USING HIGH-RESOLUTION NEAR INFRARED SPECTROSCOPY TO PROBE THE INTERSTELLAR MEDIUM AND CIRCUMSTELLAR DISKS

Abstract

By

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High-resolution infrared spectroscopy is a unique tool for probing both the structural and chemical evolution of the interstellar medium and circumstellar disks. We will highlight several examples of how this tool can shed light on chemical processes in the interstellar medium, the formation of planetesimals in circumstellar disks, and the time available for planet formation. In particular, we use high-resolution near infrared spectroscopy to address the following issues:

1) Does H_3^+ originate in dense molecular clouds?
Since the discovery of H_3^+ in the ISM, it has been observed through numerous lines of sight including dense and diffuse clouds. There is some controversy surrounding the interpretation of H_3^+ observations toward dense clouds. Some argue that most of the observed H_3^+ originates in diffuse material surrounding dense clouds rather than in the dense clouds. With this controversy in mind, we present observations of H_3^+ toward LkHα101 and discuss the feasibility of the ion originating in dense material.

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2) Is there any evidence of gas/dust stratification in circumstellar disks?
Gas and dust mixing in the extended disk around a young star is one of the most debated and untested results of theoretical modeling in recent years. Theoretical models of dust/gas mixing in the disk are at odds but the predictions set the stage for observations to guide our ideas of planet formation. The vertical distribution of dust and gas in disks is assessed by simultaneous comparison of infrared CO *absorption* lines with infrared extinction. We demonstrate that the most straightforward interpretation of the existing data confirms the stratification of dust and gas in circumstellar disks.

3) How long does gas survive in the inner circumstellar disks?
We present near infrared high-resolution spectra of CO from the circumstellar protoplanetary region around young stars. The spectra are compared to the spectral energy distribution for each star. The CO observations are used to determine the mass, density and temperature of the gas around the star and the spectral energy distribution is used to gauge the evolutionary status of the dust disk. Implications for the evolution of the disk and subsequent planet formation are discussed.