Laboratory Studies of PAH Cations of Interest for Studies of the Diffuse Interstellar Medium

Theodore P. Snow, Valery LePage, and Veronica Bierbaum
University of Colorado

We describe laboratory studies of the chemical properties of small PAH cations which have been suggested as possible carriers of the unidentified diffuse interstellar bands. Our measurements, carried out through the use of a tandem-flowing afterglow-selected ion flow tube (FA-SIFT), show that PAH cations and dehydrogenated PAH cations will quickly migrate to their protonated forms in the diffuse ISM, through the addition of atomic or molecular hydrogen. To date we have made these measurements for ionized benzene ($C_6H_6{}^+$), napthalene ($C_{10}H_8{}^+$), and pyrene ($C_{16}H_{10}{}^+$), as well as their dehydrogenated forms, with similar results in each case. The reaction rates with hydrogen are greater than those for other neutral collision partners (including small molecules); this, combined with the overwhelming abundance superiority of hydrogen, means that protonation is the dominant chemical process. Physical processes such as electron attachment and dehydrogenation via UV absorption may be competitive, so full models are needed in order to determine the ultimate fate of small PAH cations in the diffuse ISM. For now we can say that small PAH cations are probably not good candidates as diffuse band carriers, but large PAHs, large PAH ions, and various forms of radical PAH fragments are not ruled out. In addition to summarizing results already obtained, we describe plans for future laboratory work on this problem.

Acknowledgments:

This work has been supported by NASA grants NAG5-4184 and NAG5-6758 to the University of Colorado.