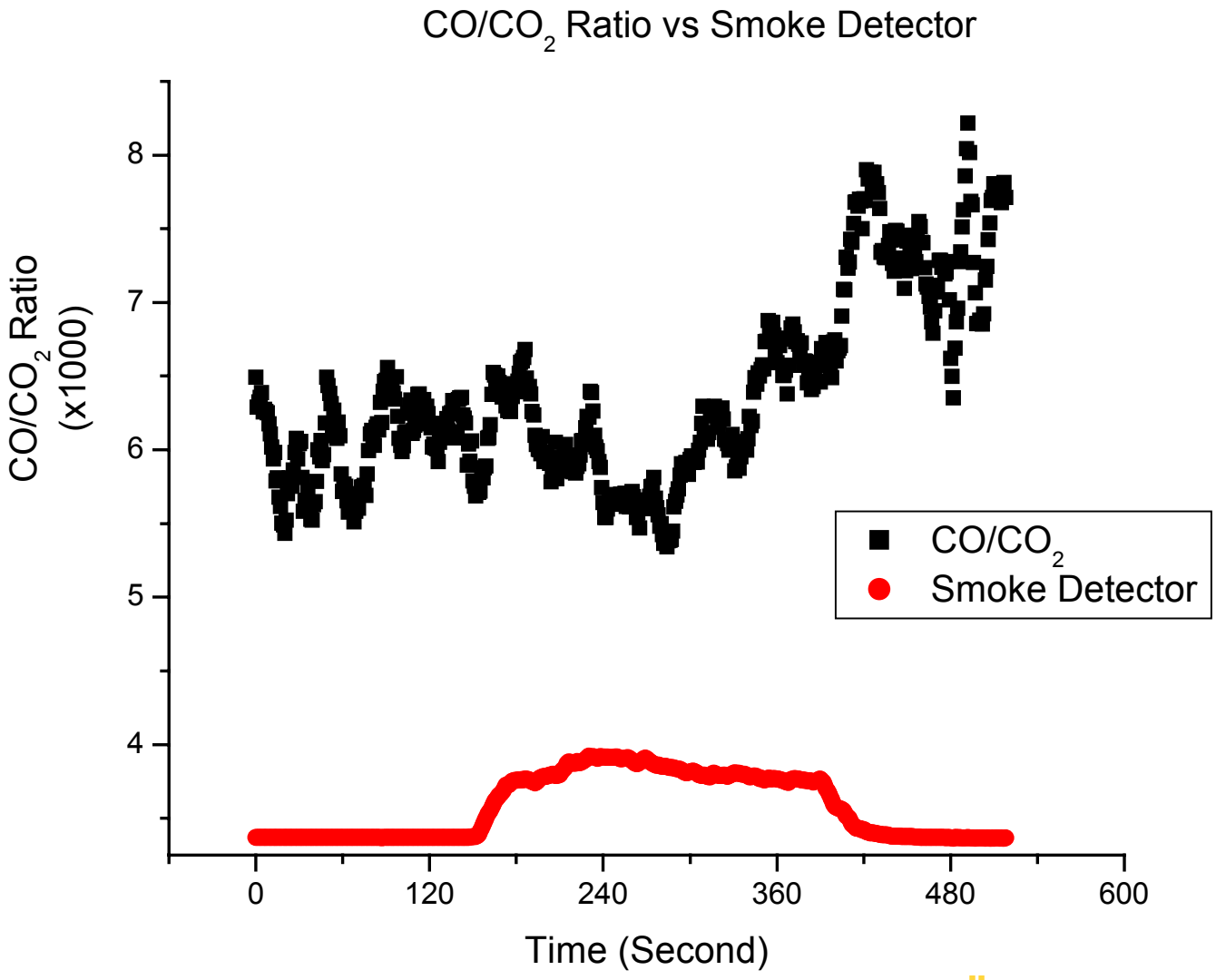
Prototype Test Data (Cont'd)



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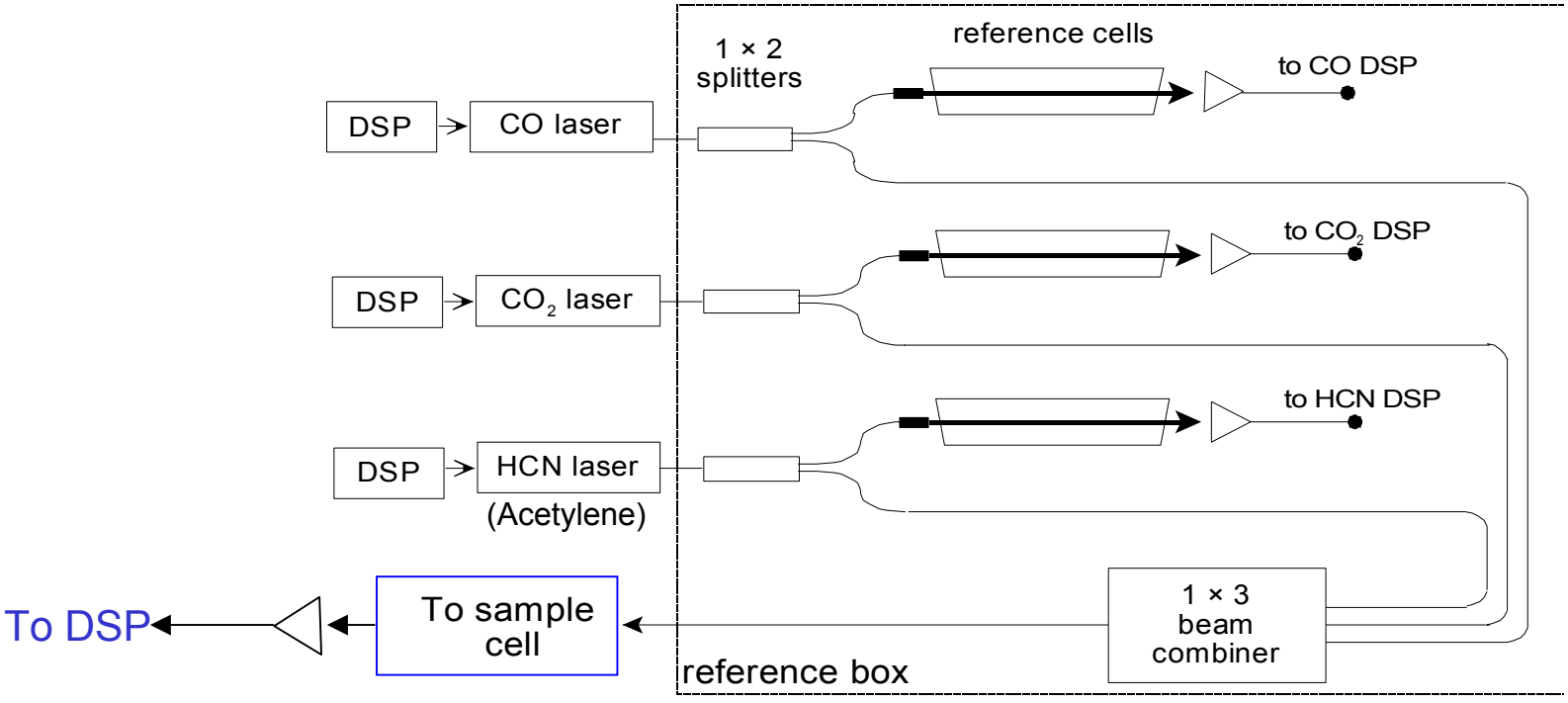
Concerns

- Optical Detection
  - Mirror Degradation (Filter)
  - Long Term Reliability (Telecom Components)
  - Measurement Location (Near Smoke Detector)
  - Orthogonal to Smoke Sensor (Algorithm Validation)
- Economics
  - Price (x4 Smoke Sensor)
  - Form Factor (x3 Smoke Sensor)
- Acceptance
  - Users (Pilots, Airlines)
  - Manufacturers (Boeing, Airbus)

Detection of Four Gases

- 3 lasers into single optical fiber
- Each laser modulated at different frequency
- Light detected on single photodiode
- DSP processor used to demodulate each laser separately
- HCN and acetylene could be detected in same spectral scan



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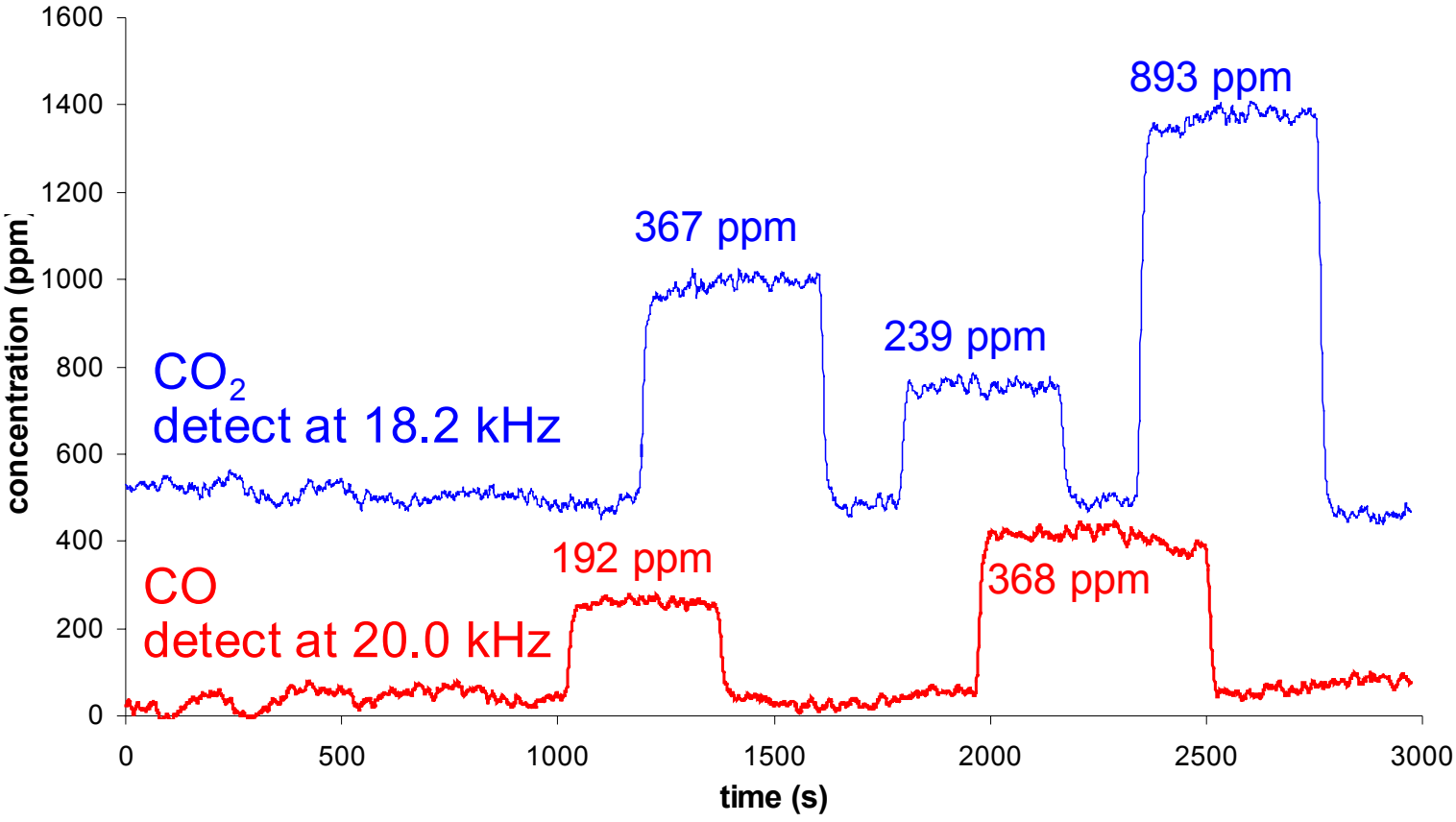
Frequency Multiplxed Detection Data



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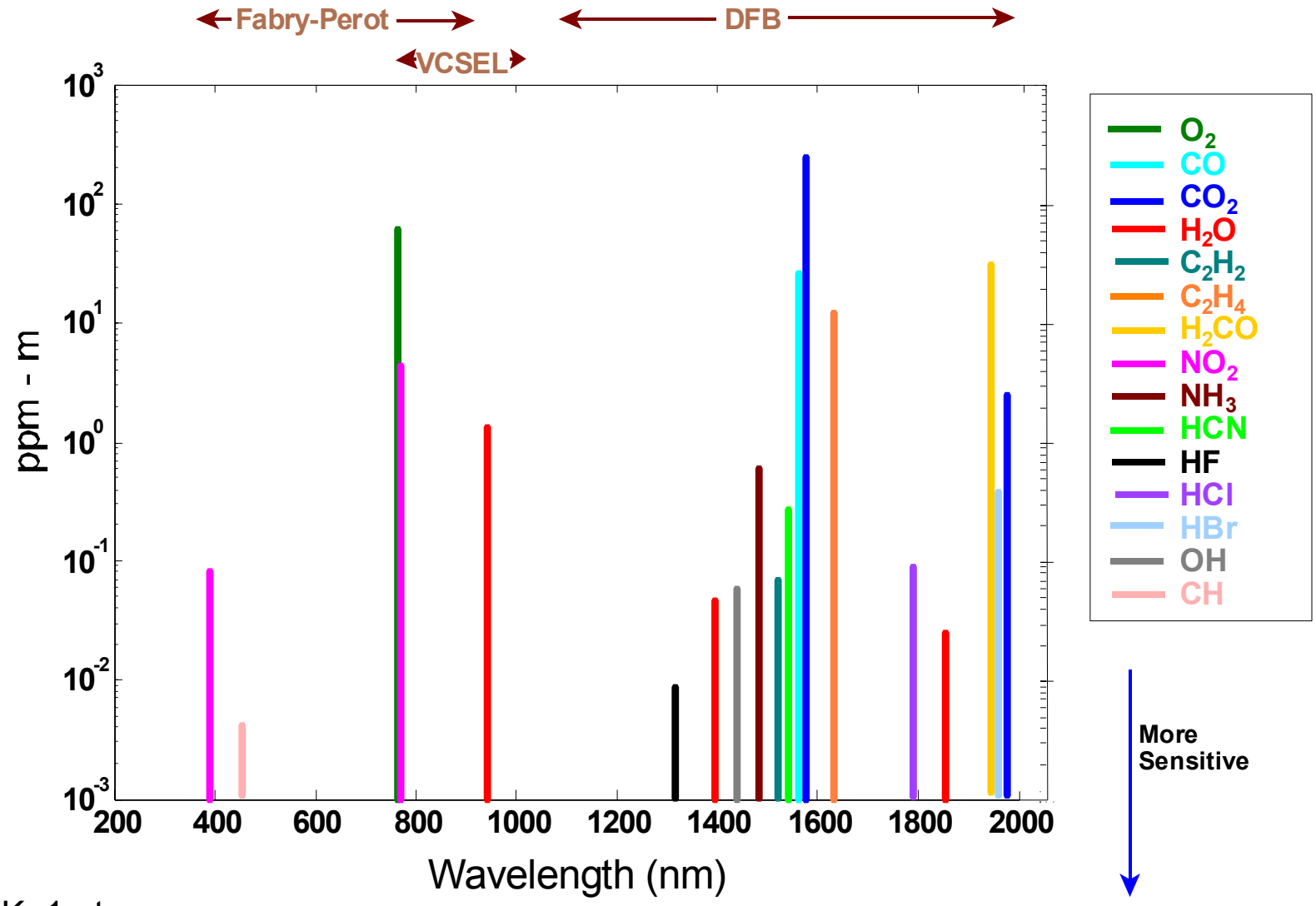
Gases Accessible for TDL Measurement



296 K, 1 atm
$\alpha_{min} = 10^{-5}$

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Future Improvements

- Optical Measurement
  - Longer Wavelength Lasers (available now)
    - Compact Optical Cell (No mirrors)
    - Integrate Smoke Detector/Gas Sensor
  - Fiber Optic Distribution
    - Multiple Measurement Locations
    - Multiple Species Detection
- Economics
  - TDL Price will Continue to Drop
  - Longer Wavelengths Reduce Form Factor