

# Portable prototype design of a mid-infrared laser-based methane sensor

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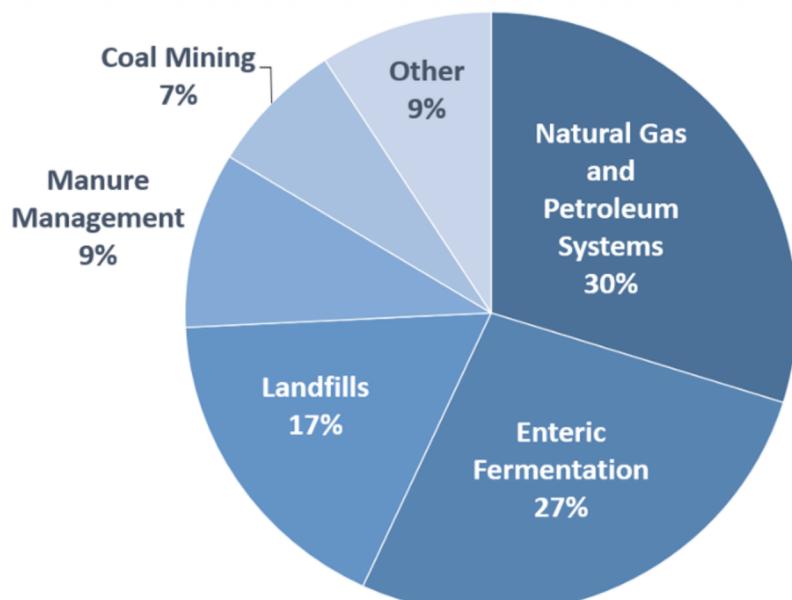
Delaware State University



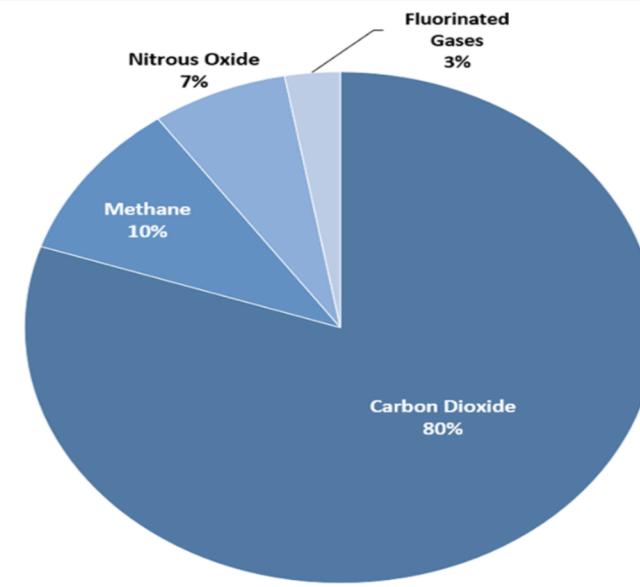
# Importance of Methane Sensing

- Methane(CH<sub>4</sub>) is the second most abundant greenhouse gas behind carbon dioxide making up about 10% of greenhouse gases in the atmosphere
- Methane has a global warming potential of 25 which means that over the course of 100 years is 25 times more effective at trapping heat than carbon dioxide.

2019 U.S. Methane Emissions, By Source



Overview of U.S. Greenhouse Gas Emissions in 2019



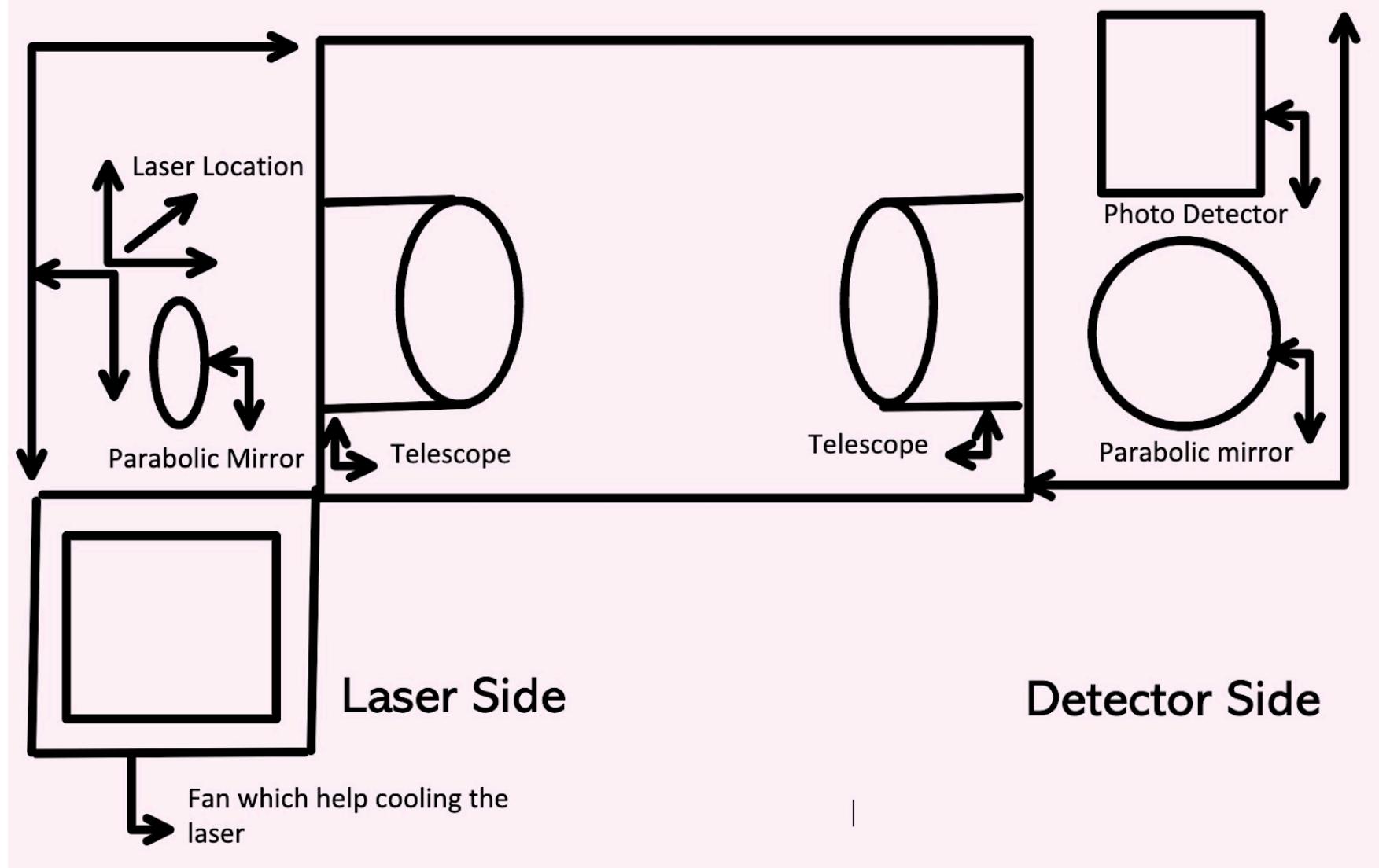
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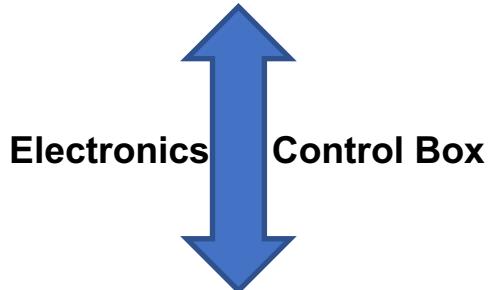
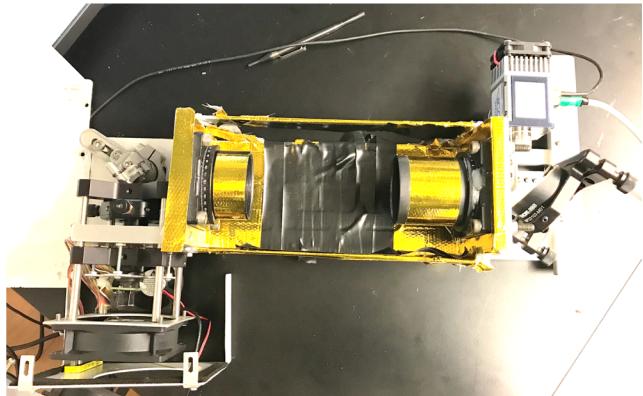


# Laser systems schematic



# Methane Sensor Prototype Design

Methane Sensor Prototype

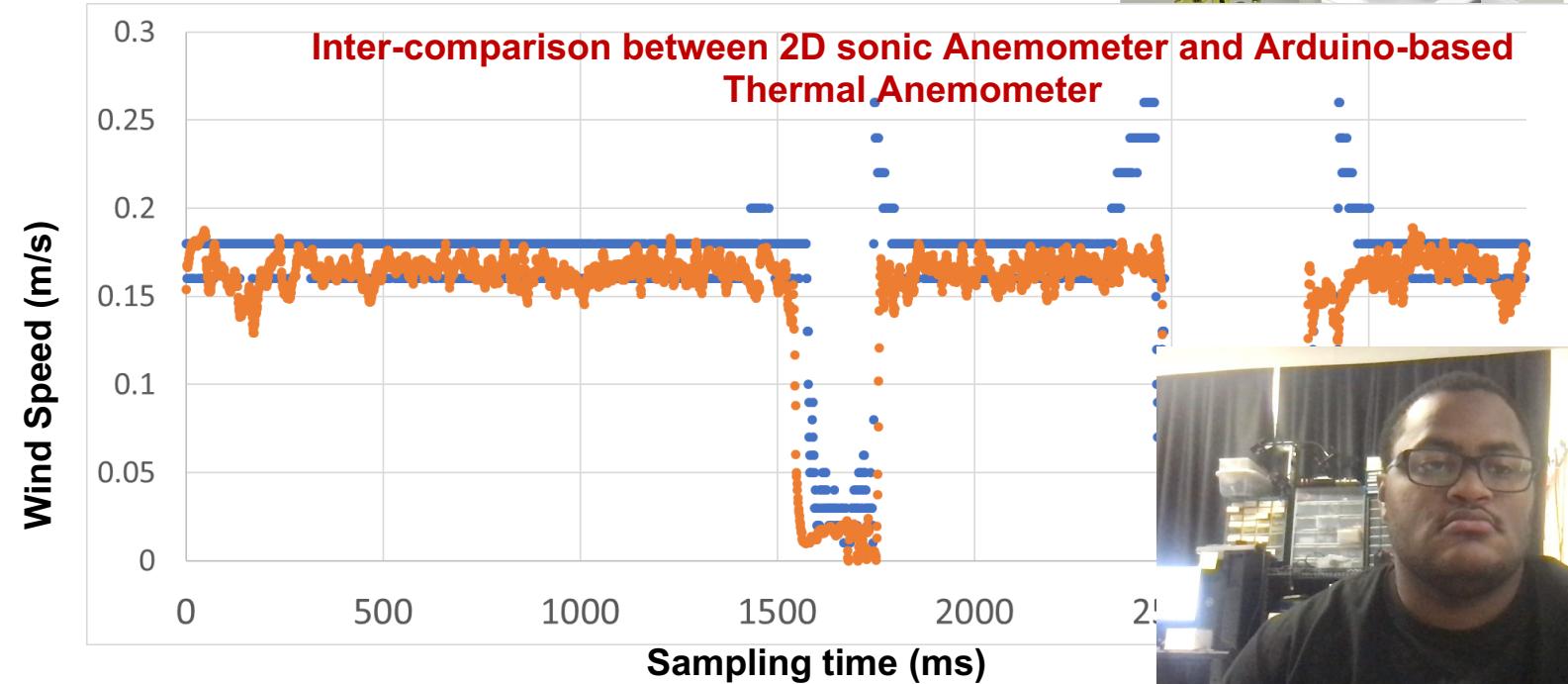


- Portable design for field deployments
- Integrated Anemometer for windspeed and wind direction

Arduino-based Thermal Anemometer

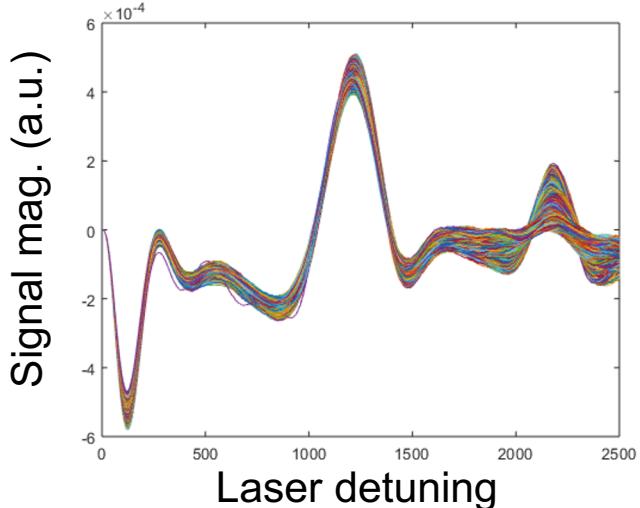


WMT 2D Sonic Anemometer

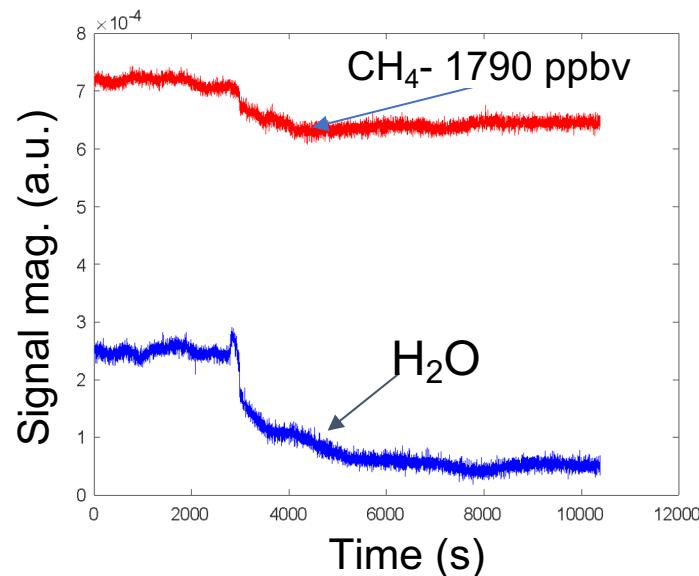


# Laboratory Calibration

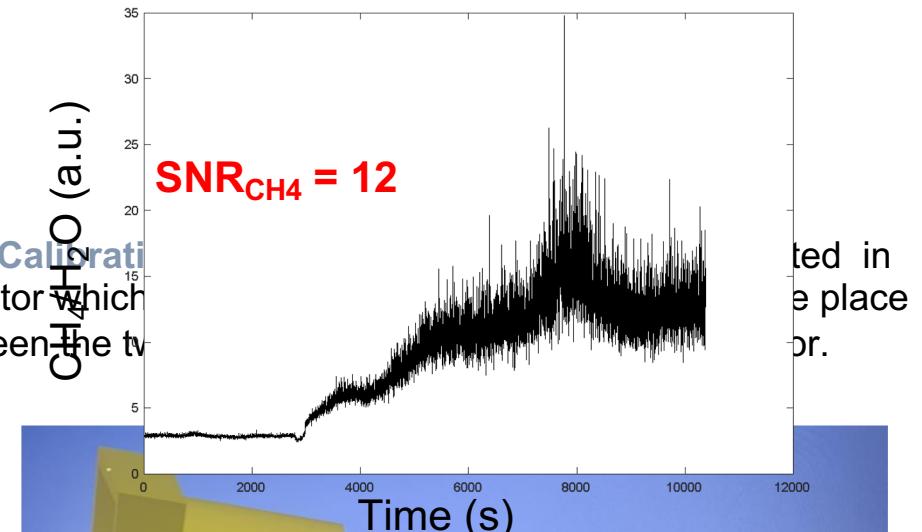
**CH<sub>4</sub>- 2f Signal**



**Methane Calibration Graph**



**Signal to Noise Ratio**



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- The MIR laser is modulated at 100 Hz to scan CH<sub>4</sub> molecular line-transitions at 3270 nm in wavelength.
- In the Methane calibration graph, the blue data set represents water vapor
- The calibration chamber is purged **1790 ppbv certified CH<sub>4</sub>**
- In the signal to noise ratio graph, it can be seen that the signal to noise ratio is 12:1



# Conclusion and Future Outlook

- Field Prototype methane sensor was tested at DSU campus
- While trying to run field tests on the roof of the OSCAR building, we ran into problems involving the thermal control of the photodetector
- The photo detector is designed to operate at a certain temperature so once the temperature exceeds a certain amount, the detector can't stabilize causing the entire sensor to lose signal.
- Utilize 3D printing to enhance portability of the sensor for field-calibrations



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