

Circumstellar Disks Around Young Stars

A. E. Glassgold*

February 3, 2006

Abstract

Disks represent a crucial stage in the formation of stars and planets. They are novel astrophysical systems, intermediate between the interstellar medium and stars. Their physical properties are very inhomogeneous and are affected by hard stellar radiation and by dynamical evolution, including instabilities. Observing disk structure is difficult because of their small sizes, ranging from 0.05 AU at the inner edge to 100-1000 AU at large radial distances. Nonetheless, substantial progress has been made by observing the radiation emitted by the dust from near infrared to mm wavelengths, the so-called spectral energy distribution of an unresolved disk. Many fewer results are available for the gas, which is the main mass component of disks over much of their lifetime. The inner disk gas of young stellar objects have been studied using the near infrared rovibrational transitions of CO and a few other molecules, while the outer regions have been explored with the mm and sub-mm lines of CO and other molecules. Further progress can be expected in understanding the physical properties of disks from observations with sub-mm arrays like SMA and ALMA, mid infrared measurements with SPITZER, and near infrared spectroscopy with large ground-based telescopes. Intense efforts have also been made to model such observations using complex thermal-chemical models. After a brief review of the existing observations and some preliminary modeling results, some of the weaknesses of the models will be discussed, including the absence of good laboratory and theoretical calculations of essential microscopic processes.

*UC Berkeley