Spitzer/IRAC Observations of the Ophiuchus molecular cloud

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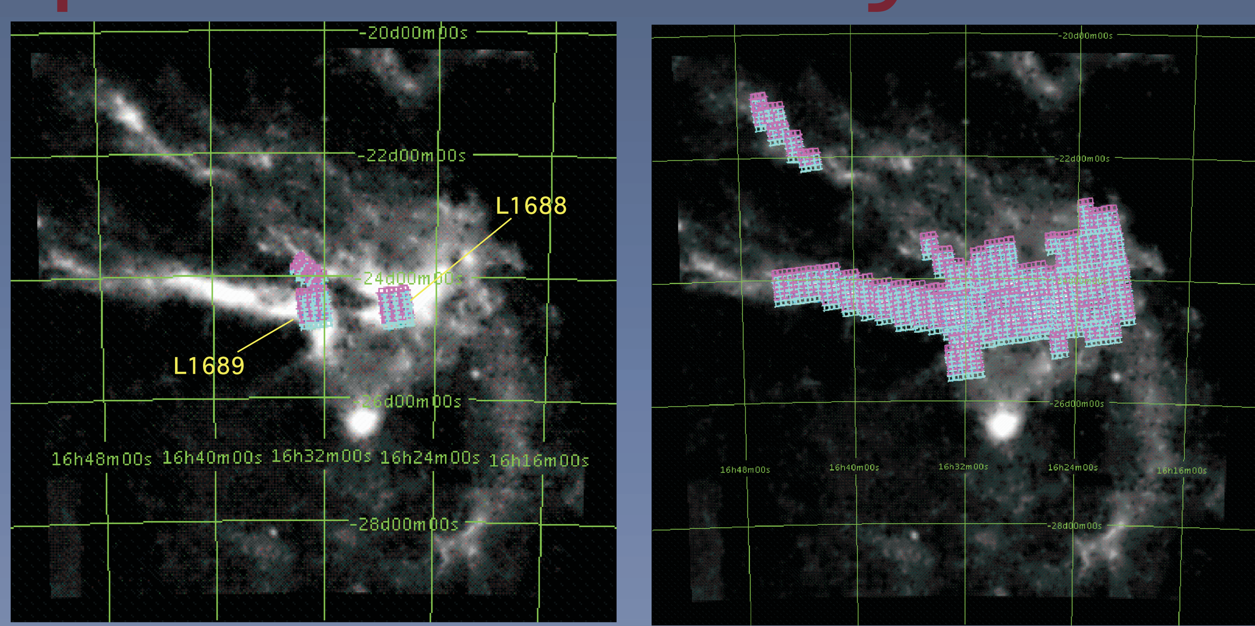
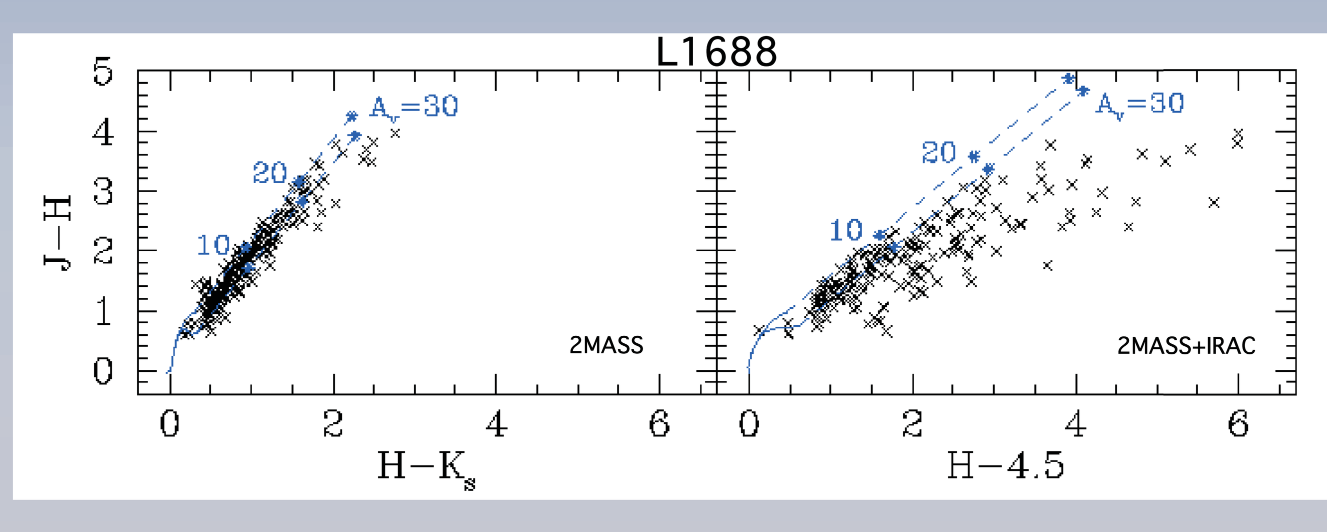
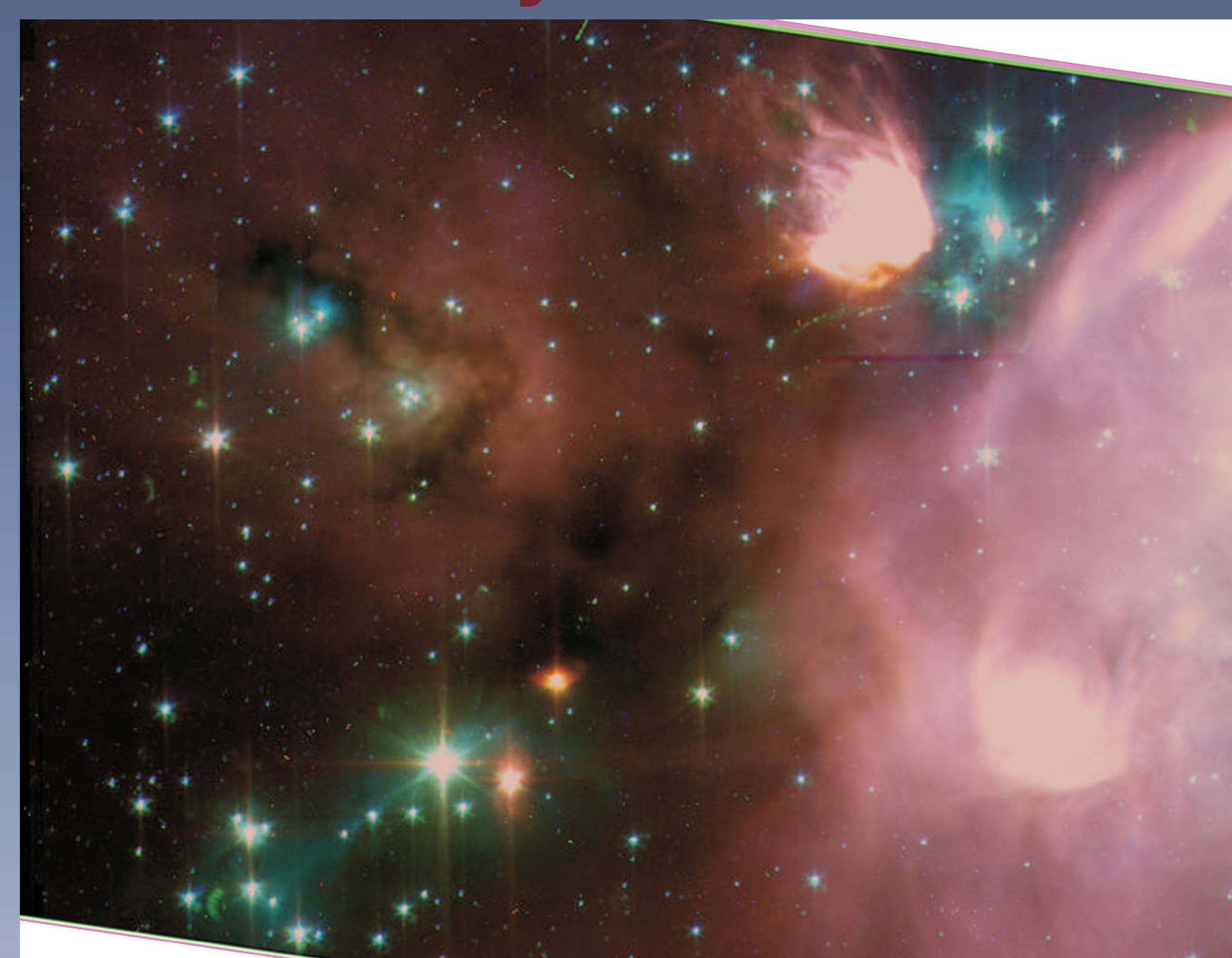
Ophiuchus Surveys

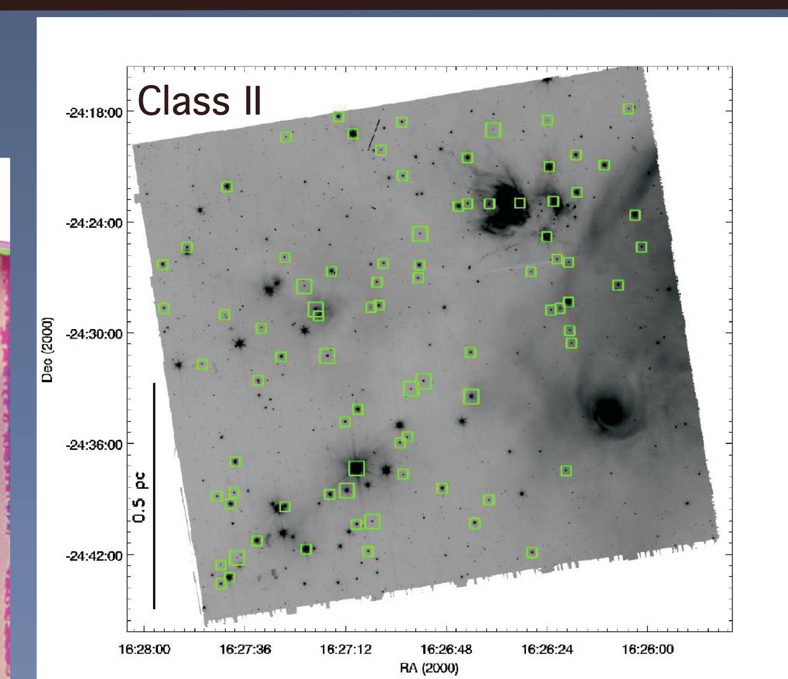


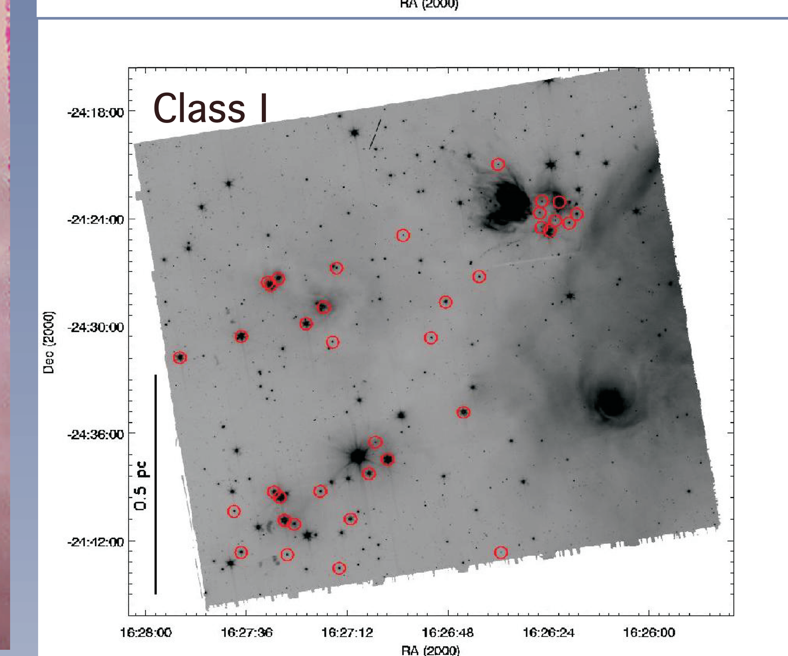
Imaging surveys with both IRAC and MIPS have already been conducted. Above left, the IRAC fields included in the IRAC Guaranteed Time Observations program (Allen et al. 2004b), and above right, the IRAC fields of the c2d Legacy program (Evans et al. 2003). The GTO fields are approximately 30x30' in area, and cover the cores of L1688 and L1689, as well as part of L1709, the "streamer" to the NE of L1688. The c2d survey area is ~8 sq. deg.



Lynds 1688

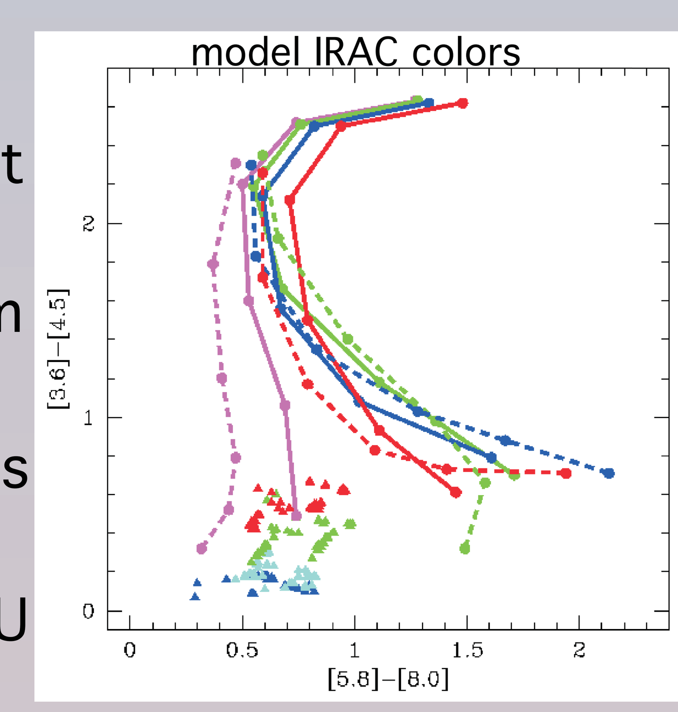


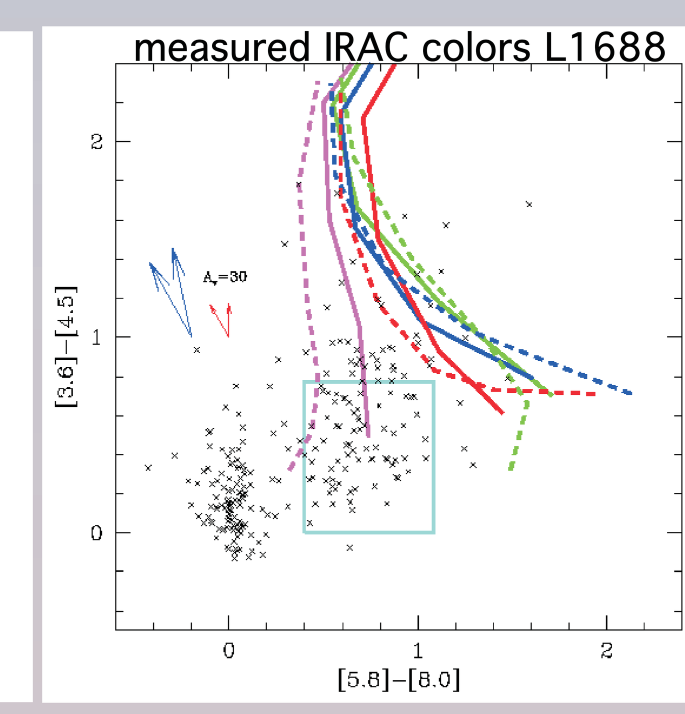




Above left: IRAC color composite of Lynds1688, using all four bands. The dense cores are conspicuous by their lack of diffuse emission. Using the IRAC colors, we classified sources as Class I (star+disk+envelope) and Class II (star+disk). Above right: spatial distributions of Class I and II sources are shown on the 4.5 micron mosaic: Class II sources as □, reddened Class II as □, Class I as ○. Left: J-H, H-Ks and J-H, H-[4.5] diagrams for the sources we were able to match with 2MASS. Those objects below and to the right of the lower reddening vectors have circumstellar disks. Note how many more disks are detected using the IRAC data. Extinction vectors from Rieke & Lebofsky (JHK) and Indebetouw et al. (JH[4.5]).

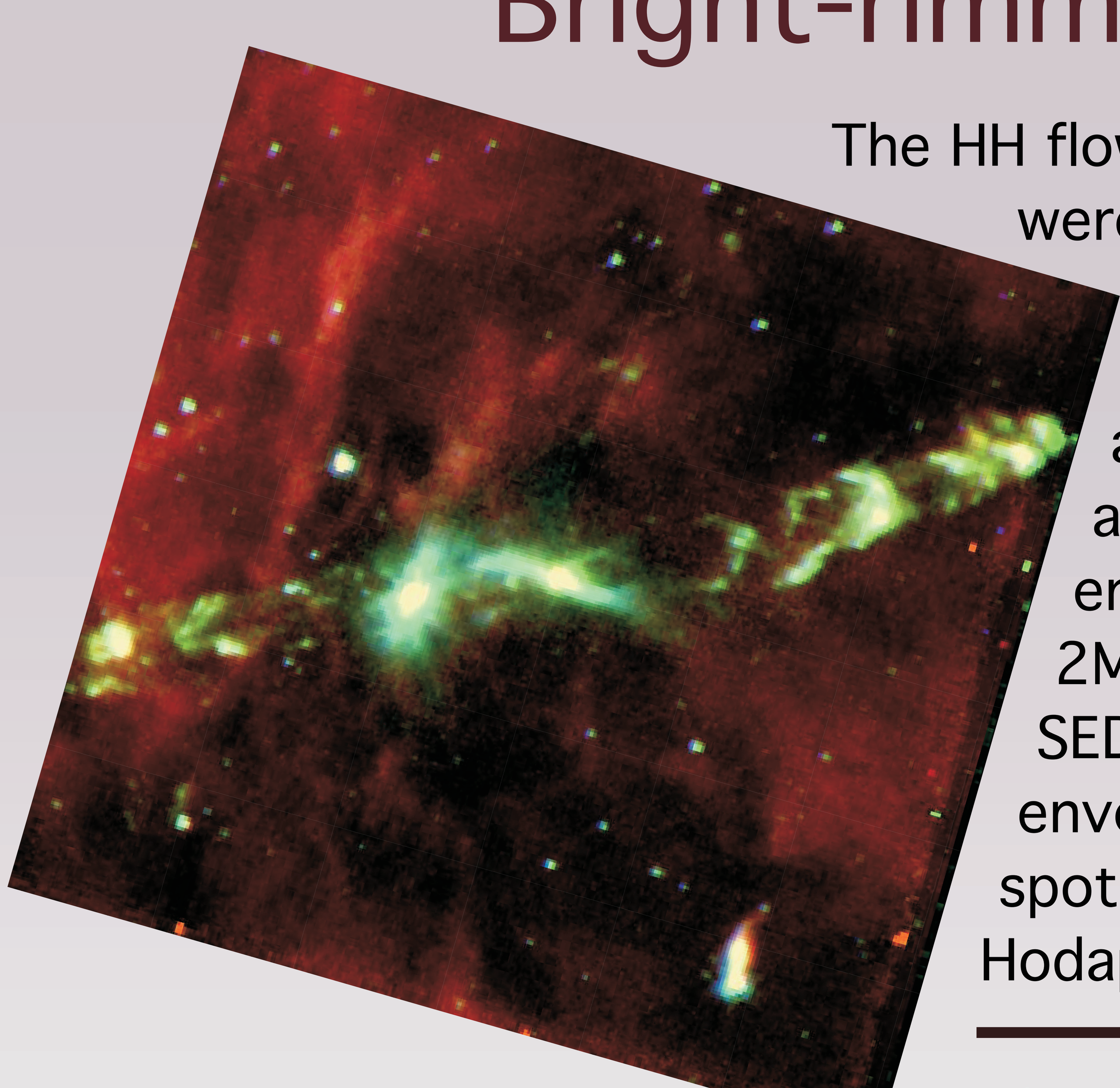
IRAC Colors of Young Stellar Objects





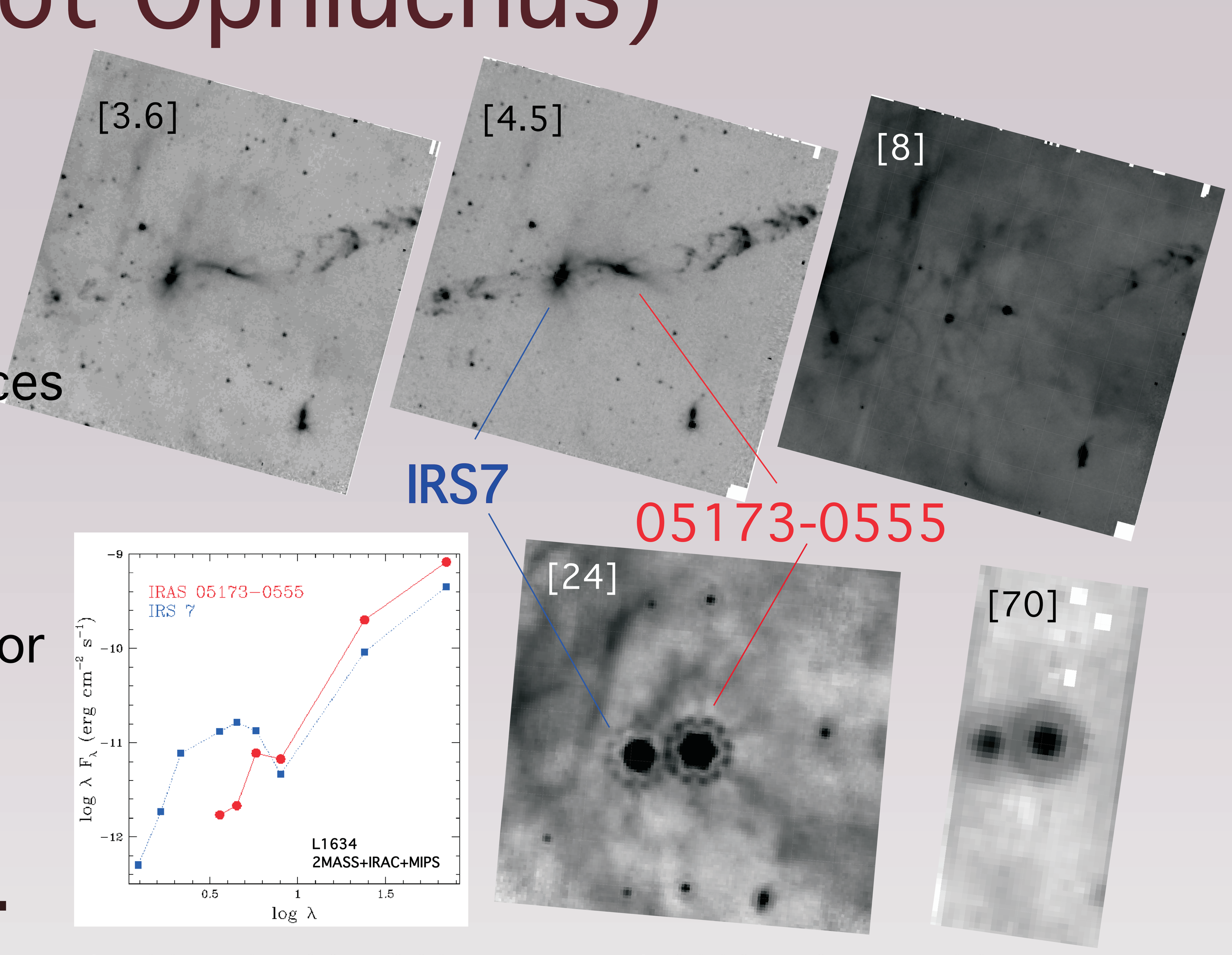
Near right: IRAC colors for disk models (triangles) and envelope models (circles) (Allen et al. 2004a). Disk models assume stellar Teff=4000K, age=1Myr. Disk accretion rates are color coded and represent log M=-9, -8,-7,-6 $M_{\ast}$ yr^{-1}. Two inclinations (30° and 60°), form discernable locii centered at [5.8]-[8]=0.6 and [5.8]-[8]=0.9. Envelope models are shown for a range of central source luminosities; 0.1, 1, 10, 100 $L_{\ast}$. Envelope densities are shown increasing from bottom to top for log ρ= -14 to log ρ= -12.5 g cm^{-3}. Models are plotted for two values of the centrifugal radius, Rc=50 AU (solid line) and Rc=300 AU (dashed line) and for one inclination, 60°. Far right: Measured IRAC colors for L1688. The light blue square shows the approximate domain of Class II sources. Extinction vectors are shown for a variety of extinction laws, with a magnitude of Av=30: large arrows are from Megeath et al. using Draine & Lee (1984; left) and Mathis (1990; right). Small arrows are from Indebetouw et al. (2004), using the laws calculated from IRAC data for RCW49 (left) and "the field" (right).

Bright-rimmed Cloud Lynds 1634 (not Ophiuchus)



0.72 pc

The HH flows 240/241 in the Lynds dark cloud L1634 were imaged with IRAC and MIPS. At left, the combined IRAC [3.6] (blue), [4.5] (green) and [8] (red) bands. At right, individual bands are shown. At 4.5 microns, the two driving sources are seen only in scattered light. Their spectral energy distributions are plotted at right (including 2MASS JHK for IRS7). The dip at 8 microns in both SEDs could be due to silicate absorption in the disk or envelope structures surrounding the stars. Can you spot both outflows in the image at left? See also Hodapp and Ladd (1995) or Davis et al. (1997).



References: Allen et al., 2004a ApJS 154; Allen et al. 2004b, in preparation; Davis et al. 1997 A&A 324, 263; Evans et al. 2003 PASP 115, 965; Hodapp & Ladd 1995 ApJ 435, 715; Indebetouw et al. 2004 astro-ph/0406403; Megeath et al. 2004 ApJS 154; Rieke & Lebofsky 1985 ApJ 288, 618.
Acknowledgments: This work is based on observations made with the Spitzer Space Telescope, which is operated by the Jet Propulsion Laboratory, Caltech under NASA contract 1407. Support for this work was provided by NASA through contract no. 1256790 issued by JPL/Caltech.