# Laser Spectroscopy of CO<sub>2</sub>

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### Overview

Measure absorption frequencies of CO<sub>2</sub> using a tunable laser

Look for:

- Linear response of the laser
  - Temperature, Current Inputs
- Agreement of results with other studies



#### **Experimental Setup**

- 1) Quantum Cascade Laser, Wavelength 4300-4350 nm
- 2) Optical chopper- "chops" laser signal into pulses
- 3) CO<sub>2</sub> vapor cell
- 4) Photodetector- measures incoming laser power, outputs voltage
- 5) Oscilloscope- displays signal from photodetector

Frequency Equivalencies for Absorption peaks

# Results so far



Laser responds linearly (frequency equivalency)

Results match expectations (Absorption peaks)



### Results cont'd

Broadening of peaks from Doppler effect was nearly imperceptible

- Buffer gas also present in vapor cell
- Long laser wavelength
- Mass of CO<sub>2</sub> molecule

Width of half-maxima of peaks: 0.025° C or 135 MHz

Limits of Resolution

- Temperature scales by 0.01° C, Current by 0.1 mA
- Scope accuracy depends on scale

# Application for other Experiments

Excite electrons confined to the surface of a dielectric

- Need a specific laser frequency to do so
- Use CO<sub>2</sub> because its excitation range contains the required frequencies to target single electrons

Use for quantum information

• Excitation states of electrons is used to store information (qubits)