

# Applications of Molecular Spectrum Detection on Environment Control

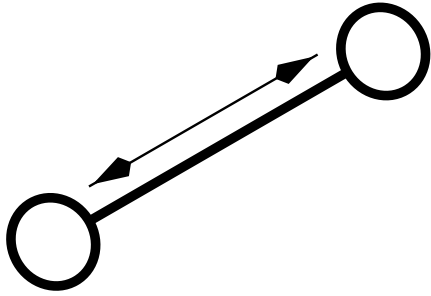
## Outline:

1. Motivation and History
2. Basic Theory
3. Detection Methods
4. Specific Application: Atmospheric Pollu-  
tants Detection
5. Summary

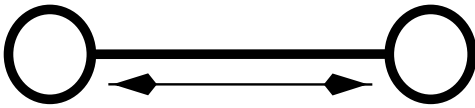
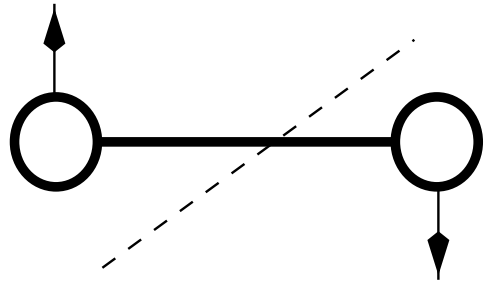
Motivation:

1. Astronomy and Astrophysics
2. Medical Science
3. *Environment Control*

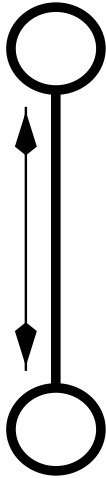
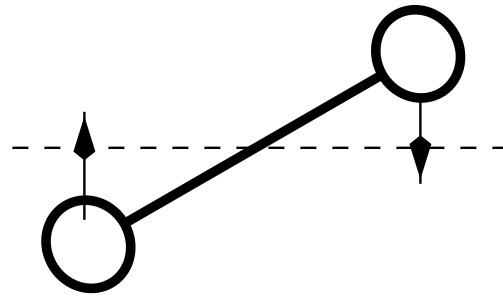
Basic Theory: Degrees of Freedom of a Diatomic Molecule.



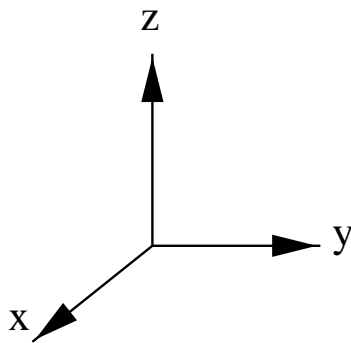
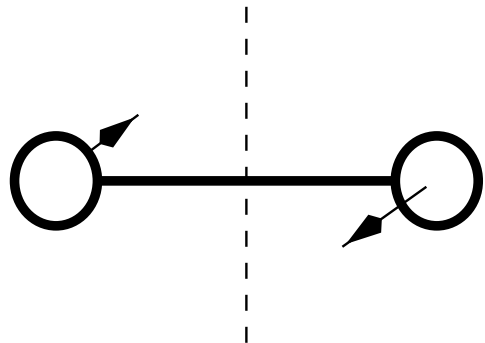
x



y



z



## Basic Theory 2:

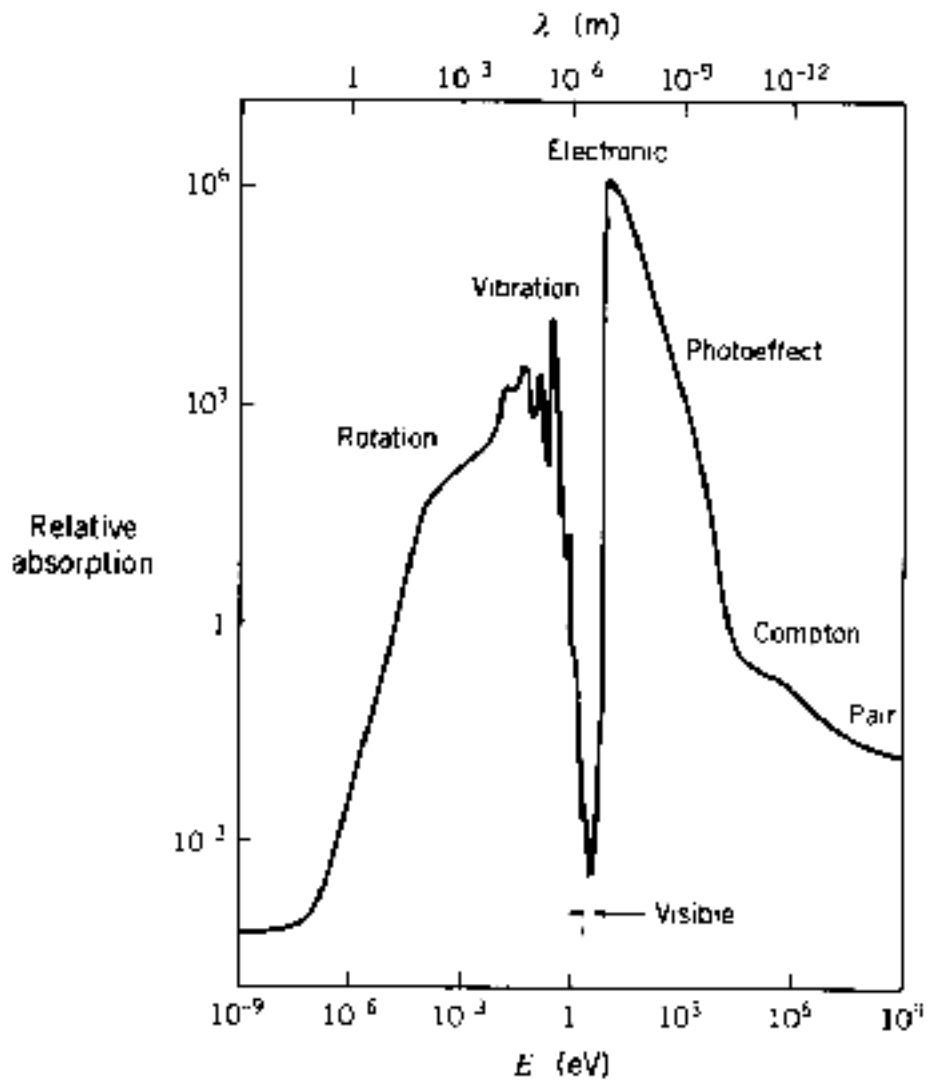
### Quantization of Energy.

- $E = h\nu$ .
- Solution of Schrödinger Equation.
- Electrons, Rotational and Vibration.

### Other Phenomena.

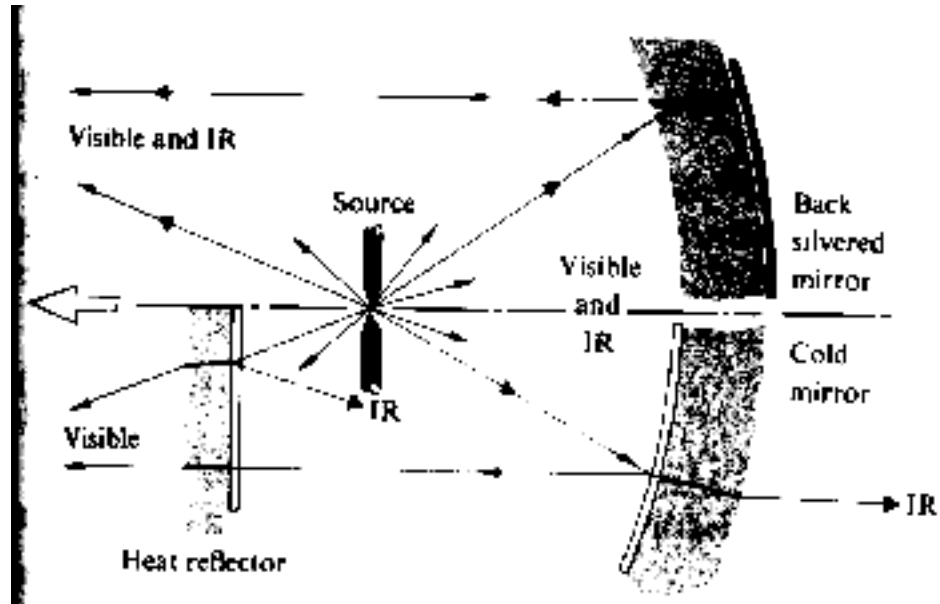
- Photoelectric Effect.
- Compton Scattering.

### Basic Theory 3: Example, H<sub>2</sub>O. (Reference 1)



## Detection Method: Filters

- Achieve by coating.
- An example: Filter out IR. (Reference 2)



Detection Method:

Dispersive Methods.

- Gratings, Prisms
- Fourier Transform
- Other types of Spectrometer



Detection Method:

Differential Methods-relying on absorption spectra.

- List of radiation sources:
  1. tunable lasers
  2. two or more fixed frequency lasers
  3. incoherent emission lines
  
- Example:
  - Tunable IR laser differential absorption spectroscopy (TILDAS)

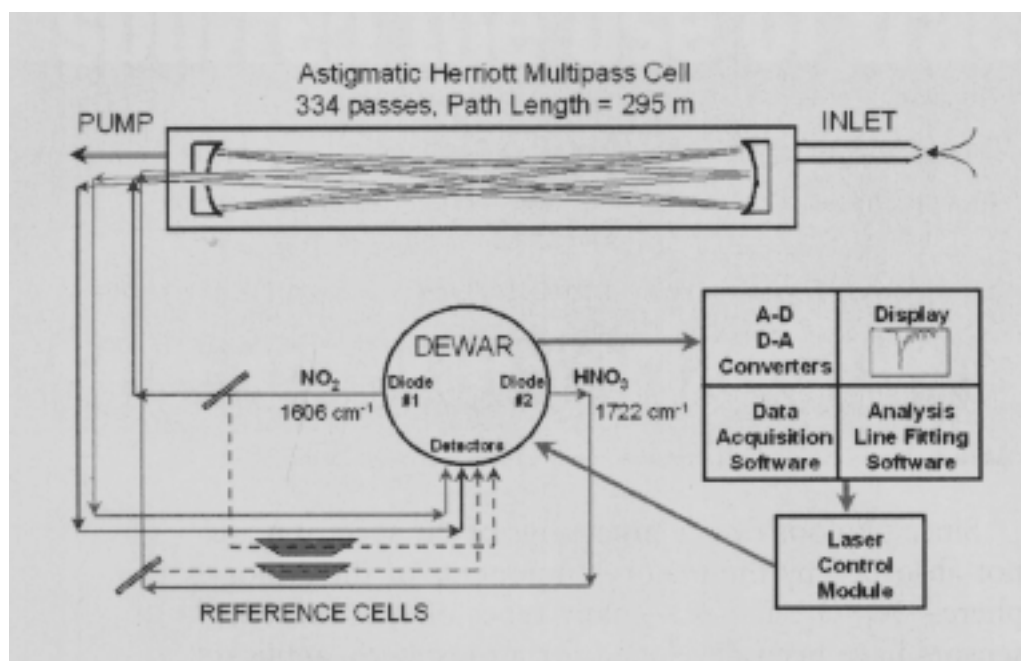
Specific Application:

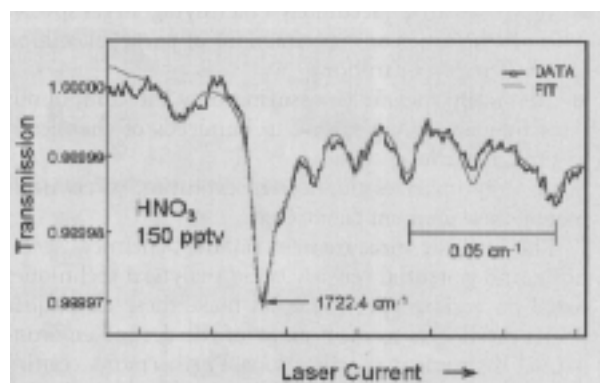
Atmospheric Pollutants Detection

- Advantages over traditional techniques:
  1. Real time
  2. Portable
  3. Chemically specific
  4. Sensitive (See Table)

Specific Application:

Example - TILDAS





**Figure 2.** TILDAS spectrum of gas phase nitric acid sampled from an urban atmosphere. The data is shown along with the calculated least squares fit to a synthetic spectrum computed from a compilation of molecular line parameters for 40 overlapping lines using the measured pressure, temperature, and path length of the absorption cell. This high signal-to-noise spectrum is the result of co-averaging for six hours to obtain an average nitric acid concentration in the atmosphere of 150 ppt by volume.

## Summary:

A lot of optoelectronics chemicals detection devices are based on the technique of spectrum identification. They can be used in many fields such as medicine and pollution control. And they are based on optical techniques such as optical filtering and spectroscopy, an example is TILDAS.