# Laboratory Studies of Cosmic Dust: From Molecules to Grains

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Carbonaceous materials are an important component of cosmic dust. Polycyclic Aromatic Hydrocarbons (PAHs) are a ubiquitous component of the carbonaceous cosmic materials. PAHs are the best-known candidates to account for the infrared emission bands. They are also thought to be among the carriers of the diffuse interstellar bands (DIBs) that are seen in absorption in the near ultraviolet to the near infrared range. PAH ionization states reflect the ionization balance of the medium while PAH size, composition, and structure reflect the energetic and chemical history of the medium. A major challenge is to reproduce in the laboratory the physical conditions that exist in the emission and absorption interstellar zones.

The harsh physical conditions of the interstellar medium (ISM) -low temperature, collisionless, strong UV radiation fields- are simulated in the laboratory by associating a free jet expansion with an ionizing discharge to generate a cold plasma expansion. PAH ions and radicals are formed from the neutral precursors in an isolated environment at low temperature and probed with high-sensitivity cavity ringdown spectroscopy in the NUV-NIR range. Carbon nanoparticles are also formed during the short residence time of the precursors in the plasma and are characterized with Reflectron time-of-flight mass spectrometry. These experiments provide unique information on the spectra of large carbonaceous molecules and ions in the gas phase that can now be directly compared to interstellar and circumstellar observations (DIBs, extinction curve). These findings also hold great potential for understanding the formation process of interstellar carbonaceous grains from their molecular precursors. We will review recent progress made in the experimental and theoretical studies of PAHs, compare the laboratory data with astronomical observations and discuss the implications for cosmic dust.