

Laboratory Studies of the Stabilities of Heterocyclic Aromatic Molecules and Suggested Gas Phase Ion-Molecule Routes to their Production in Interstellar Gas Clouds, ISC

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February 3, 2006

Abstract

Over the years, several small ring compounds have been detected in ISC, including the aromatic, benzene. Polycyclic aromatic hydrocarbons, PAHs, have been implicated as carriers of diffuse interstellar bands, DIBs, and unidentified infrared (UIR) bands. Heterocyclic aromatic rings of intermediate size containing nitrogen, possibly PreLife molecules, were included in early searches (1973-81) but were not detected and a recent search for Pyrimidine was unsuccessful, although there have been tentative detections of the less biochemically important 2H-azirine and Aziridine. Also, the recent disputed detection of the simple amino-acid, glycine, has emphasised the difficulty of such searches. Our laboratory investigations of routes to such molecules could establish their existence in ISC and suggest conditions under which their concentrations would be maximized in ISC thus aiding the searches. The stability of such compounds (Pyridine, C_5H_5N ; Pyrimidine, $C_4H_4N_2$; Piperidine, $C_5H_{11}N$ and also Dioxane, $C_4H_8O_2$) has been tested in the laboratory using charge transfer excitation in ion-molecule reactions. Some of these reactions, notably those with N^+ and N_2^+ , may also be important in the Titan atmosphere. The stabilities of the compounds are also being tested in less energetic proton transfer reactions some of which are directly relevant to ISC. The fragmentation paths, including production of $C_4H_4^+$, $C_3H_3N^+$ and HCN, suggest reverse routes to the parent molecules, which are presently under investigation as production sources.

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