Session 20: Very Young Stars

Oral Session, 2:00–3:30 pm, Salon V

2001

Discovery of New 2μm Sources in ρ Ophiuchi

M. Barsony, J.E. Carlstrom (U.C. Berkeley), M. Burton (NASA/Ames Research Center), A. Russell (JAC), and R. Garden (U.C. Irvine)

A 12′ × 12′ region in the ρ Ophi cloud core, corresponding to an area of 0.56 × 0.56 pc², has been surveyed with a 2 μm array camera mounted on KPNO’s 2.1 m telescope. The survey limiting magnitude was m K ≈ 14.2. We detected 61 sources, of which 35, with 12 < m K < 14, are new.

Our data show no turnover in the 2 μm luminosity function in ρ Ophi, in contrast with earlier claims (Rieke, Ashok, and Boyle 1989). This result shows the importance of completely surveying large areas to a uniform limiting magnitude for future studies of the luminosity function of embedded, young star clusters.

There is a hint of a gap in source counts in the 11 < m K < 12 bin. This gap corresponds to bolometric luminosities of 10 L⊙ < L < 30 L⊙ for Class I sources (those with steeply rising spectra from 1–25 μm: see Wilking, Lada, and Young 1989). This gap may correspond to the predicted “luminosity jump” in the pre-main-sequence evolution of intermediate mass stars (Stahler 1989).

20.02 (Disertation)

A Near-infrared Search for Brown Dwarfs in the Pleiades

D. A. Simons, E. E. Becklin (UH-IffA)

We present preliminary results of a large scale near-infrared search for low mass stars and "free-floating" brown dwarfs in the Pleiades. Observations were conducted at Mauna Kea in the form of deep mosaic imaging of fields in the cluster at wavelengths of 0.9 μm and 2.2 μm. Since low mass stars typically peak in their emission at ~2 μm, our program was particularly sensitive to such objects. Fields were also imaged outside of the cluster to generate a control data set, which allowed us to check the overall significance of our results.

Photometry of all detected point sources in the Pleiades fields yielded a number of objects that lie along the theoretical lower main sequence of the cluster, which have masses as low as ~0.08 M⊙. By measuring the cluster Luminosity Function, and using already existing models of the mass-luminosity relation for low mass stars and brown dwarfs, we expect to be able to set constraints on the Pleiades IMF for objects near the lower mass limit of star formation.

20.03 Interferometric Observations of Cold IRAS Sources at 2.7 mm

B. A. Wilking (Univ. of MO-St. Louis), L. G. Mundy (Univ. of MD), and J. H. Blackwell (Univ. of MO-St. Louis)

In a recent survey of cold IRAS sources associated with star-forming clouds, 05338-0624 (in L1641-N) and 21391+5802 (in IC1396) were found to be unresolved sources of cold dust emission (Wilking et al. 1989, Ap. J., 345, 257). Both objects are associated with heavily obscured YSOs of relatively low mass (M < 4M⊙) and lie at the center of bipolar molecular outflows. Observations of the 2.7 mm continuum and CO(1-0) emission from these objects with 7 arcsec resolution have been made with the Owens Valley Radio Observatory Millimeter-Wave Interferometer. The continuum emission from both sources is unresolved, however, there are several compact structures observed in CO. The structure and dynamics of the circumstellar gas revealed by these observations will be discussed. Comparisons will be made to the distribution of high velocity molecular gas as determined by 28 arcsec resolution observations of 12C O(2-1) emission.

20.04 Luminosity Jumps in Pre-Main-Sequence Stars

S. W. Stahler (MIT)

I show that young stars of intermediate mass (about 2 to 5 M⊙) undergo a rapid increase in luminosity in the course of their pre-main-sequence contraction. This “luminosity jump” is the visible manifestation of an internal relaxation process, in which the stars evolve away from the interior conditions inherited from their prior accretion phase. The relaxing stars undergo “nonhomologous contraction,” in which their deep interiors contract and transfer heat to the expanding exterior regions. The contraction process spreads through the star, accompanied by a thermal pulse that eventually erupts at the surface. In the B-R diagram, the stars appear below the vertical, convective portion of their classical evolutionary tracks and relax to a position on the horizontal, radiative portion. A crude calculation of this effect in a 3 M⊙ star shows the luminosity increasing from 15 L⊙ to 490 L⊙, while the effective temperature increases from 5,000 K to 12,000 K. Most of the luminosity increase occurs over a period of several hundred years; accurate determination of the period will require a more detailed calculation.

20.05 Hydrodynamic Simulations of Bipolar Flow Ejection from Accretion Disk Boundary Layers

M.V. Torbert (U. Kentucky)

Numerical hydrodynamical calculations of the ejection of bipolar flows from stars accreting from a disk are reported. Assuming disk matter is arrested in a strong shock in a boundary layer between the accretion flow and