We present results of a search for centimeter wavelength dust emission from the five embedded young stellar objects: NGC 1333 IRAS 4A, IRAS 4B, IRAS 05338-0624, IRAS 05375-0721, and S86FBS1, and the three T Tauri stars: RY Tau, GG Tau, and DL Tau. Continuum observations were obtained with the NRAO Very Large Array at wavelengths of 1.3, 2.0, and 3.6 cm.

Emission was detected from all five of the embedded objects. In three of these, this emission is identified as arising from ionized gas, probably associated with stellar winds. In the remaining two cases, NGC 1333 IRAS 4A and 4B, dust emission is suspected to be responsible for between 20 and 100 percent of the $\lambda=1.3$ cm flux.

Emission was detected from only one of the T Tauri stars, RY Tau. It is presently unclear if this emission arises from ionized gas or dust. Using standard circumstellar disk models for the dust emission associated with T Tauri stars, the upper limits to the centimeter wavelength fluxes for DL Tau and GG Tau can be used to constrain the properties of the circumstellar dust. Assuming a power law form for the dust emissivity ($\propto \lambda^{-\beta}$), the upper limits require that $\beta$, as measured from millimeter to centimeter wavelengths, is greater than 0.8 for DL Tau and greater than 1.6 for GG Tau. These values of $\beta$ are considerably larger than values measured at sub-millimeter wavelengths in the same sources ($\beta \sim 0$). If the dust emissivity is described as a two power law corresponding to two different values of $\beta$, as is suggested for dust in the interstellar medium, the GG Tau data indicate the value of $\beta$ changes around $\lambda=2$ mm. This change occurs at an order of magnitude greater wavelength than that proposed for interstellar dust and may reflect the growth of grain size in the circumstellar environment.

39.06

The Radio Source Around γ Carinae

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The first high–spatial–resolution (1") radio image of the source surrounding the famous massive southern star γ Carinae has been obtained with the Australia Telescope. The image shows a number of interesting features: a strong central peak; ridges of emission close to the peak and extending away from it in the directions of putative "jets" seen in the HST image of the region, and also other ridges in the directions of the lobes of the Homunculus; a box–like extended feature of dimension 7" × 5", with its major axis orthogonal to the major axis of the Homunculus; and two fainter lobes extending to 5" from the star in the direction of both lobes of the Homunculus. The radio image bears a strong resemblance to the high–resolution infra-red images of the region around the star. No radio emission associated with the more extended X–ray–emitting nebula is detected. The current rate of mass loss from the star is estimated, and physical conditions within the nebula are discussed.

39.07

Star Formation in the Outer Galaxy

Alexander L. Rudolph (NASA Ames Research Center), Eugene J. de Geus (University of Maryland)

We have made high–resolution (∼ 5") interferometric observations with the BIMA array and the VLA of star–forming regions in the outer Galaxy, in order to study molecular cloud properties and the star formation process in a physical and chemical environment different from the Solar neighborhood. These clouds are close enough to allow us to resolve structures as small as individual 0.25 pc star–forming cores.

Eleven sources have been mapped at 6, 3.6, and 2 cm with the VLA in order to probe the ionized gas in the regions. Of these 11 sources, three have also been imaged with the BIMA array in CO (J=1-0) and CS (J=2-1) emission, to probe the molecular gas content of the clouds, and to determine their structure. The BIMA array observations have been combined with single–dish maps of the sources, in order to recover the total flux from the clouds.

Using the radio fluxes and sizes observed, we have calculated various H II region parameters, such as emission measure, excitation parameter, electron density, and $N_{H}$, the number of Lyman–alpha photons implied by the total emission. From $N_{H}$, we have determined the spectral type of a zero–age main sequence star capable of producing such a flux of ionizing photons. In addition, we have compared the far–infrared and 6 cm luminosities of the sources to try to determine the high–mass stellar content of the clouds.

From the BIMA array CO maps, we have determined the clump mass spectrum for two of the three clouds and find that the slope of the spectrum is flatter (-1.0) than that found locally (-1.5). This result is somewhat surprising, since Garmany et al. (1982, ApJ, 263, 777) found that the slope of the massive star IMF is steeper in the outer Galaxy (-2.1) than in the inner Galaxy (-1.3). Thus, our results challenge the naive assumption that the mass of a star is directly proportional to the mass of the clump from which it formed, and suggest that fragmentation of clumps plays an important role in the star formation process.

39.08

Molecular Gas in Luminous Infrared Galaxies

P.M. Bryant, N.Z. Scoville (Caltech)

Using the Owens Valley millimeter array, we have observed several ultraluminous infrared galaxies in CO(1–0) at resolutions as small as 3". We have also observed and detected one galaxy, NGC 3690, in HCN(1–0). The galaxies in our sample all have infrared luminosities in excess of $10^{12} L_{\odot}$. These observations are part of an ongoing project to determine the amount and distribution of the large masses ($10^{10}$–$10^{11} M_{\odot}$) of molecular gas that exist in ultraluminous galaxies.

Previous interferometric CO observations have revealed that the molecular gas of ultraluminous galaxies is largely confined to within a couple kiloparsecs or less of the nucleus, so that at a resolution of 6", less than or equal to the resolution of almost all previous observations, the molecular gas is unresolved or poorly–resolved. The observations reported here significantly increase the sample of ultraluminous galaxies that have been observed in CO at a resolution of 3".

Interferometric HCN observations of ultraluminous galaxies have been very rare as of this date. Our HCN detection of NGC 3690, along with a previous Owens Valley CO map from Sargent and Scoville (1991), allows a detailed comparison of the HCN and CO emission in this relatively nearby system (42 Mpc), allowing a comparison of the amount and distribution of molecular gas in dense, potential star–forming cores (n(H$_2$) $\sim$ 10$^3$ cm$^{-3}$) versus more diffuse molecular clouds (n(H$_2$) $\sim$ 10$^2$–10$^3$ cm$^{-3}$).

39.09

Atmospheric Seeing at Infrared Wavelengths

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Data taken with the Infrared Spatial Interferometer (ISI) at Mt. Wilson have been analyzed to characterize atmospheric pathlength fluctuations, in preparation for astrometric work. In this paper we will discuss two features observed in recent astrometric phase time series data: 1) The presence of non–random fluctuations, and 2) the correlation of pathlength variations near the ground with those along the path to the stars.

The data analysis indicates that fluctuations in pathlength through the entire atmosphere at 11 μm as well as fluctuations near the ground show substantial deviations from the Kolmogorov–Taylor model with the commonly assumed large (≥ 1 km) outer scale. Under excellent seeing conditions, the ISI astrometric phase structure functions are consistent with an outer scale in the range of 5 – 20 m. Generally the results indicate that large-aperture telescopes and long baseline interferometers, particularly at IR wavelengths, will likely perform better than is expected on the basis of the Kolmogorov–Taylor model.

Under certain conditions, spikes are observed in the phase time series which are consistent with brief excursions of the index of refraction of air toward smaller values. The presence of such spikes could partially account for discrepancies in slopes between structure functions and power spectra of phase fluctuations as observed with the ISI.

A high correlation (r=0.6) between the atmospheric fluctuations within the telescope optics and those along the path to the star has been observed for some...