Observations of H_2 Rotational Lines from Young Stars with Disks

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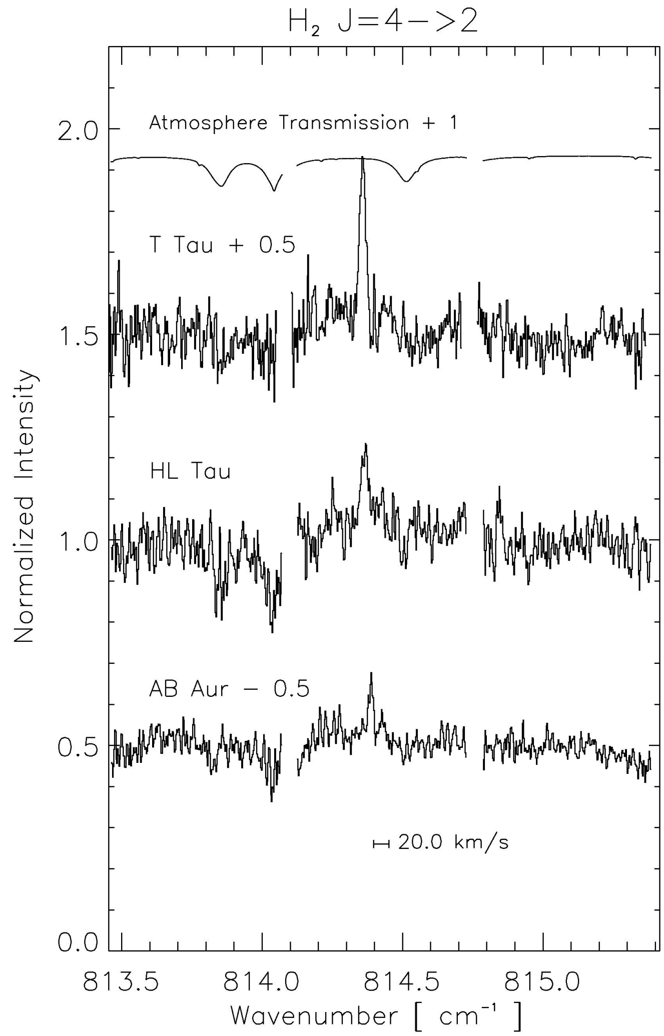
The currently accepted view for formation of stars and their planets involves a gas cloud collapsing under gravity. Because the original cloud material was rotating, not all the gas could fall directly to the star; some of the gas ended up in a disk surrounding the young star. **Recent observations on the IRTF using the Texas Echelon-Cross-Echelle Spectrograph (TEXES) may pave the way for studying the gas in the interesting distance range where planets might form around young stars.**

The most common molecule in circumstellar disks is molecular hydrogen (H_2). The temperatures in the disk where most of the molecular hydrogen exits are so low that the hydrogen molecules will mostly emit radiation at wavelengths in the mid-infrared (5 to 30 μm).

TEXES is a mid-IR (5 – 25 μm) spectrograph designed and built by a group under the direction of Prof. John Lacy at UT Austin and available to all astronomers for use at the IRTF. It can separate wavelengths of light to 1 part in 100,000 corresponding to velocities as small as 3 km/s. TEXES provides a unique combination of spectral resolution and sensitivity for mid-infrared observations.

In the accompanying figure, we show TEXES spectra of molecular hydrogen emission from three stars with circumstellar disks: AB Aur, HL Tau, and T Tau. Most of the light at these wavelengths, near 12 μm, comes from warm dust near the star and not from the star itself. For clarity, the intensity levels of the dust emission from each star has been normalized to 1.0, and offset by different (constant) amounts. The top curve shows the Earth's atmospheric transmission (offset by a constant value of +1), showing that the molecular hydrogen emission, seen as a peak in each spectrum centered near 814.4 cm^{-1} (wavenumbers), is well separated from telluric absorption features. The emission lines are all broad enough that we will be able to extract some velocity information. These data were acquired during our December 2002 observing run (one month ago at the time of this writing), and so these finding are still considered preliminary.



In total, 9 sources were observed in at least one of the three molecular hydrogen lines available from the ground. For five sources, we observed all three wavelength settings. From these data, we will estimate gas temperatures and the total mass of warm gas. If this emission truly comes from the circumstellar disk, we may be able to use the line profiles to study the temperature and mass as a function of radius and thus begin to uncover the initial conditions for planet formation.