HIGH RESOLUTION STUDIES OF STAR-FORMING MOLECULAR CLOUDS

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Observations of star formation sites in a number of molecular clouds, including NGC 7538, NGC 2071, Cepheus A and K3-50A, have been made using the Owens Valley millimeter wave interferometer. The measurements of ^{12}CO, ^{13}CO, CS and continuum emission are at resolutions of order 7". Continuum emission at 2.7 mm is detected from all the cloud cores and, in general, the ^{12}CO interferometer maps reveal the presence of high velocity, bipolar outflows within 10" of these continuum sources. Thus, the origins of the outflows are readily identifiable; the flows themselves appear to remain collimated on scales of less than 10^{17} cm. The orientations of the flows are similar to those seen at lower resolution, except in Cepheus A, where the interferometer is capable of distinguishing between two outflows which are confused in single telescope maps.

The structure of the lower velocity, ambient gas, visible in the ^{13}CO and CS interferometer maps is quite different. Usually, the ^{13}CO emission region is elongated, centered on the continuum source at the origin of high-velocity outflow, and appears likely to play a role in collimating the bipolar CO emission. In NGC 7538, in particular, the disk-like structure is oriented perpendicular to the direction of outflow and shows evidence of rotation.

In a number of clouds, the 2.7 mm continuum flux far exceeds that expected on the basis of 2-cm continuum measurements, suggesting that this emission arises from high density stellar wind H II regions, which are optically thick at centimeter wavelengths.

ZINNECKER: We have carried out infrared speckel observations of young stars in the southern hemisphere similar to those by Beckwith *et al.* (1985) in the northern hemisphere. The observations were obtained at the ESO 3.6-m telescope in Chile in collaboration with C. Perrier and A. Chelli, and are presented in the poster session. The objects studied were the Elias (1978) sources No. 29, 21, 14, 9 in the Rho Ophiuchi Cloud. In 3 out of the 4 cases we find solar system sized dust halos or disks not unlike the case of HL Tau studied by Beckwith and his colleagues to which you referred in your talk.

HARRIS: Do you have any feeling for whether this result is likely to be representative of T-Tauri stars in general, or is it singular to HL Tau which is a rather unusual T-Tauri source?

SARGENT: So far we have confined own observations to only a few sources for which speckle interferometry indicates the presence of a disk of

dust. We did not find gas associated with DG Tau. However, gas has been found around LkHα 234 and T-Tauri itself I see no reason why further surveys should not reveal more such sources.

THOMPSON: Since HL Tau shows strong Brγ, Brα and Balmer emission lines, how did you determine that the radio continuum was not optically thick or thin free-free emission?

SARGENT: Using the value of the Brα flux derived by Persson *et al.* we calculated the expected flux at 2.7 mm, assuming the continuum emission to arise from free-free radiation from dust. The value derived, 30 m Jy, is quite incompatible with our measured value of 100 m Jy.

STROM: Could you provide a limit on the gas to dust ratio in the HL Tau disk?

SARGENT: The gas mass we deduce is only a lower limit. If the emission is optically thick, or if the source is much smaller than our beam, the mass will be higher and, as a result, close to the mass calculated from the observed continuum flux using Hildegrand's (1984) methods and assumptions. It would be premature to make any predictions about the gas to dust ratio in the disk on the basis of the measurements so far.

POLARIZATION OBSERVATIONS IN THE NEAR INFRARED AS A PROBE OF BIPOLAR FLOW REGIONS

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It is shown that near infrared polarization is to be expected in star-forming regions and new observations with the UK Infrared Telescope (UKIRT) are reported which include the discovery of a molecular hydrogen reflection nebula in Orion and an extensive dust cloud around S106.

Star-forming regions are dusty/gaseous environments with embedded sources which are heavily obscured at optical wavelengths. At longer wavelengths, however, the scattering optical depth $\tau_{sca}(\lambda)$ decreases and for $\tau_{sca} < 1$ then dust particles with a substantial albedo (ω) are efficient polarizers.

Provided line-of-sight integration of scattered light is minimal then reflection nebulae exhibiting large polarization should occur in the near infrared. Of course, one would like to use the observed polarization as a diagnostic of the dust but it is interesting to invert the problem and check the initial conditions. By expressing the scattering optical depth (τ_{sca}) in terms of the grain scattering efficiency (Q_{sca}) and the column density of molecular hydrogen N_{H_2} we have

$$\tau_{sca}(\lambda) = 3/4 \left(\frac{Q_{sca}(\lambda)}{a}\right) \frac{Xm_{H_2} N_{H_2}}{\rho}$$