Identifying Young Stars in Cepheus C

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TARGET REGION

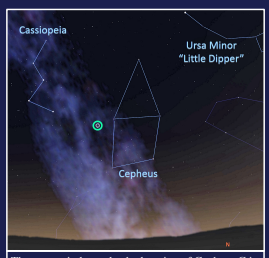
Our target region was ~20 arcminutes on a side, centered on 23h05m51s +62d30m55s. Image above: Red: DSS2 IR, Green: DSS2 Optical Red, Blue: DSS2 Optical Blue

METHODS

- For each source, we constructed a spectral energy distribution (SED) by aggregating available data from the literature and assembling photometry from released PACS catalogs, preliminary SPIRE catalogs, and our own photometric measurements.
- We did aperture photometry on the Herschel data using IDL and APT.
- We also created color-color and color-magnitude diagrams to see how these sources compared to each other and to other populations of YSOs.
- Each source was then classified based on its SED slope from 2-25um and its locations on color-color and color-magnitude diagrams.

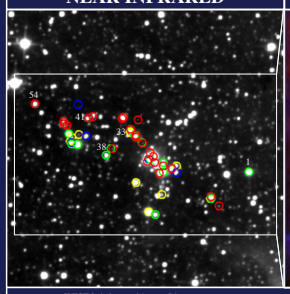
BACKGROUND

Young stellar objects (YSOs) are surrounded by disks of gas and dust which absorb energy from the newly-forming star and re-emit it in the infrared. YSOs can be identified by this excess infrared radiation. We used archival Herschel Space Observatory data to search for YSOs in the Cepheus C region of the Cepheus OB3 molecular cloud. Our initial search focused on longer infrared wavelength data – Herschel (70, 160, 250, 350, 500 μm) archival data and SCUBA (450, 850 μm) data from the literature (DiFrancesco et al. 2008). Through image inspection and catalog matching, we assembled a list of 54 candidate YSOs detected at wavelengths longer than 22 μm. By beginning the investigation of YSOs in this region, we are adding to the body of YSO knowledge which can be used to understand the process of star formation.



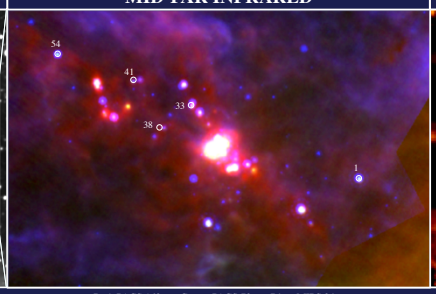
The green circle marks the location of Cepheus C in the galactic plane near the constellation Cepheus.

NEAR INFRARED



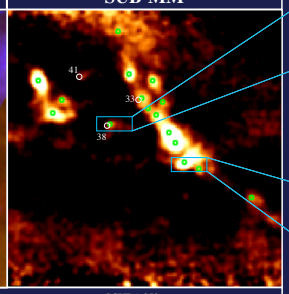
WISE2 4.6μm with our 54 sources
Source Classes: Red I, Yellow Flat, Green II, Blue III

MID-FAR INFRARED

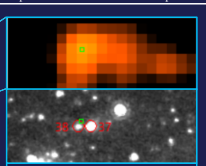


Red: PACS 160μm, Green: PACS 70μm, Blue: MIPS 24μm
The five sources highlighted are also shown in the SEDs below.

SUB-MM

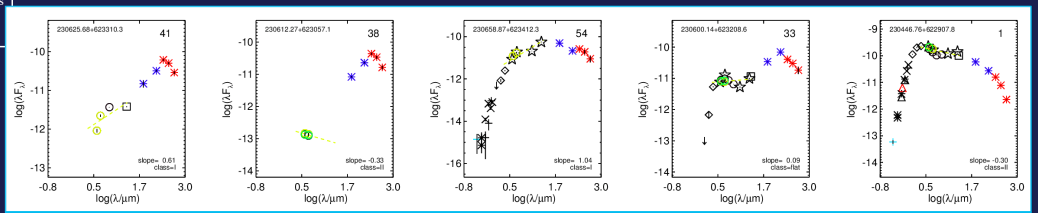


SCUBA 850μm
Green dots are sources identified by DiFrancesco et al. 2008



A single SCUBA 850μm source breaks into two sources in IRAC2 4.5μm.

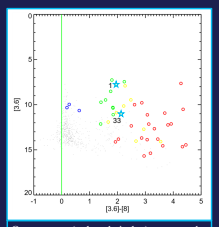
Two SCUBA 850μm sources break into many sources in MIPS 24μm.



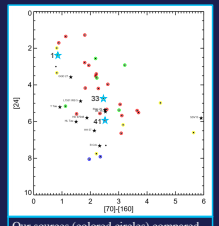
SPECTRAL ENERGY DISTRIBUTIONS (SEDs)

Plots are log λF_λ in cgs units (ergs/s/cm^2) against log λ in microns. · =SDSS u; + =SDSS; x=Pan-STARRS1; △=IPHAS Hα; △=IPHAS r, i; ◇ = 2MASS; ☆=WISE; ○ = IRAC, YSOVAR mean; ○ = IRAC, Cryo-era; ○ = IRAC, GLIMPSE; □ near middle of plot (@24 μm) = MIPS; ▽=PACS; ▽ =SPIRE; □ on right=SCUBA; ↓ =limit; - - - = slope; vertical lines=error bars.

COLOR MAGNITUDE DIAGRAMS

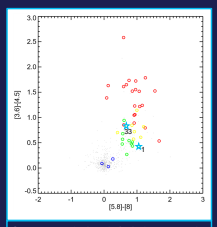


Our sources (colored circles) compared to other objects (black dots) in our field of view. Source Classes: Red I, Yellow Flat, Green II, Blue III.

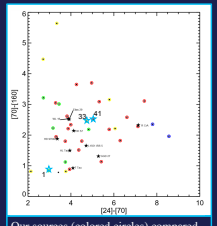


Our sources (colored circles) compared to other sources in our field (small black dots) and well-known young stars (labeled black stars).

COLOR COLOR DIAGRAMS

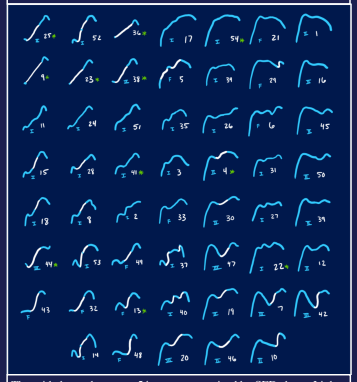


Our sources (colored circles) compared to other objects (black dots) in our field of view. Source Classes: Red I, Yellow Flat, Green II, Blue III.



Our sources (colored circles) compared to other well-known young stars (labeled black stars).

SOURCE SED SHAPES

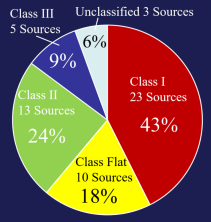


The grid above shows our 54 sources organized by SED shape. Light blue lines generally follow our data points. White lines indicate missing data. Each source is labeled with its spectral index and source number. Previously unidentified sources are marked with green stars.

RESULTS

- We suspect that all of our 54 sources are likely YSOs, some of which are very embedded; ~40% are likely SED Class I or 0.
- 11 of the 54 sources have not been previously identified at all.
- Adding Herschel data (70, 160, 250, 350, 500 μm) to SEDs has improved our understanding of previously identified sources, giving possible insight into disk and/or envelope structure.

Spectral Index Distribution



FUTURE WORK

- Improve photometry by doing PSF fitting for Herschel data.
- Tie what we know about these sources to variability data (YSOVAR).
- Model SED shapes to understand star, disk, and envelope structure.
- Develop methods to further identify and analyze possible Class 0 sources.

*To learn more about our NITARP experience, go to the NITARP website to check out our education poster: **Stalnaker, et al. : NITARP: Bridging the Gap Between the Traditional Science Classroom and Authentic Research.***

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