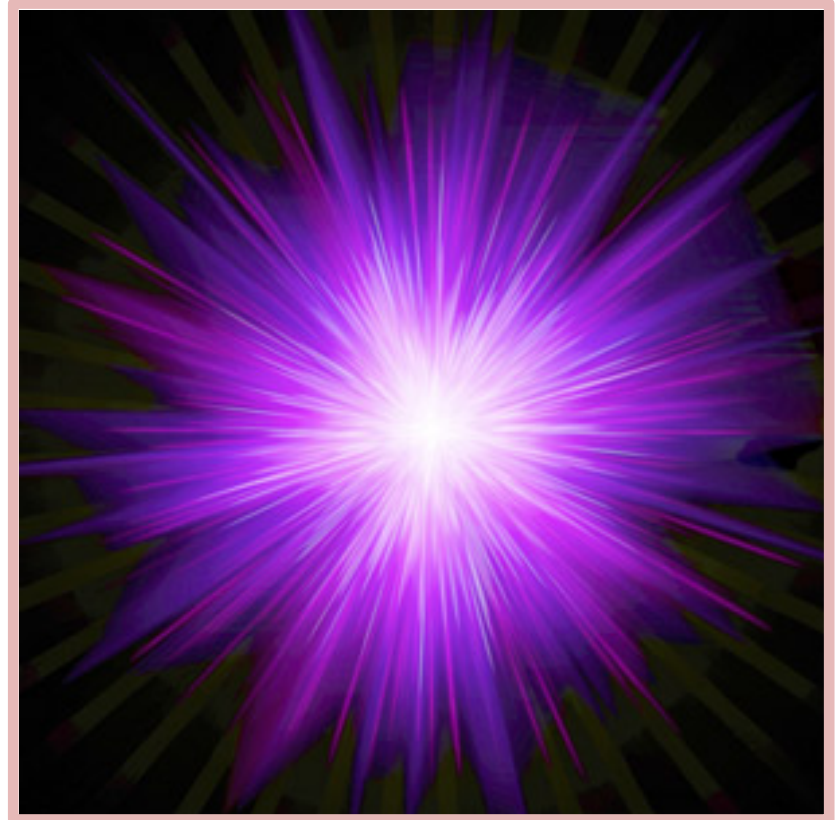


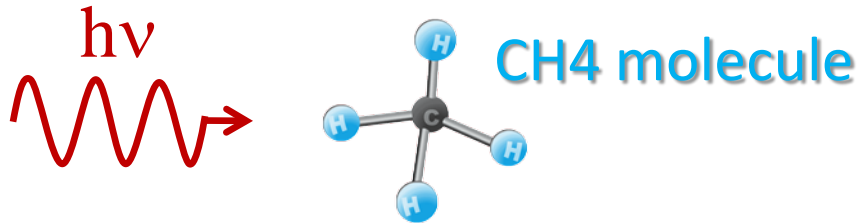
What Makes Cavity Ringdown Spectroscopy (CRDS) Work?

CRDS: A technology that can assess the amount of molecules in the air by measuring the molecular absorption of laser light in an optical cavity.

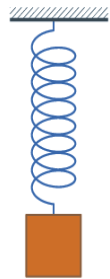
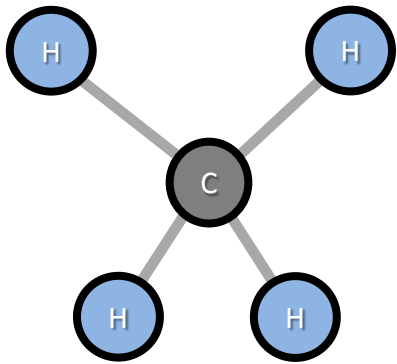


Light (photons) and Molecules

Molecules can absorb light and get “excited” at special frequencies.



These special frequencies are molecule specific.



$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$$

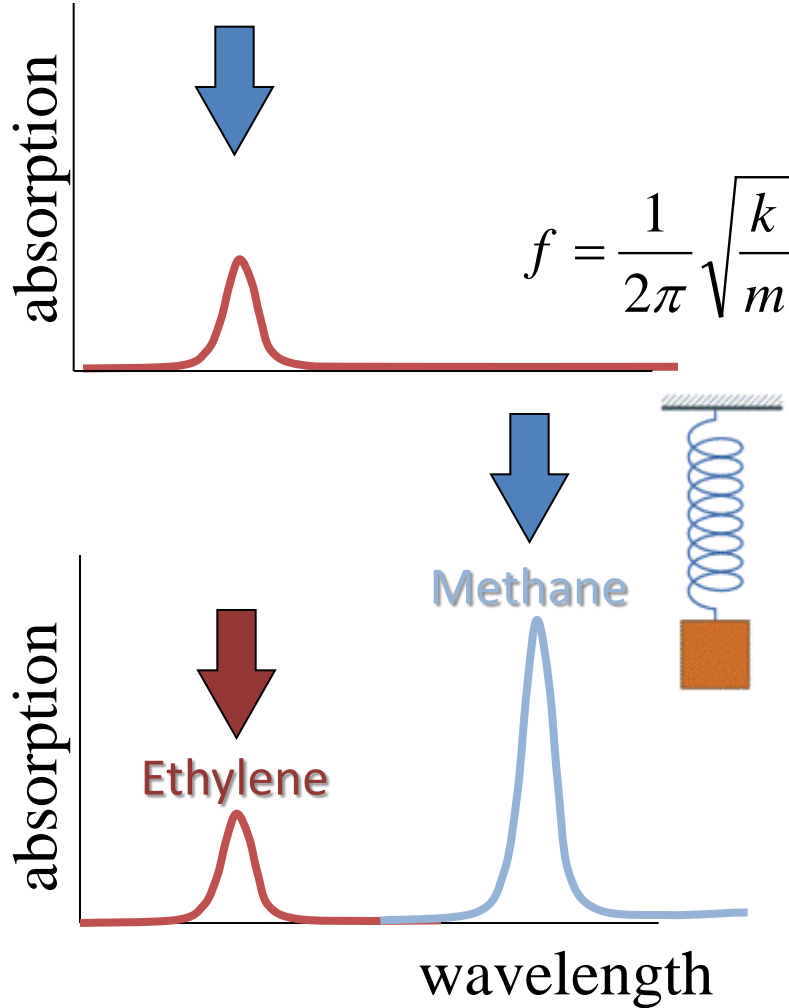
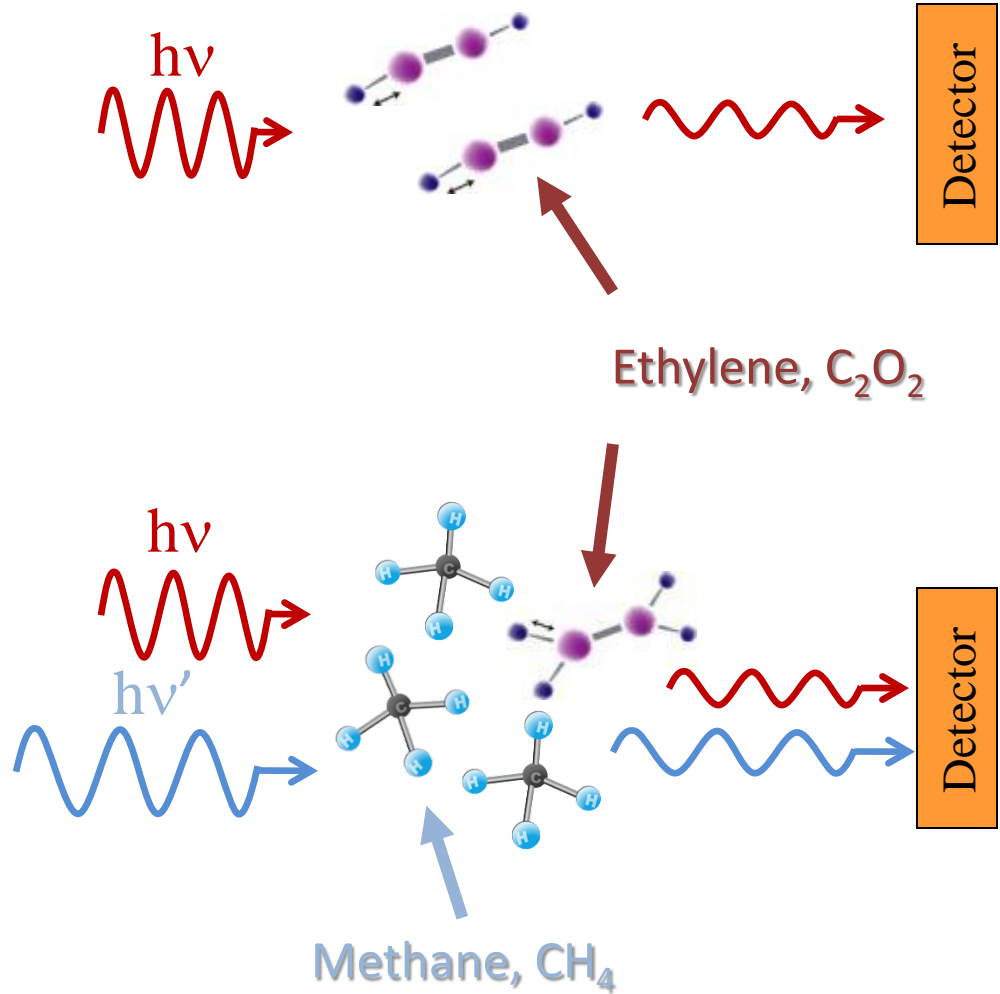
$f =$ special frequencies

$k =$ spring constant

$m =$ mass

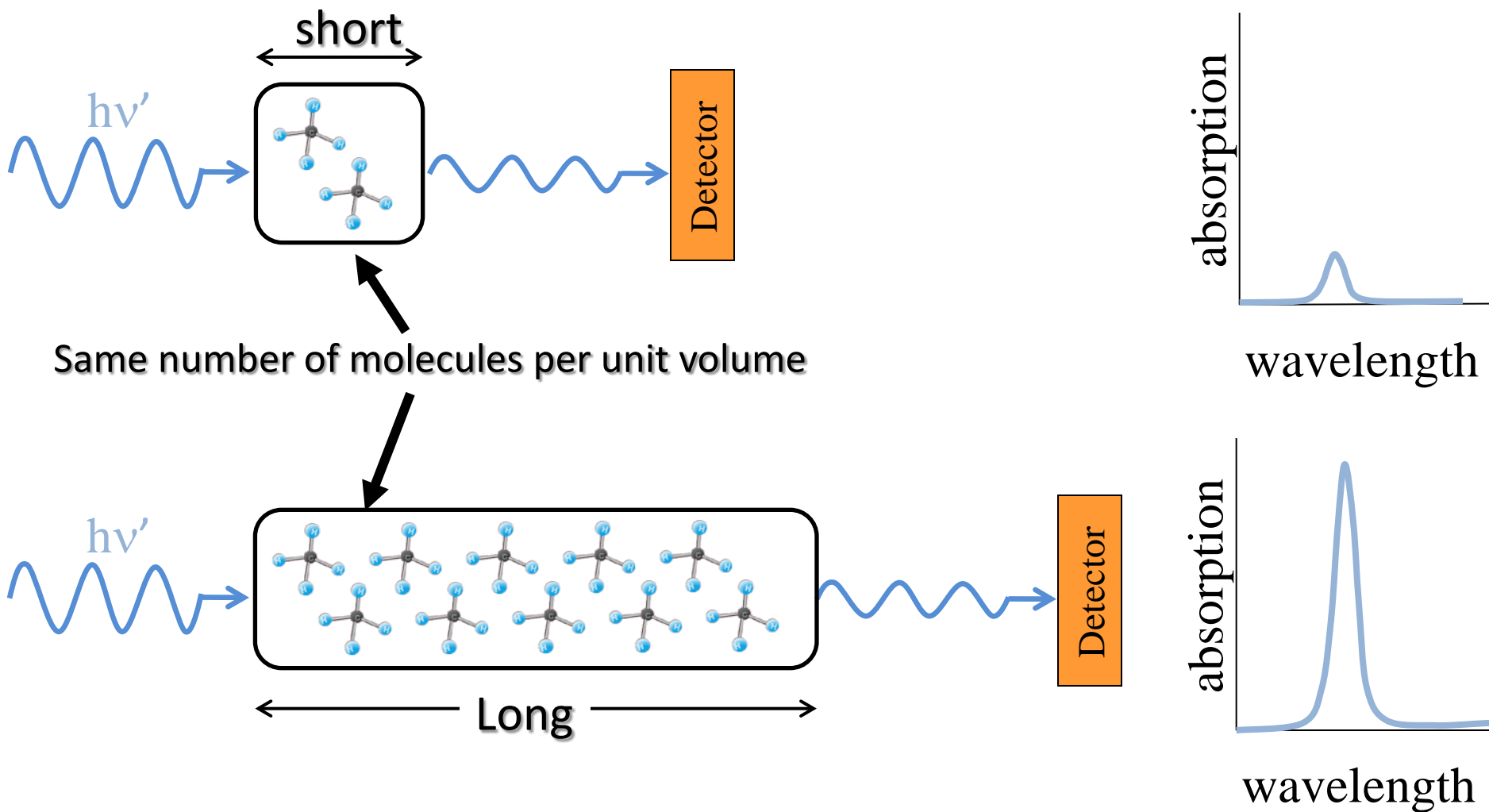
Each type of molecule absorb light only at its special frequencies.

Light is absorbed at special frequencies specific to each molecule.

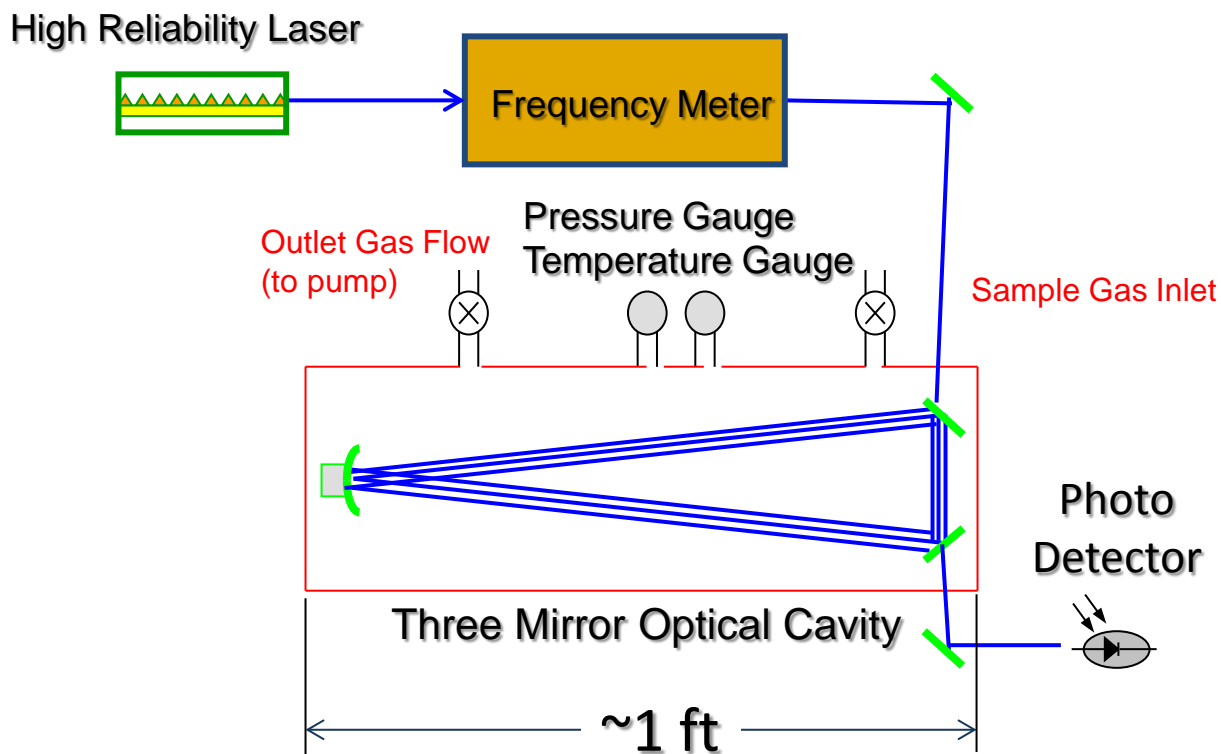


wavelength

At these special frequencies, the greater the distance the light travels through the sample the greater the total absorption.



CRDS's optical cavity transforms 45,000 ft (8.5 miles) into 22,500 round trips in a ~1 ft long sample cell.



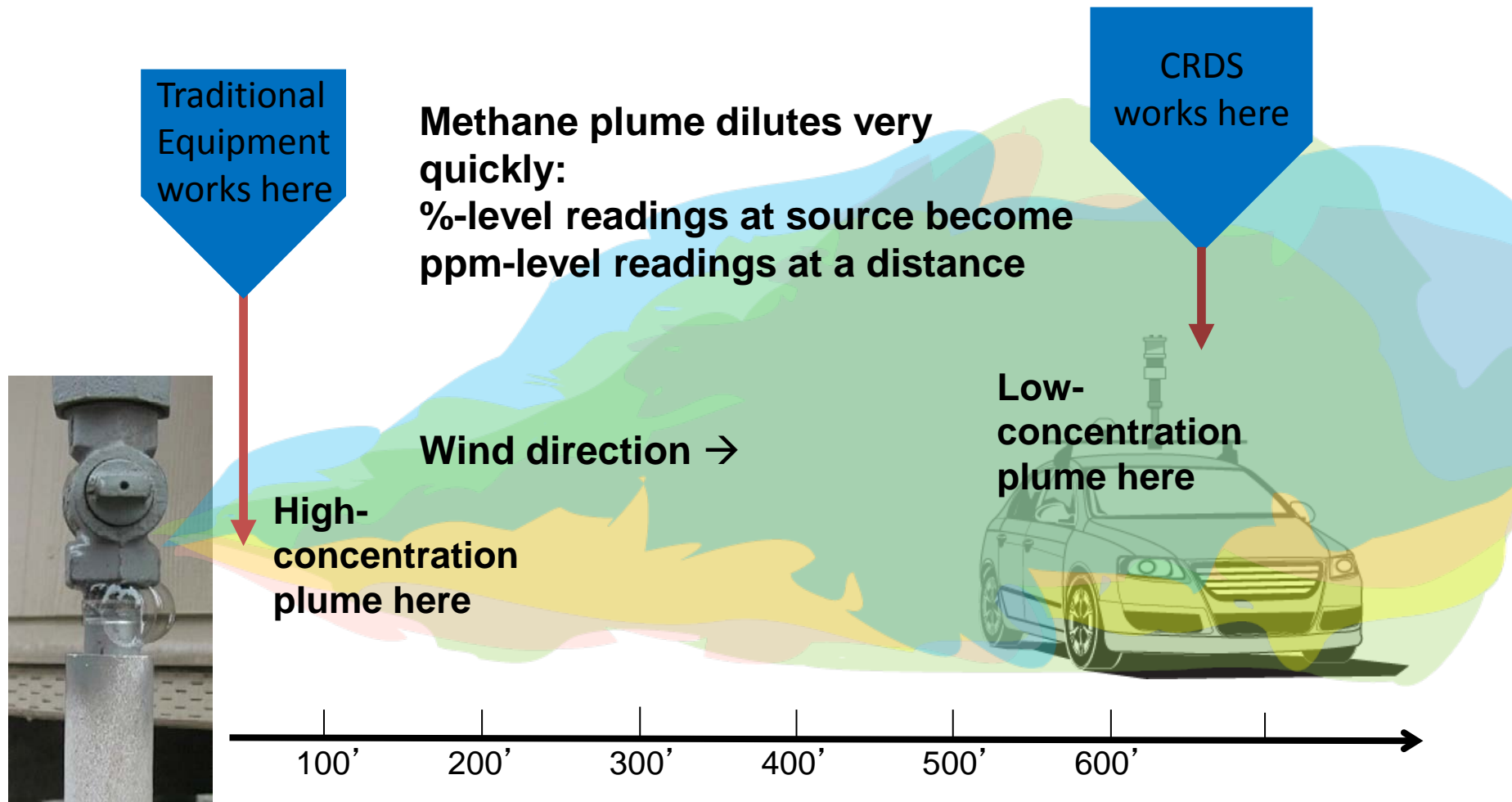
Resulting in parts-per-billion sensitivity

Control of these four factors make CRDS ideally suited to perform scientific and industrial measurements all over the world.

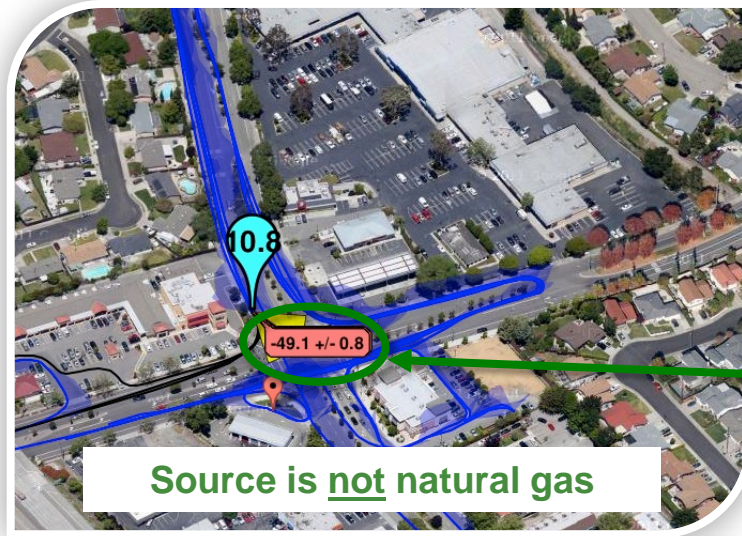
- Detecting low levels of trace gases
- Measuring small changes in the concentration of gases
- Ensuring measurement accuracy
- Ensuring long-term reliability of the measurement



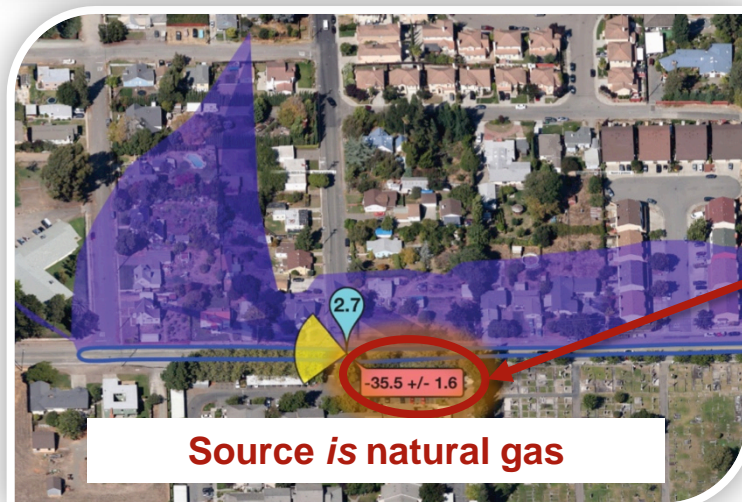
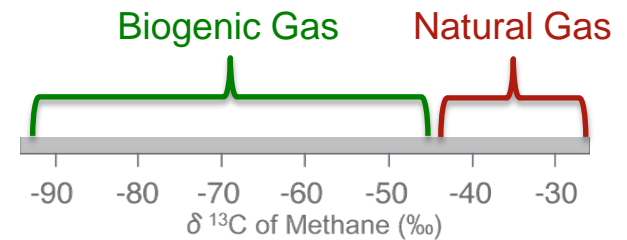
Cavity Ring Down Spectroscopy (CRDS) detects leaks much further from a source



CRDS enables Isotopic Analysis: Is Leak Source Natural Gas?

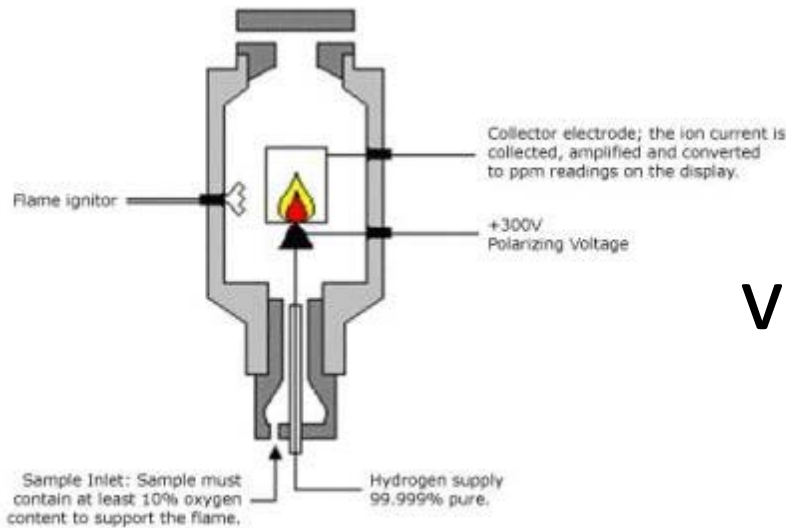


Range of stable carbon-13 isotope values in methane

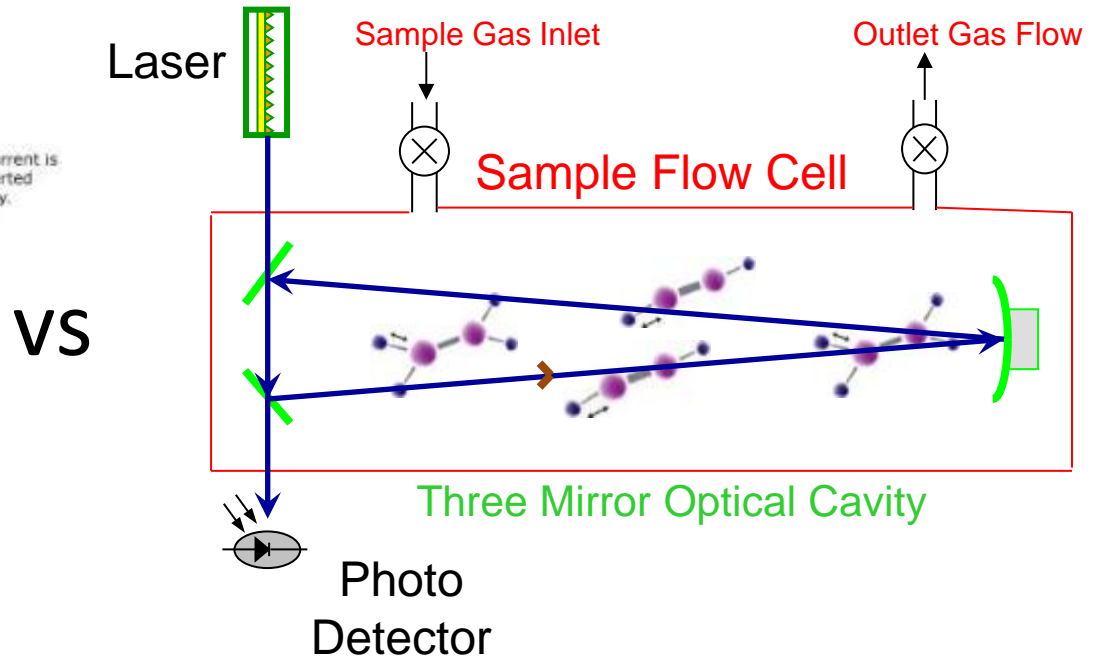


Comparison of CRDS and FID Technology

FID



CRDS



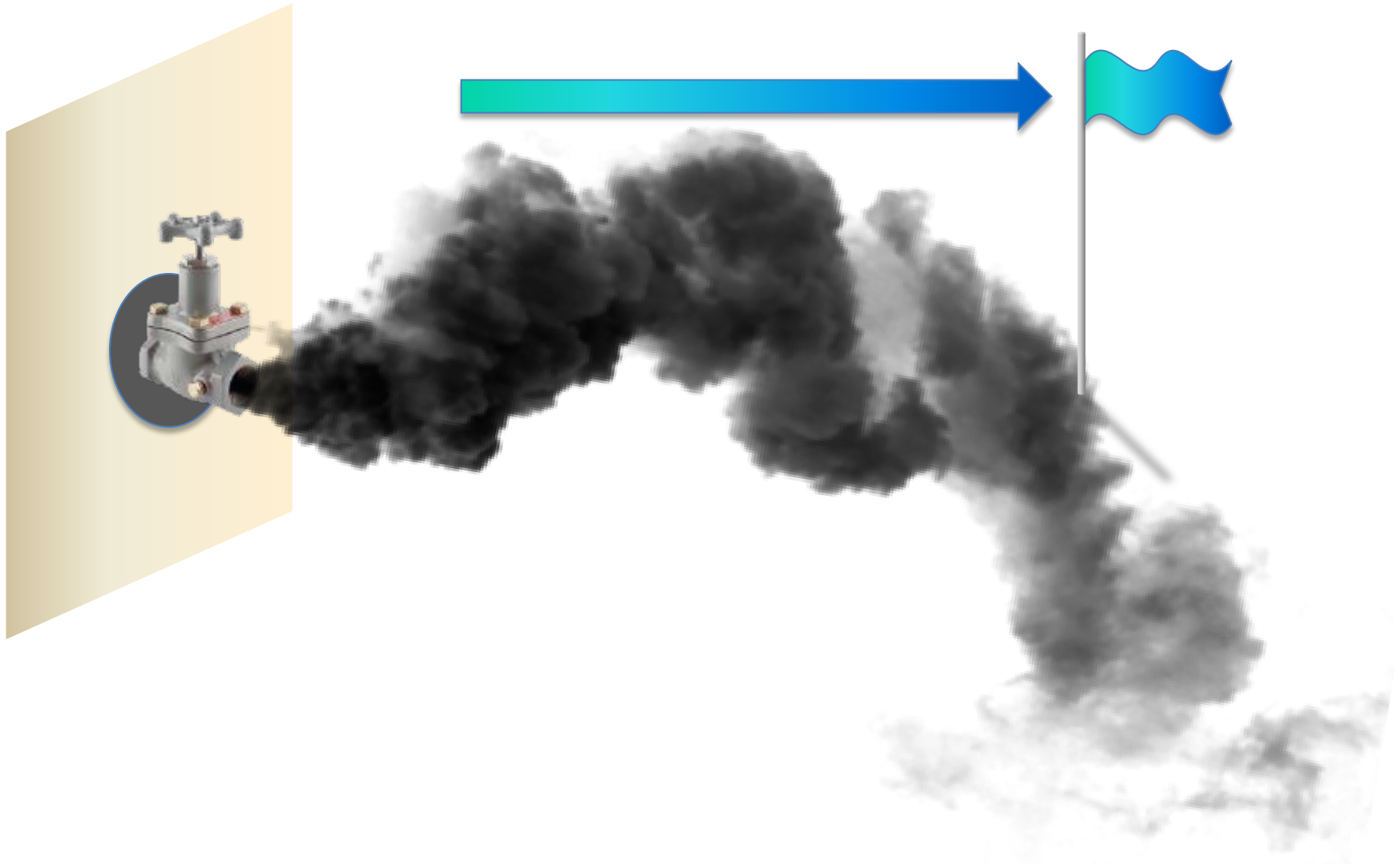
VS

- 1000 times more sensitive than FID.
- Far less drift (much greater confidence in measurement)
- Can distinguish between natural gas and other hydrocarbon sources
- No Flame or Gas Bottles (laser based technology).

Methane plumes from leaks behave like smoke plumes



Plumes dilute in air due to wind turbulence



Methane concentration in a plume gets smaller as you move away from the source

CenterPoint Energy Observations of CRDS

- Found more leaks in less time than current technologies
- Issues that warrant more consideration: low level emissions from appliance vents, manholes, roadwork, unlit gaslights, leaking grills, CNG vehicles
- Likes the wind
- Quickly focuses Survey Tech on the area of concern