

**N87-15098**

## IDENTIFICATION OF POLYCYCLIC AROMATIC HYDROCARBONS

A. Léger and L. d'Hendecourt  
Groupe de Physique des Solides de l'Ecole Normale Supérieure  
Université Paris 7, Tour 23 - 2 place Jussieu  
75251 PARIS CEDEX 05 - FRANCE

**ABSTRACT.** The nature of the Very Small Grains evidenced by K. Sellgren (1985) is discussed. Their stability suggests that they are graphitic material and specifically Polycyclic Aromatic Hydrocarbons (PAHs). The expected IR emission of a typical PAH, coronene, gives an impressive spectroscopic agreement with the five observed "Unidentified IR Emission Features", leading to an unambiguous identification. Those PAHs are the most abundant organic molecules detected to this date ( $f \sim 10^{-5}$ ).

## 1. NATURE OF VERY SMALL GRAINS

## 1.1. Refractory grains... which are large molecules

Sellgren (1984, 1985) has shown strong evidence for quantum heating of Very Small Grains. To survive heating up to temperatures about 1000 K these particles must be refractory. Léger and Puget (1984) have shown that ices and silicates would be sublimated whereas graphitic grains could resist. Graphite is made of weakly bound planes. Therefore frequently heated graphitic clusters are likely planar. In addition, the presence of ambient H atoms and dangling bonds on peripheral C atoms (Duley and Williams, 1981) suggests that they are large Polycyclic Aromatic Hydrocarbon (PAH) molecules.

## 2. SPECTROSCOPIC IDENTIFICATION

Léger and Puget (1984) derived the expected IR emission spectrum of such free molecules using the laboratory measured absorption of a typical large PAH: coronene. They found an impressive agreement with the so-called "Unidentified IR Emission Features" at 3.28 - 6.2 - 7.7 - 8.6 - 11.3  $\mu\text{m}$  (Fig. 1), a similar agreement is obtained with other large peri-condensed PAHs. This proposition can also solve the puzzle of the *high efficiency of the conversion - incoming UV/outcoming IR* - because when the energy is absorbed by a free flyer molecule and degraded into vibrational energy it is entirely re-radiated in the IR.

From the point of view of the Analytic Chemistry the presence of some bands (3.28 - 6.2 and 11.3  $\mu\text{m}$ ) are highly characteristic of PAHs (Bellamy, 1966) and leaves little doubt on their identification in the numerous objects where the bands are observed.

### 3. THE MOST ABUNDANT ORGANIC MOLECULES DETECTED IN SPACE

The abundance of PAHs can be derived from the relative emitted fluxes in FIR (large grains) and near-mid IR (transient heating of PAHs). One finds that few percent of the cosmic C is needed in those PAHs molecules. This brings PAHs to the level of *very abundant detected cosmic molecules, the most abundant organic ones* (see Table).

These molecules have been unrecognized for a long time because they have no clear signature in the radiofrequency domain.

The presence of those PAHs may have many consequences: (1) if they are present in the Diffuse Interstellar Medium as well as in more irradiated regions where they have been detected, they can explain the strong unexpected 12  $\mu\text{m}$  emission of the IRAS Cirrus. Spectroscopy of these clouds should give us the answer; (2) they can play a role in the formation of  $\text{H}_2$  as their geometrical cross section is larger than that of ordinary grains; (3) they are attractive candidates for the Diffuse Interstellar Bands mystery in the Visible.

#### REFERENCES

- Bellamy L.J., 1966 : IR Spectra of Complex Molecules, Wiley.
- Duley W.W. and Williams D.A., 1981 : MNRAS 196, 269.
- Léger A.; Puget J.L., 1984 : Astr. & Astrophys. 137, L5.
- Sellgren K., 1984 : Ap. J. 277, 623.

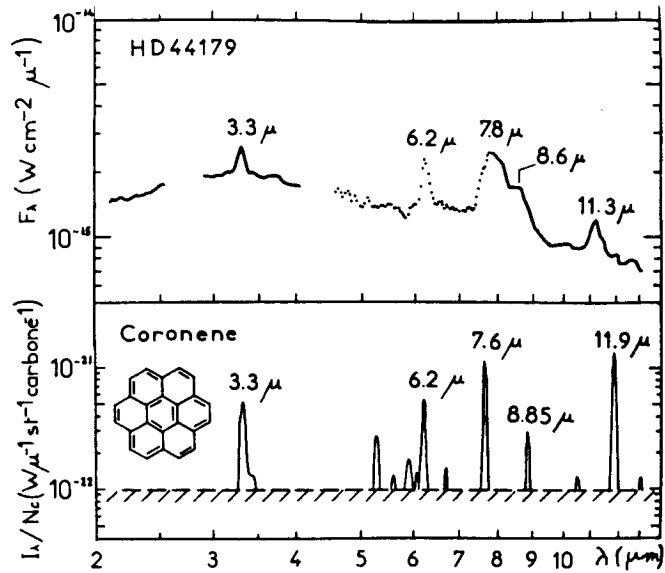


Figure 1 : Observed IR emission from HD 44179 (adapted from Russell et al. Ap. J. 220, 568) and expected emission from coronene heated at 600 K.

molecule	$f = \text{atoms}/n_{\text{H}}$
$\text{H}_2$	$\sim 1$
CO	$10^{-4}$
PAHs	$10^{-5}$
HCN	$\sim 10^{-7}$
$\text{H}_2\text{CO}\dots$	$\sim 10^{-7}$
$\text{HC}_{11}\text{N}$	$10^{-10}$