Spitzer + SMA Observations of an Embedded, Class I Disk in Corona Australis

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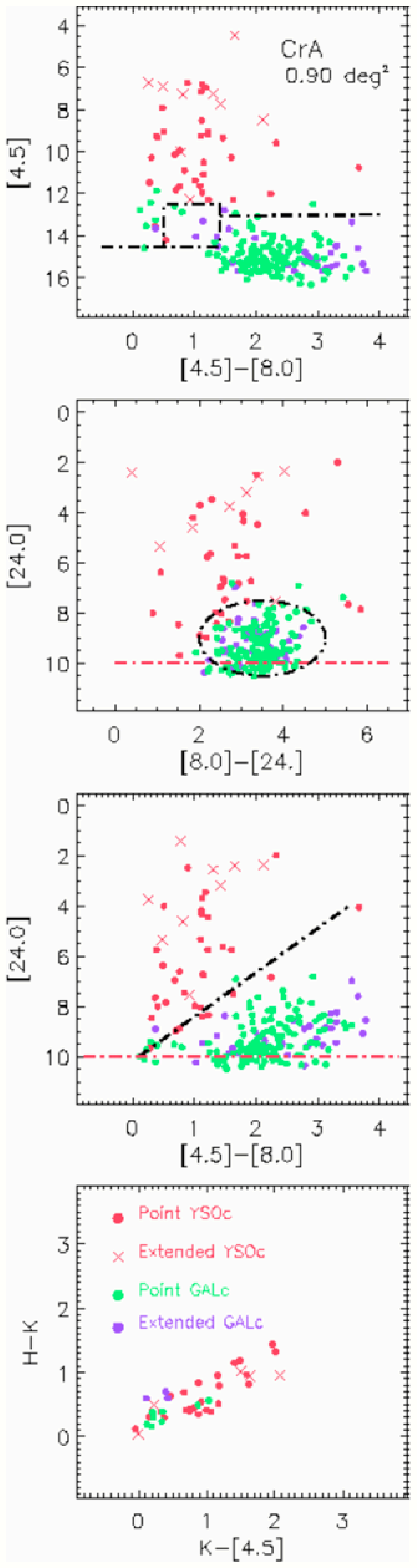
Abstract

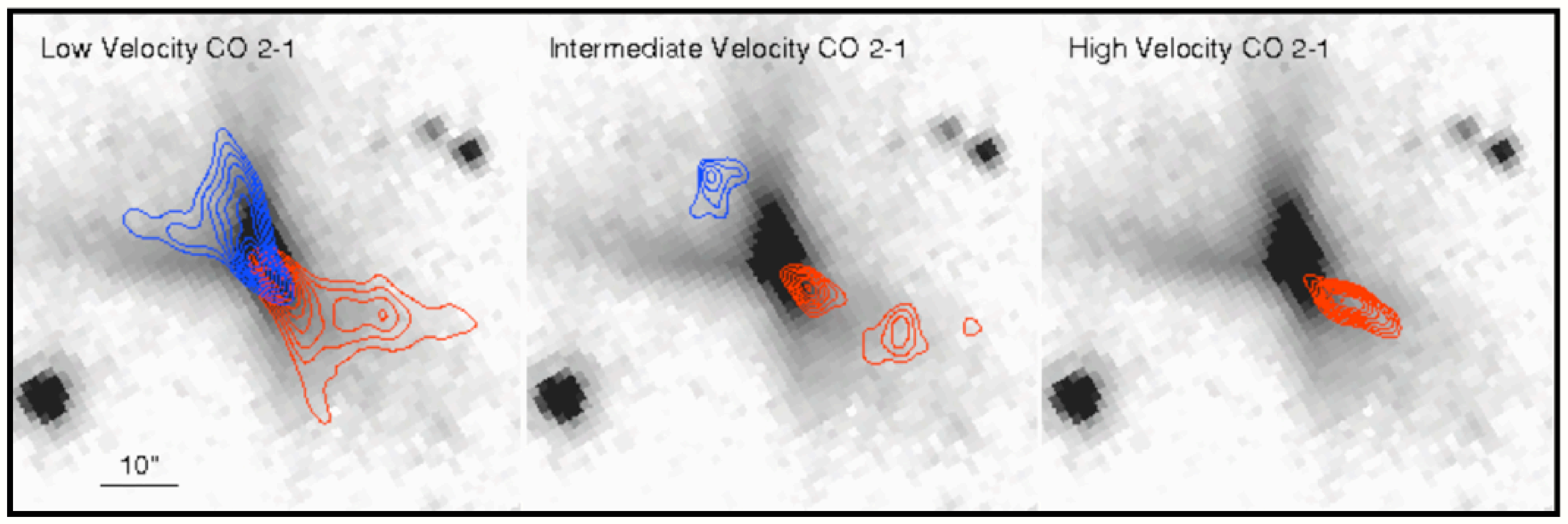
We present high resolution Spitzer and Submillimeter Array (SMA) observations of a Class I young stellar object (YSO) in the nearby (130 pc) Corona Australis (CrA) star forming region. Combined infrared and submillimeter observations provide important complementary information about the distribution of the star-forming material, from the inner envelopes to disks around YSOs. Archival single-dish 850 micron SCUBA maps provide a good estimate of the disk + envelope mass. The SMA, with its excellent angular resolution, can detect the cold outer regions of the disk, and Spitzer is sensitive to the warm inner disk and the star. Taken together, these data allow us to disentangle star from disk, and disk from envelope, the first step toward establishing the evolutionary timescales for the early stages of star formation (Lommen et al. 2008; Jorgensen et al. 2007). We constructed spectral energy distributions for YSOs in CrA from known J,H,K-band fluxes (2MASS) and Spitzer photometry (3.6-24 micron). Several YSOs were observed with the SMA, and one source, IRAS 32 (SMM 8), which displays an extended near-infrared nebula in the infrared, shows a clear CO outflow (and high velocity jet).



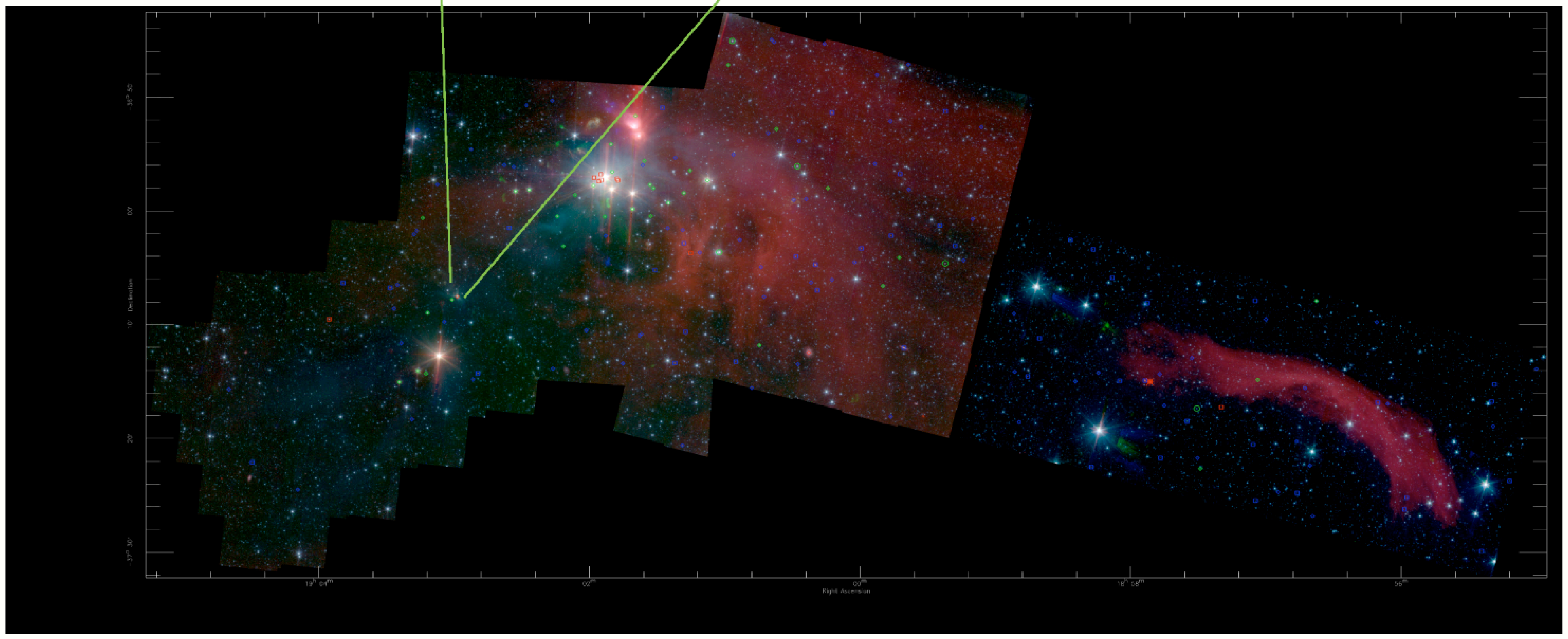
Spitzer Observations

- Spitzer Observations of CrA were taken for the "Young Cluster Survey," a guaranteed time observation (GTO) and the map was extended to the east of the Coronet through Gould Belt (GB) Legacy survey time.
- CrA was observed with IRAC, in all 4 channels, and with MIPS, in all three bands; the map is 0.9 deg^2.
- A total of 40 YSO candidates were selected in CrA, using color-magnitude and color-color diagrams for selection (figure at right), following the method of Harvey et al. (2007).

- The Spitzer image below shows the distribution of YSOs. The colors that make up the image are 3.6 (blue), 4.5 (green), and 8.0 micron (red).
- IRAS 32 is classified as a Class I from the mid-IR SED.



(Above) SMA observations (CO 2-1) overlaid on an inverse-scale 4.5 micron Spitzer image of IRAS 32.



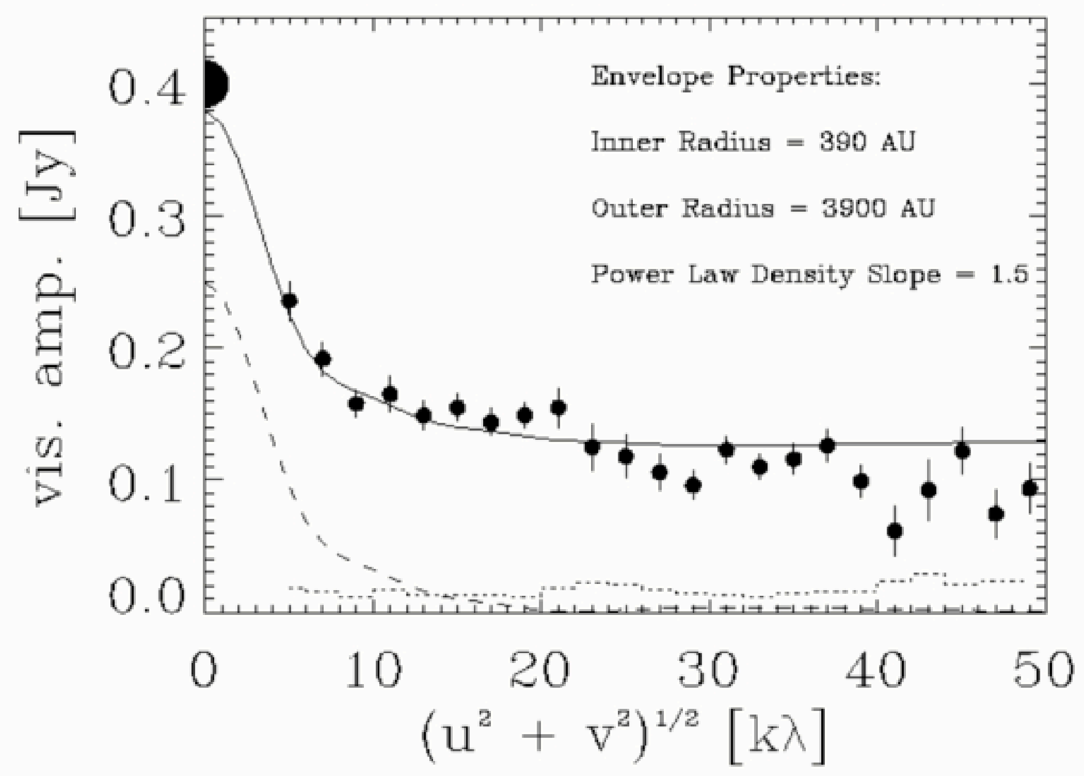
SMA Observations

- Observations of IRAS 32 were made on 6 June 2008 using the SMA on Mauna Kea in Hawaii in the CO (2-1) line, SO, ^{13}CO, & C^{18}O.
- In the literature, IRAS 32 (Wilking et al. 1992) = SMM 8 (Nutter et al. 2005) = MMS 23 (Chini et al. 2003) = IRAS 18595-3712

Disk/Envelope Modelling

We are using available 1D dust radiative transfer model tools (i.e. DUSTY code) to reproduce the full SEDs from near-infrared through millimeter wavelengths for IRAS 32.

- For our first step, we took the single-dish flux from the SIMBA map (Chini et al. 2003) to fix the envelope. As you can see from the figure on the right (dashed line), an envelope only model does not fit the data well for a Class I YSO (similar results were seen in e.g. Lommen et al. 2008).
- Then we changed the inner radius and the disk flux to match the envelope as well as the points from the SMA (small black dots). The figure (right) shows the continuum amplitude as a function of projected baseline with the best fit model overplotted (solid black line). The small dotted lines indicate the expected amplitude for zero signal. The data are best fit by a combination of a disk+envelope model.



References

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