Searching For the Interstellar Signatures of Large Carbon Molecules and Ions from the Ultraviolet to the Near IR.

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Multiwavelength observations from space (HST, ISO, IRTS) indicate that interstellar molecules range from simple diatomic molecules and ions to very large molecules and clusters containing up to hundreds of atoms. This large molecular distribution which links the gas phase to solid phase of IS dust is dominated by carbon-containing materials among which polycyclic aromatic hydrocarbons (PAHs) are an important component. Although the study of atoms, small molecules and ions in space based on laboratory measurements is now well established, almost no information has been available on large molecular systems until recently. The importance of this issue and its impact on our understanding of the evolution of the ISM is one of the cited priorities in the NASA/UVGA Laboratory Astrophysics list of recommendations.

In response, we have developed, a laboratory program to: (i) simulate realistic IS environments and (ii) measure the spectroscopy of large, refractory, molecular systems. Since IR observations show that PAHs are widespread throughout the ISM, absorption spectra of neutral and ionized PAHs isolated in a cryogenic (5 K) neon matrix were measured together with the oscillator strengths of the bands. This laboratory program has resulted in a *unique* data base on the spectroscopy of neutral and ionized PAHs from the UV to the NIR spectral range (1800-10,000 Å). The data base consists of the electronic spectra of about 30 species containing up to 25 carbon atoms and includes regular PAHs in their neutral and cationic forms as well as hydrogenated PAHs and PAHs with side groups. The experimental results will be compared with theoretical calculations and astronomical observations and important astrophysical implications discussed. These include possible diffuse interstellar band carriers, UV absorptions, molecular budget of the diffuse ISM, UV-to-IR energy conversion in the ISM, etc.... The UV, visible and NIR IS spectral features which should be searched for using space platforms and in existing archival data will be discussed. It will be argued that the next phase in the study of carbon- containing materials should also include parallel studies of the gas phase spectroscopy of isolated molecules and ions. This next step is technically very challenging. We propose to measure the UV-to-NIR vibronic spectra of neutral and ionized PAHs and derivatives (fullerenes) using supersonic jet techniques and to build a data base (wavelengths and oscillator strengths) of the characteristic UV and visible bands of these molecules and their ions. This data base will be used to predict structures that can be searched for with the HST (new diffuse UV and visible bands) and to test for the presence of specific PAHs or derivatives in the ISM and derive their IS abundances. Providing such data is fundamental and represents an experimental challenge which needs to be addressed.

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