

The PAH Hypothesis: A Dream or a Nightmare for Astrophysicists?

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Since 1983, with the advent of the IRAS mission, the term "VSG" (for Very Small Grains) has been largely used in the astronomical community to name small particles of poorly known chemical composition that permeate the diffuse interstellar medium. Such small particles are believed to be heated by the absorption of single UV photons and relax in the IR by emitting photons in the 12, 25 and, at least partly, 60 μm IRAS emission bands.

Simultaneously, short wavelength mid infrared emission bands (UIB's), from 3 to 12 μm have been convincingly attributed to emission from large polycyclic aromatic species (PAH's), relaxing from a "hot" vibrational state following the absorption of one UV photon. Connection between these PAH's and the VSG's has been tentatively and qualitatively proposed but never firmly established. PAH's are believed to be quite abundant and "ubiquitous" in many astronomical sites, they have thus been proposed to be not only at the origin of the UIBs but also responsible for the notorious Diffuse Bands in the Visible as well as part of the broad 2200 \AA absorption bump in the interstellar extinction curve.

In the infrared, with the improvements from ground based observations and the success of the European Infrared Satellite Observatory (ISO) mission, largely devoted to spectroscopic studies of "solid state" astronomical features [1,2], many observations have tried to focus on the PAH hypothesis in order to provide stronger and definite (?) conclusions. The interpretation of these observations heavily rely on laboratory data from experiments often specifically designed for astronomical purpose. Indeed, for a physicist and a molecular spectroscopist, PAHs do represent an "ideal" molecular system, placed in a very specific environment, all of which can be, in principle, "completely" reproduced in the laboratory to provide a non ambiguous interpretation of the astronomical spectra. Yet, despite this huge effort, interstellar PAHs are characterized by an evident lack of positive identification, relating them to given molecular species.

In this paper, I will critically review the state of the art of the PAH hypothesis, its successes as well as the most controversial points. Observations will be confronted to experiments and theoretical work, including recent developments that may help to solve not only the PAH hypothesis but also its link to the VSG mystery.

References:

- [1] "First ISO Results" *Astron. Astrophys.* **315**, L27 - L400 (1996).
- [2] "Solid Interstellar Matter: the ISO Revolution," L. d'Hendecourt, C. Joblin, A. Jones, eds., Les Houches Workshop, No11, EDP Sciences, Springer (1999).