

Infrared Study of Young Stellar Objects with Methanol Maser Emission:  
A Search for Circumstellar Disks  
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The association between interstellar masers and the formation of massive stars has been known for several decades. These masers are naturally occurring molecular lasers that only exist under certain conditions and in very confined regions (i.e. maser spots) near newly forming stars. Therefore, they serve as powerful probes of small-scale structure, dynamics and physical conditions of these environments. The associated infant stars are known as "young stellar objects" (YSOs), and it is their energy which is responsible for exciting these masers which emit strongly at radio wavelengths. While increases in radio resolution have pinpointed the location of the individual maser spots, details about their relationship to the star-formation process remain unclear. In recent years, methanol (CH<sub>3</sub>OH) masers have joined the extensively observed H<sub>2</sub>O and OH masers as immensely valuable tools for studying these regions near YSOs. Methanol masers, though frequently correlated with OH masers, are suspected to originate within disks of material surrounding these young stars. Radio results obtained by Norris et al. (1993, ApJ, 412, 222) of more than a dozen methanol maser groups (each group of maser spots being associated with a single star) indicate a very strong preference for individual methanol maser spots to be located along lines or arcs. Norris suggests several hypotheses for the alignment and concludes the most likely explanation is that the maser spots are located in a circumstellar disk that is viewed nearly edge-on.

While these masers emit strongly in at radio wavelengths, these YSOs cannot be viewed at visible wavelengths because they are still heavily embedded in their birth clouds, and therefore are totally obscured at the visible wavelengths. Indeed, interpretation of maser data obtained over the last twenty years has been limited by our inability to locate the central stellar source. On the other hand, observations in the infrared would allow one to peer into these clouds and identify the young star associated with the maser. The most complete survey of these regions at infrared wavelengths was performed by the Infrared Astronomical Satellite (IRAS) in the mid 1980s. Unfortunately, the small-scale spatial complexity of the YSO environment made interpretation of data from this survey difficult due to the satellite's relatively low resolution. However, using large ground-based telescopes with mid-infrared detectors will yield both the required resolution and the ability to penetrate the significant obscuration in these regions. This as yet unexplored application of the new generation of mid-infrared array technology will allow identification of the stellar source associated with the maser phenomena, and yield an interpretation of the morphologies seen at other wavelengths (e.g. radio).