Spectroscopic diversity of the UIR bands as revealed by ISO. Towards a molecular carrier identification.

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The Infrared Space Observatory, ISO, has confirmed the ubiquity of the well-known "unidentified" infrared (UIR) emission bands between 3 and 13 μm over a wide range of physical conditions in the interstellar medium including very low UV field regions. A wealth of data has been obtained on the UIR bands not only at low spectral resolution (PHOT-S and CAM) but also at higher resolution using the SWS instrument. Careful study of the SWS data clearly shows that the UIR bands at 6.2, 7.7 and 8.6 μm are resolved in a coherent set of individual features. The positions and widths of these features are fully consistent with the carriers being polycyclic aromatic hydrocarbon-like molecules (PAHs) transiently heated by individual UV photons. The challenge is now clearly to identify these species. Although the "generic" spectrum observed in different regions presents the same main bands at 3.3, 6.2, 7.7, 8.6, 11.3 and 12.7 μm, a detailed analysis points to significant differences which are very likely related to changes in the exact composition of the interstellar PAH mixture. To interpret these differences, it is necessary to characterise the physical conditions (mainly the local UV field and density) which prevail in the observed objects. However, inhomogeneities in the composition of the initial mixture cannot be excluded. It is therefore important to study the spatial variations of the UIR bands within extended objects. This has been achieved with ISO-CAM. The data reveal strong variations of the relative intensities of the UIR bands. The results will be interpreted in the light of ground-based observations recently performed at the Canada-France-Hawaii telescope both in the UIR bands and in the gas (H, H_2). These observations focus on the environment of the young stellar object S106-IR and the reflection nebula NGC1333-SVS3. We will show how the coupled study of the emission of PAHs, H and H_2 can help to understand the physical and chemical evolution of these species in the interstellar medium. These results are clearly the motivation for new laboratory experiments and dedicated observations.