MOLECULAR SPECTROSCOPY: THE KEY TO UNDERSTANDING THE INTERSTELLAR MEDIUM

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Ever since Newton first dispersed sunlight with a prism and coined the term *spectrum*, the field of spectroscopy has been intimately coupled with astrophysics. The first astronomical molecular spectra were obtained nearly 70 years ago, but it is only in the past few decades that molecular astronomy (and "astrochemistry") has come to the forefront. There are now roughly 150 known interstellar molecules, and molecular spectroscopy has become the key to understanding the physical conditions, chemical nature, and evolutionary status of interstellar clouds and star-forming regions.

Our group at Illinois is working to further our understanding of the interstellar medium through an interdisciplinary program of astronomical observations and laboratory spectroscopy. I will present an overview of our group's work on the simplest polyatomic molecule (H_3^+), which is the cornerstone of interstellar chemistry and a powerful probe of interstellar conditions. Our astronomical spectroscopy of H_3^+ has revealed a surprisingly large ionization rate in diffuse clouds, as well as a puzzling non-thermal ortho:para-H_3^+ ratio. In the laboratory, we have utilized infrared spectroscopy to enable detailed studies of the electron recombination of H_3^+ and the reaction $H_3^+ + H_2 \rightarrow H_2 + H_3^+$, which is the most common bimolecular reaction in the universe. I will also discuss our group's development of a fast ion beam spectrometer that will be capable of high-sensitivity and high-precision spectroscopy of a wide range of astrophysically important molecular ions, and our efforts to extend the tools of high resolution spectroscopy to the large, highly symmetric, and astrophysically interesting molecule C_{60}.