OASIS: an Optical Absorption Setup for Ice Spectroscopy

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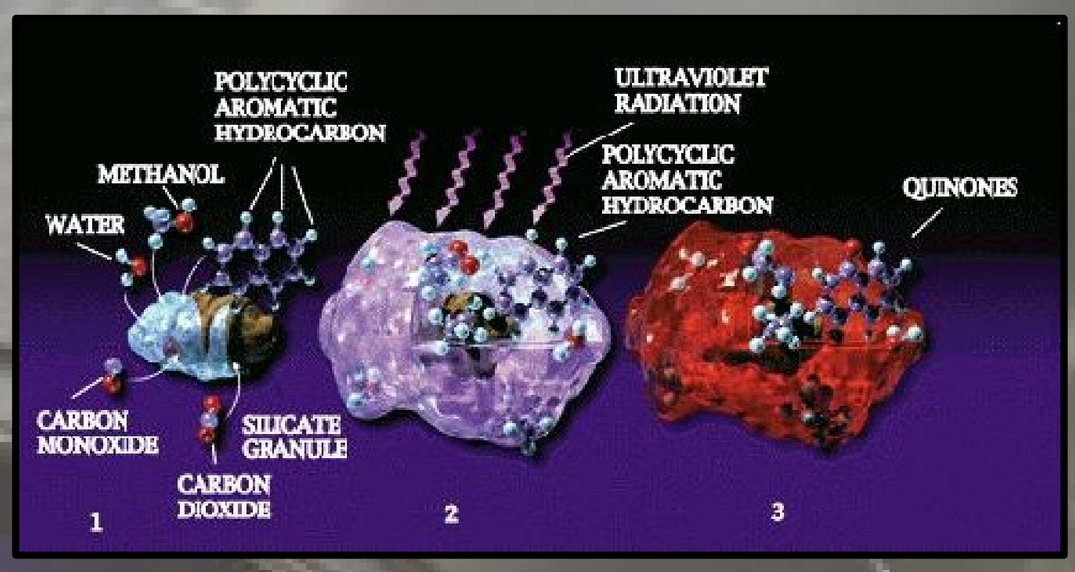
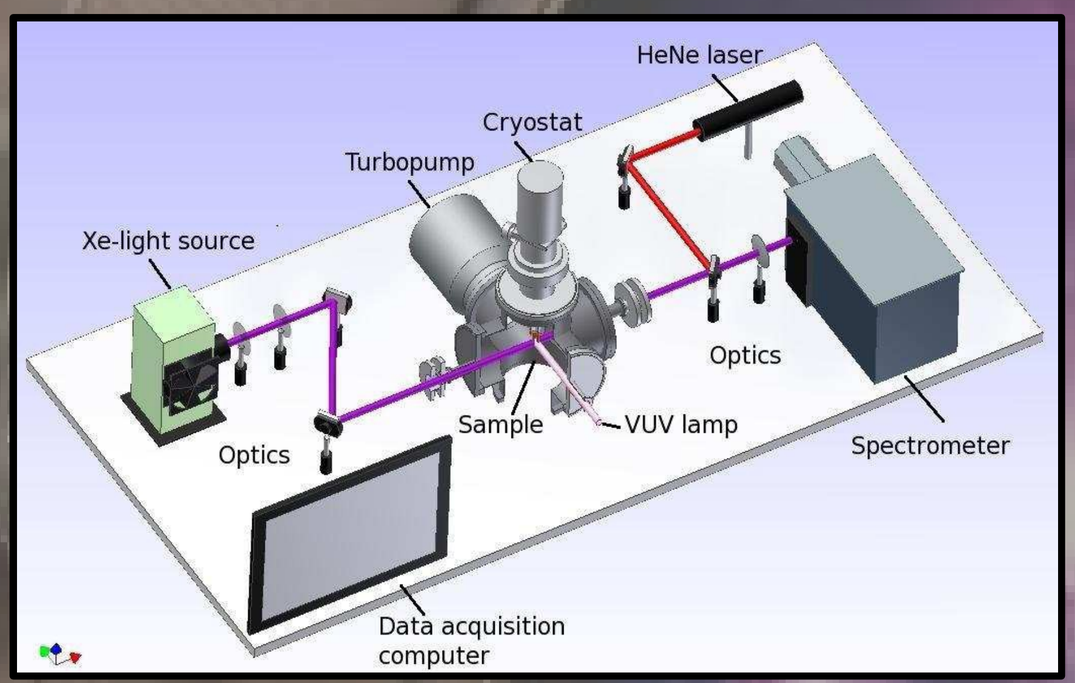
The scientific background

Roughly 15-20% of the cosmic carbon is stored in Polycyclic Aromatic Hydrocarbon (PAH) molecules. These molecules are observed through their infrared (IR) emission signatures

1. In star forming regions, molecules like H_2O, CO, CO_2 ... freeze out onto dust grains forming ice layers. PAH emission features are quenched indicating the PAH's are probably embedded in interstellar ices.
2. The interstellar grains are irradiated by UV light or cosmic rays. Such processes lead to a complex chemistry.
3. The processed PAHs are finally converted into different species

The experimental investigation will shine light on the origin and behaviour of complex molecules in the universe.





The experimental setup

The OASIS (Optical Absorption Setup for Ice Spectroscopy, see figure) setup can:

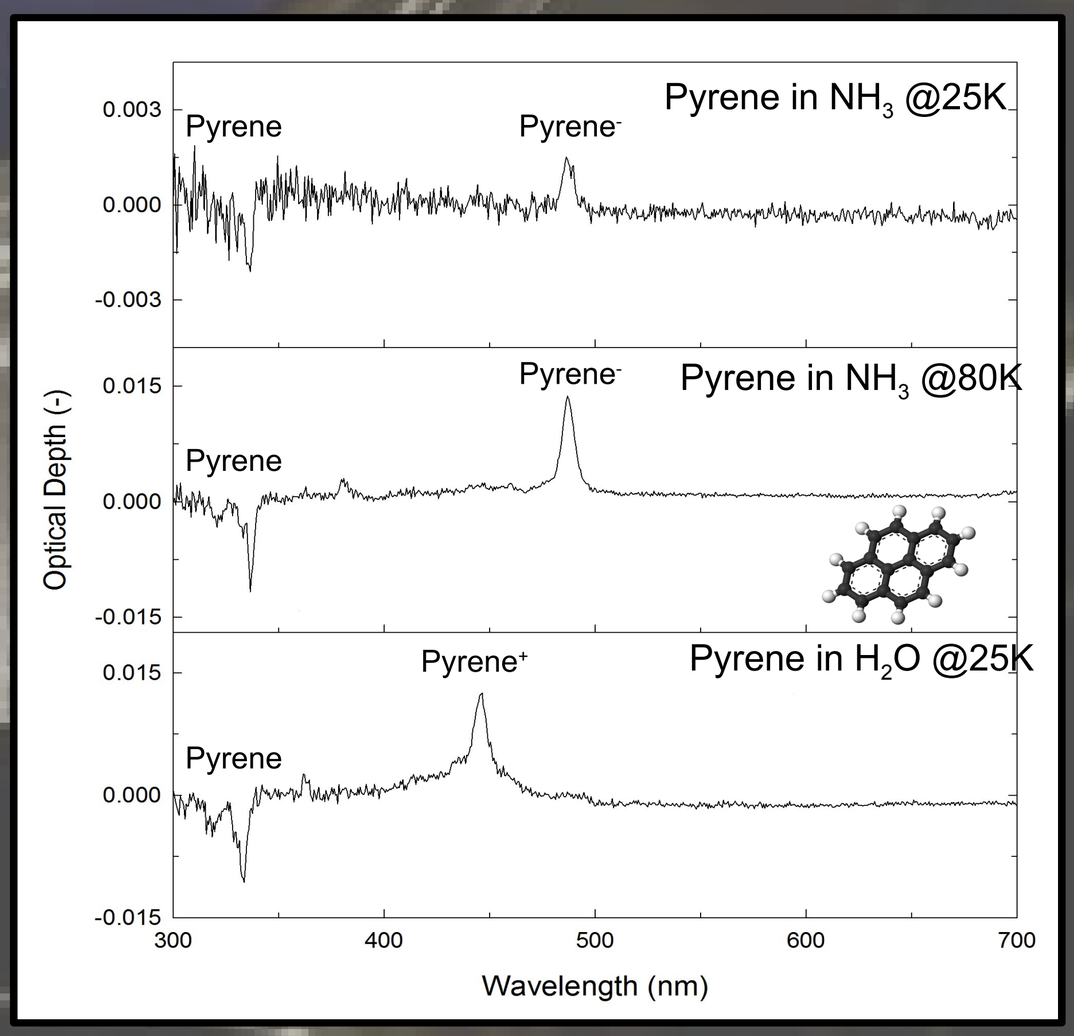
1. Simulate outer space analog conditions.
   - Low temperatures (10-150K)
   - High vacuum ($4*10^{-7}$mbar)
2. Create interstellar ice analogues.
   - Use a window as an interstellar dust grain analogue.
   - Measure the thickness of the ice.
   - Measure the amount of complex molecules inside the ice by means of visible-UV absorption spectroscopy.
3. Perform photolysis of the ice.
   - Simulate the interstellar Ly α UV field.
   - Investigate the chemistry in the ice by using visible-UV absroption spectroscopy.
4. Analyze the final reaction products.
   - Perform temperature programmed desorption (TPD) and use a quadrupole mass spectrometer (QMS) to analyze the desorbed species.

The Scientific results

Measurements on different PAH's (like Pyrene) reveal that the chemistry is matrix and temperature dependent.

- Matrix dependence
  - PAH in water ice matrix
    - Cation ($Pyrene^+$) formation, decline after time
    - Neutral is consumed
  - PAH in ammonia ice matrix
    - Anion ($Pyrene^-$) formation, very slow decline after time
    - Neutral is consumed
- Temperature dependence
  - Ion formation (cation and anion) is independent of temperature
  - Recombination is strongly dependent on temperature
  - Cation recombination increases with increasing temperature
  - Anion recombination decreases with increasing temperature

These experiment show that a very complex chemistry is happening in interstellar ices. OASIS is an excellent tool for the investigation of such processes. The next step is to move to species of astrobiological interest.



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