Multiwavelength Survey of the Dark Globule DC314.8–5.1

Point Source Identification and Diffuse Emission Characterization (submitted to ApJ)

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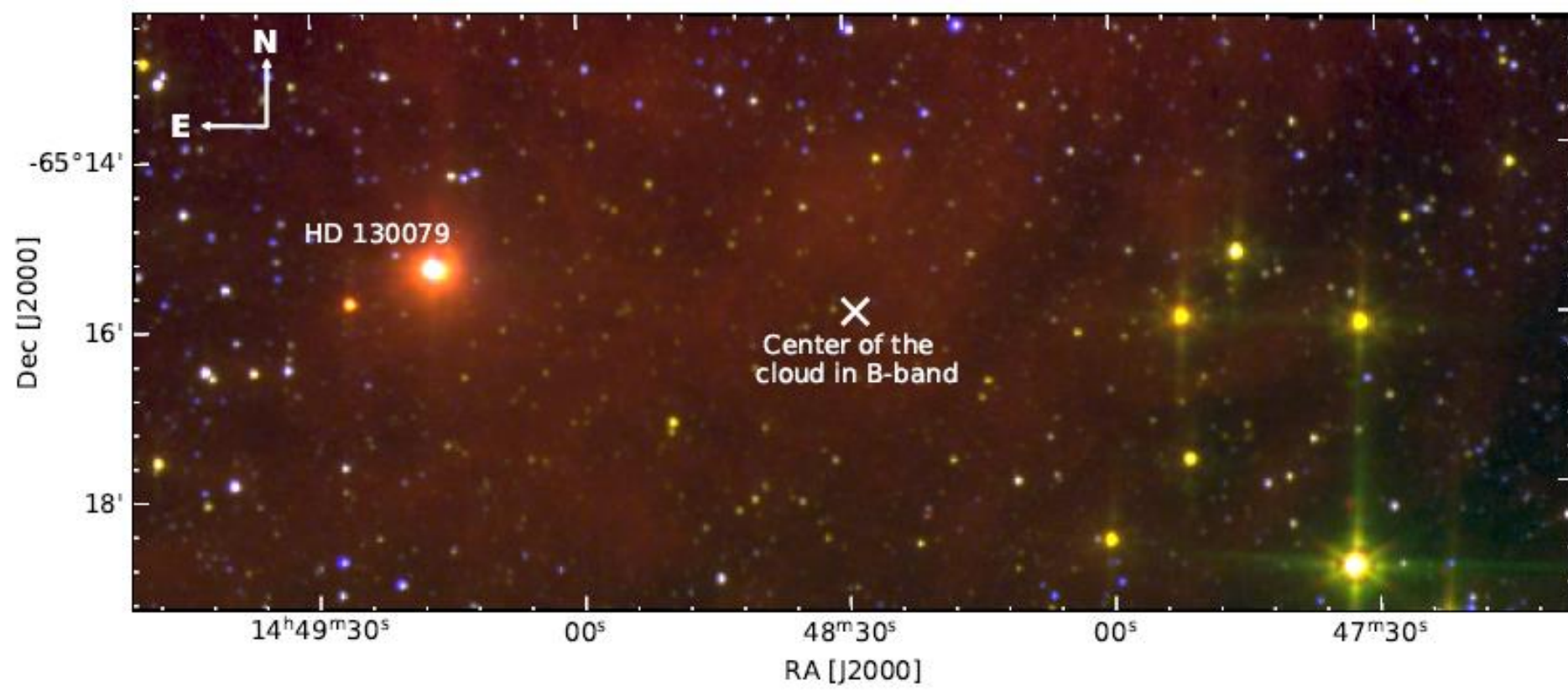
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DC 314.8-5.1

Infrared Study
Kosmaczewski et al. (2022)

➢ Optically-opaque isolated globule
   ➢ 5'-8' in extent
   ➢ 0.6 x 0.9 pc
   ➢ −5° Galactic latitude
   ➢ Distance of 435 pc
➢ HD 130079 Field Star
   ➢ 10th Magnitude, B9 V Star
   ➢ Embedded in eastern boundary
   ➢ Reflection nebula ~1' in diameter
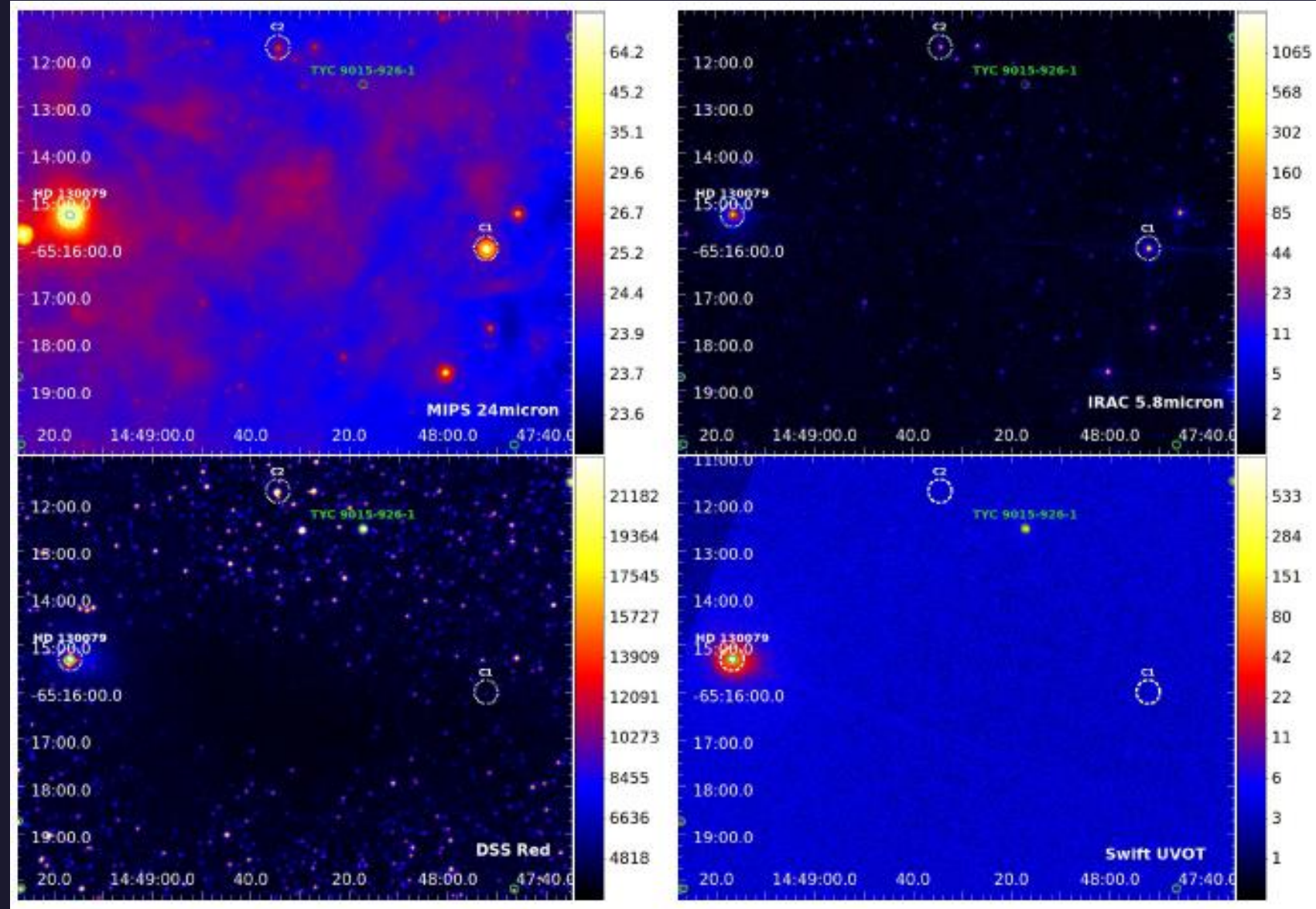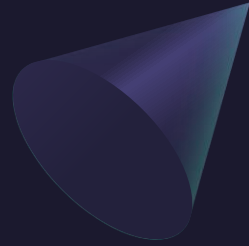
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Science Goals

I. **Primary Goals:**

   a) Confirm YSO candidates and Pre-Main Sequence Stars

   b) Based on all-sky surveys not previously available (WISE, Gaia, SEIP, etc)

   c) Confirm ROSAT detection of pre-main sequence stars present in our system, possibly heavily obscured in optical and infrared light due to the intrinsic absorption of the cloud with Swift ToO observations
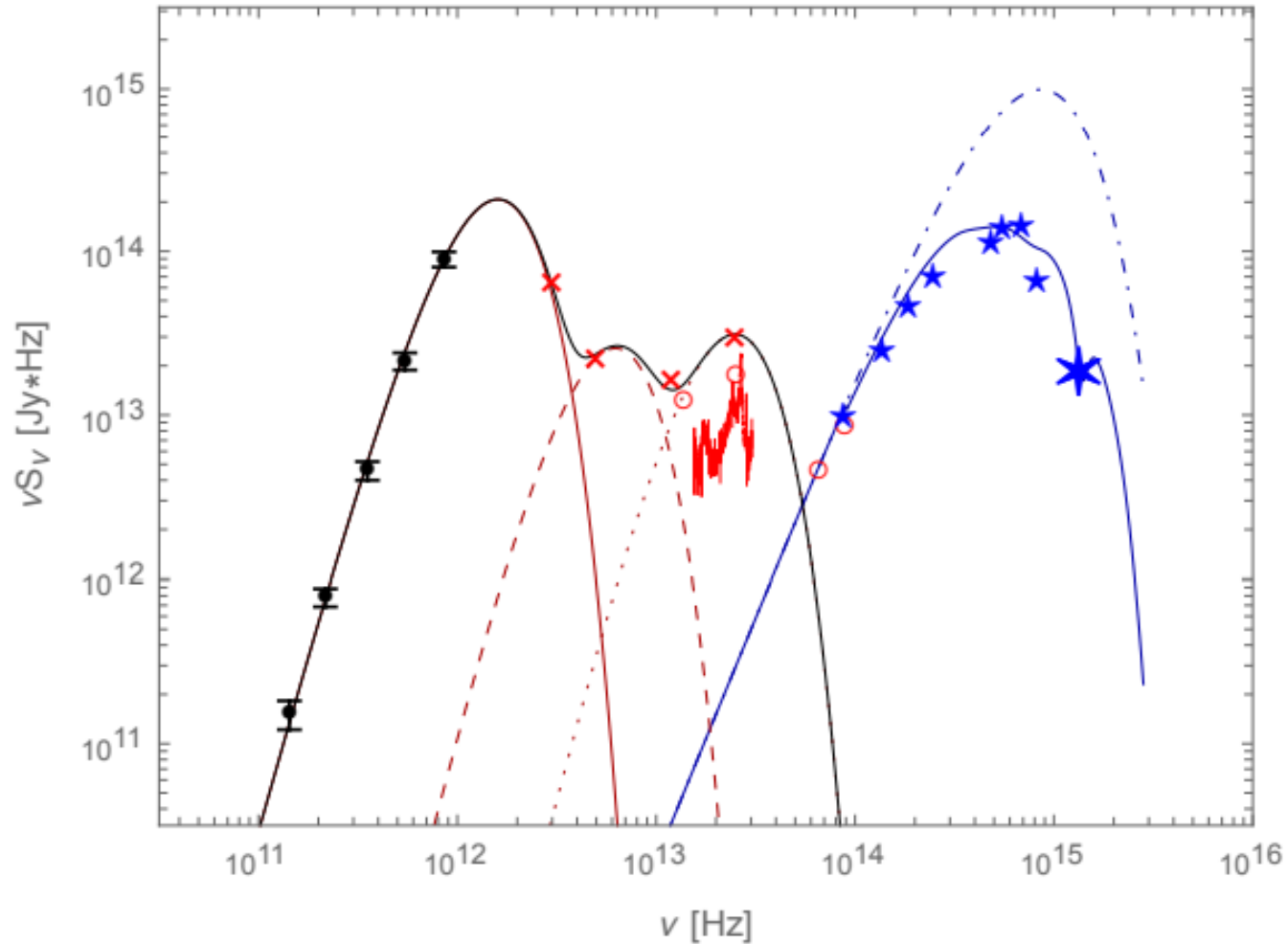
II. **Secondary Goals:**

   a) Investigate the interactions between cosmic-rays (CRs) and the molecular cloud
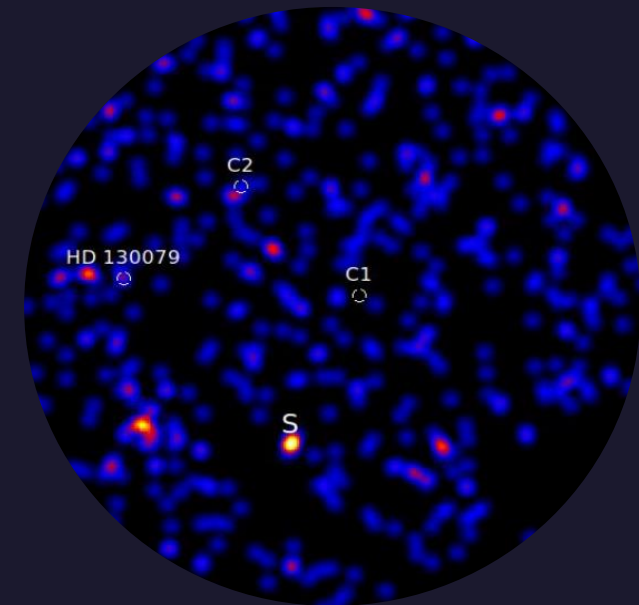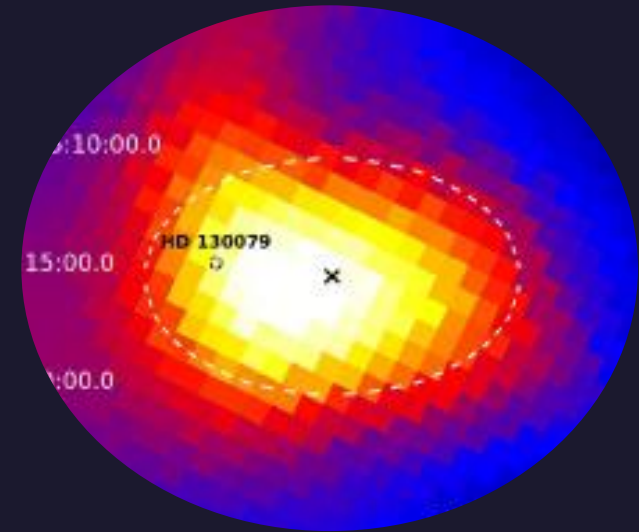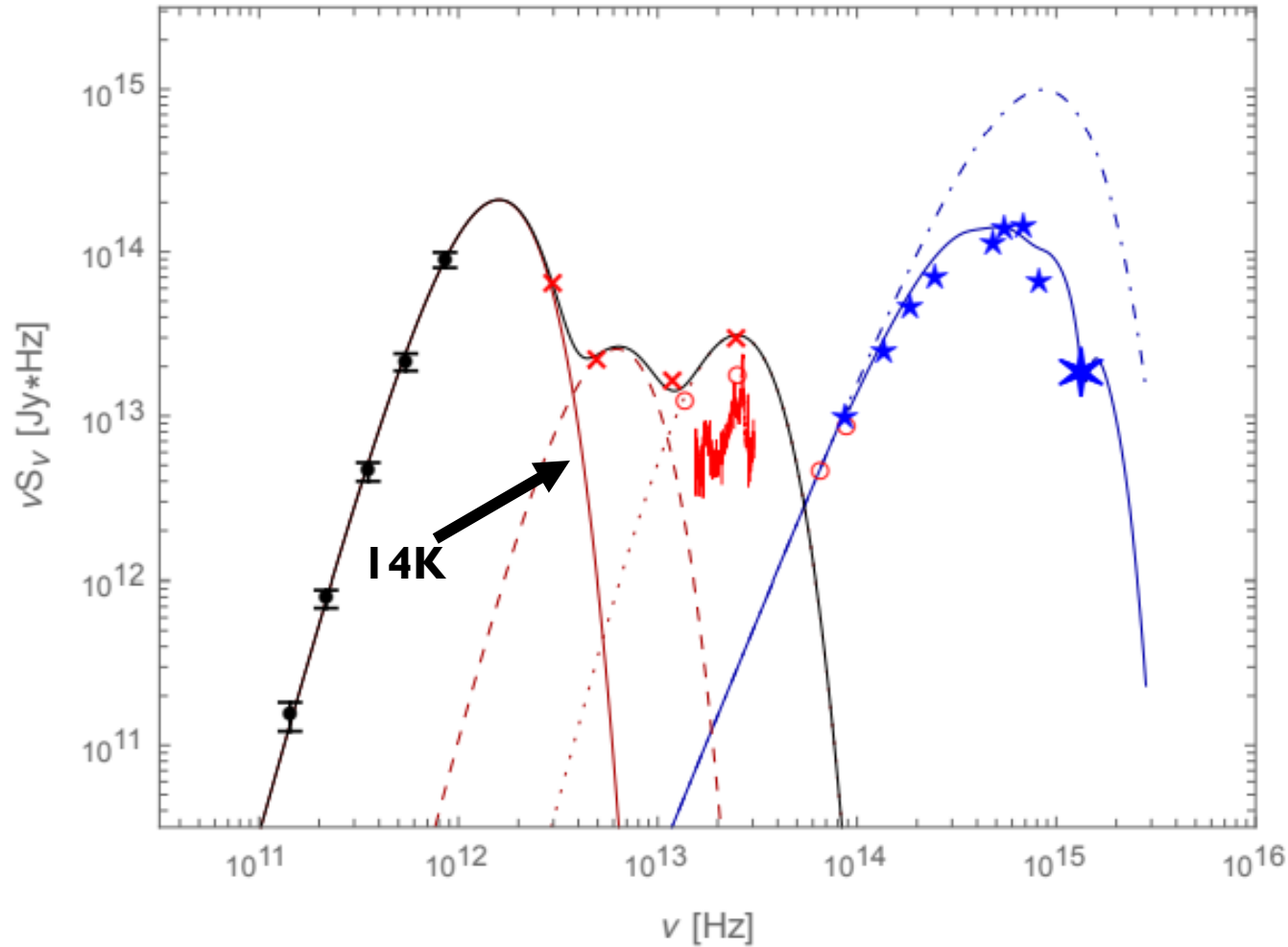
Multi-wavelength Observations

DC314 SED

- ❑ Black Circles: Planck Fluxes
- ❑ Red Crosses: IRAS Infrared Fluxes
- ❑ Thin Red Curve: Spitzer IRS Stare observation
- ❑ Blue Stars: Ground-based telescopes and Gaia (small) & Swift UVOT (large)
- ❑ Dark red solid, dashed, and dotted curves: modified blackbody models for cold (14 K), warm (50 K), and hot (200 K) dust
- ❑ Black solid curve: total dust model
- ❑ Dark blue dot-dashed curve: intrinsic emission of HD 130079
- ❑ Dark blue solid curve: intrinsic emission subjected to the interstellar reddening.
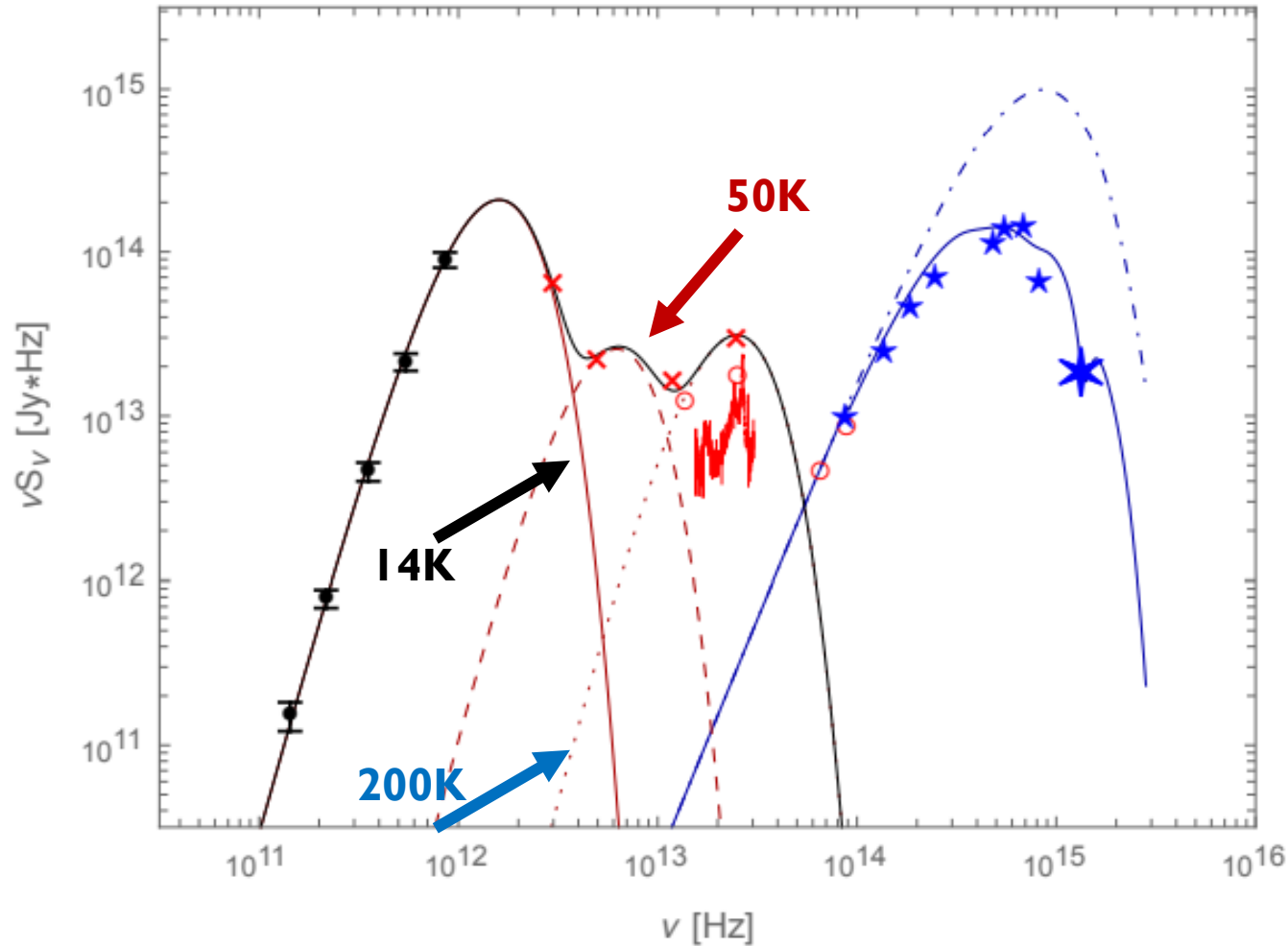
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Spitzer YSO Selection

➤ IRAC colour-colour diagrams for 1,319 sources from the SEIP query for the central region of DC 314.8-5.1

➤ Selection cuts: Gutermuth et al. (2009)

✓ Top two panels: Removing SFGs
    ➤ Red diamonds

✓ Bottom left: Removing AGN
    ➤ Blue squares

✓ Bottom right: Galactic-scale unresolved shocks
    ➤ Magenta circles (none present)

✓ Bottom right: unresolved PAH emission sources
    ➤ Green pentagons
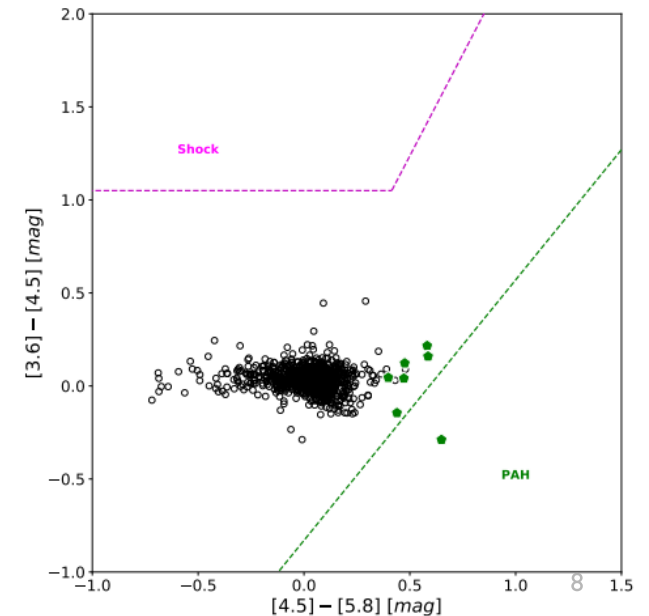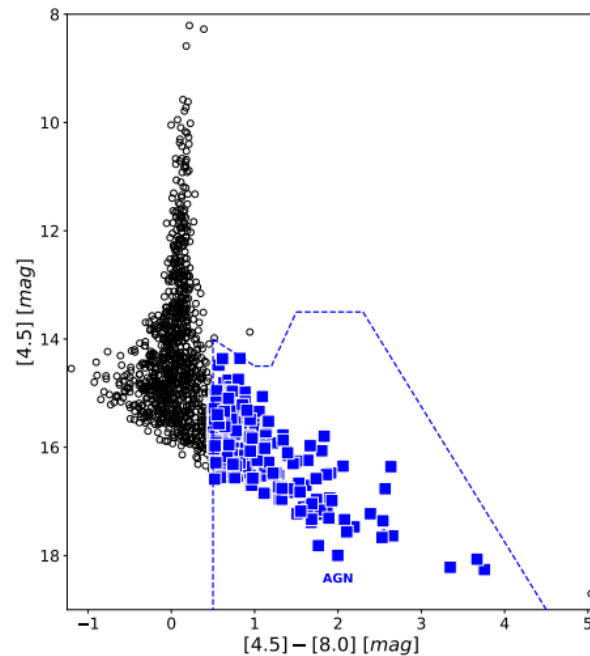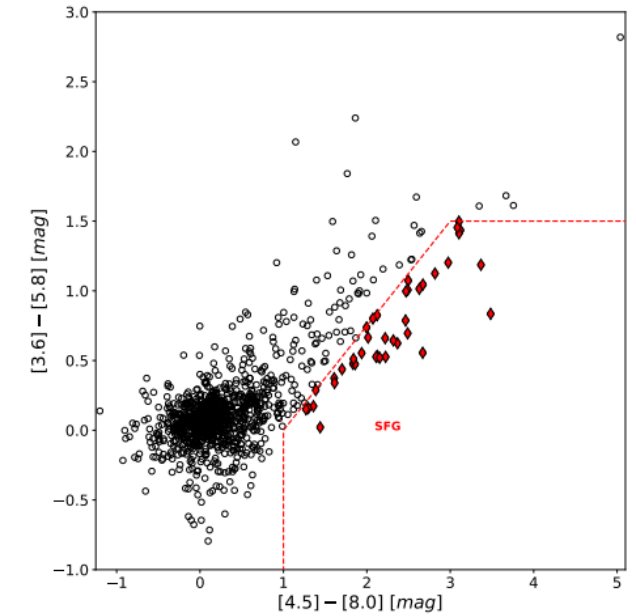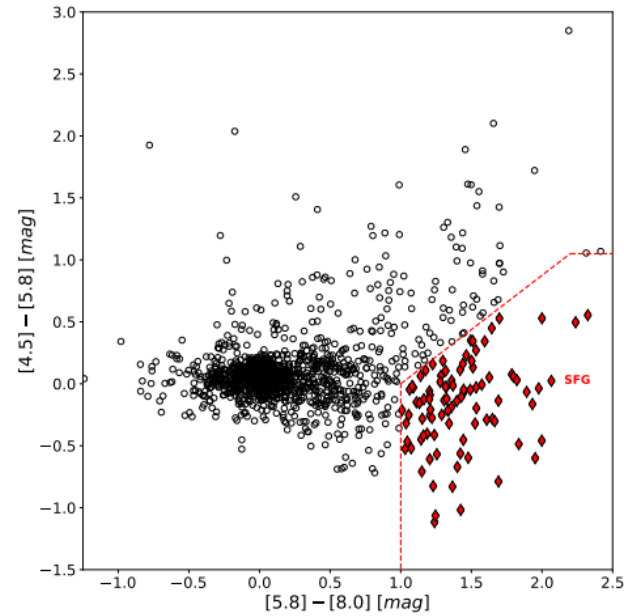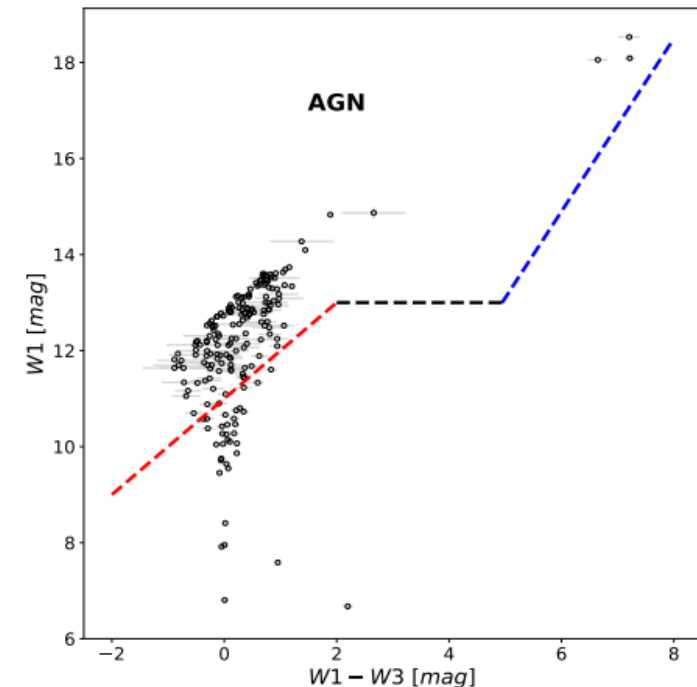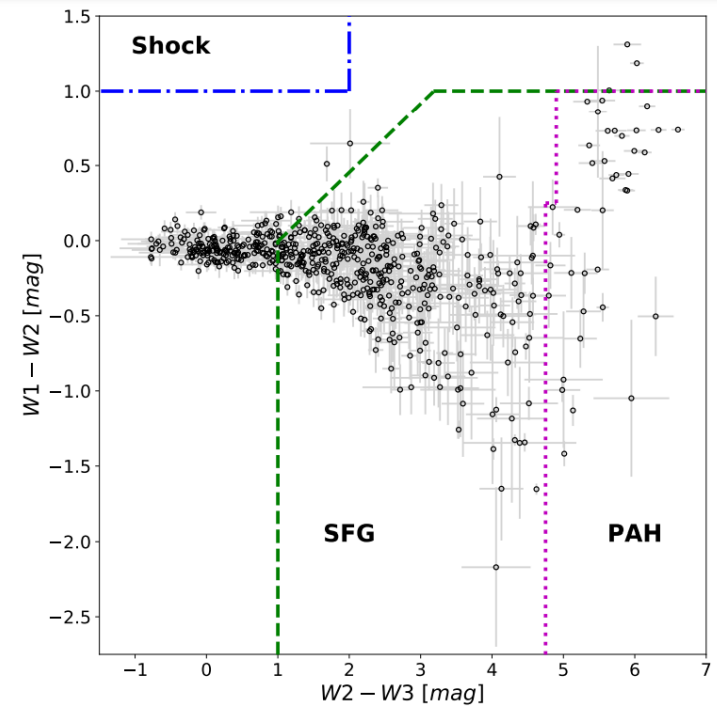
Spitzer YSO Selection

➢ IRAC color-color diagram for the remaining 924 sources

➢ Following Gutermuth et al. (2009):
  ✓ Selection cuts to identify Class I and Class II YSOs
    ✓ None identified in this selection
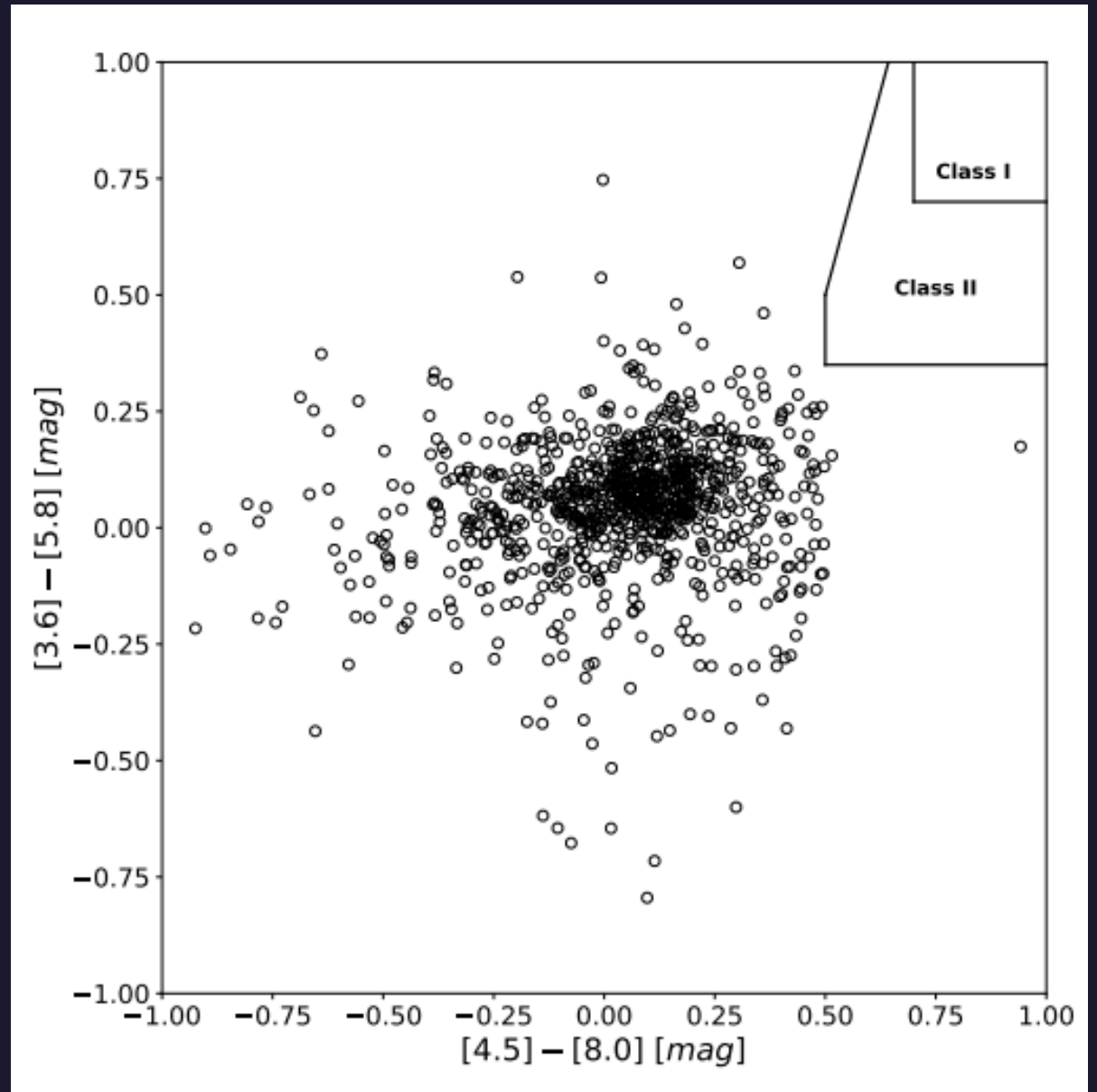
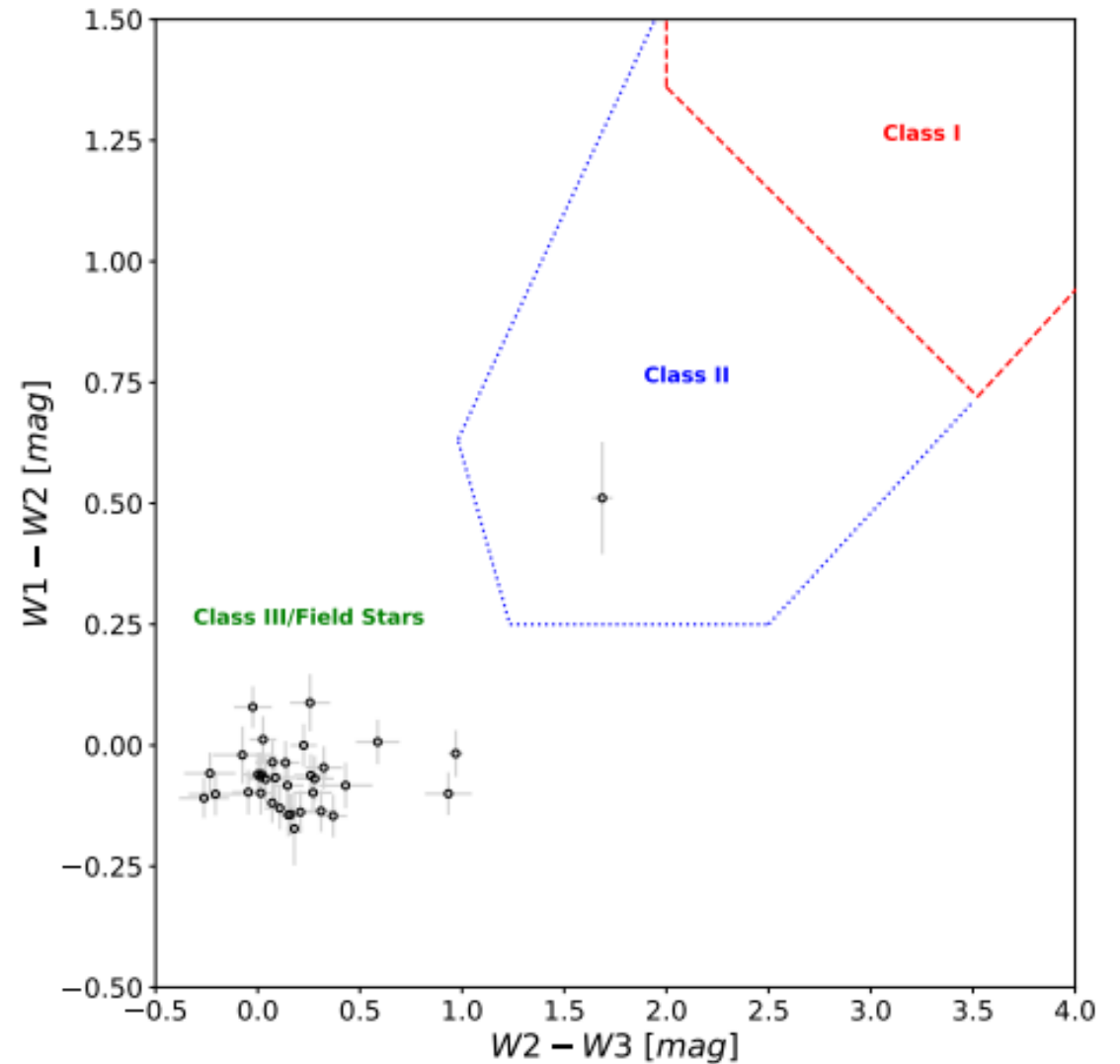# *WISE & 2MASS Selections*

- 618 sources within 5" of the central position of DC 314.8-5.1

- 476 have secure 2MASS colors

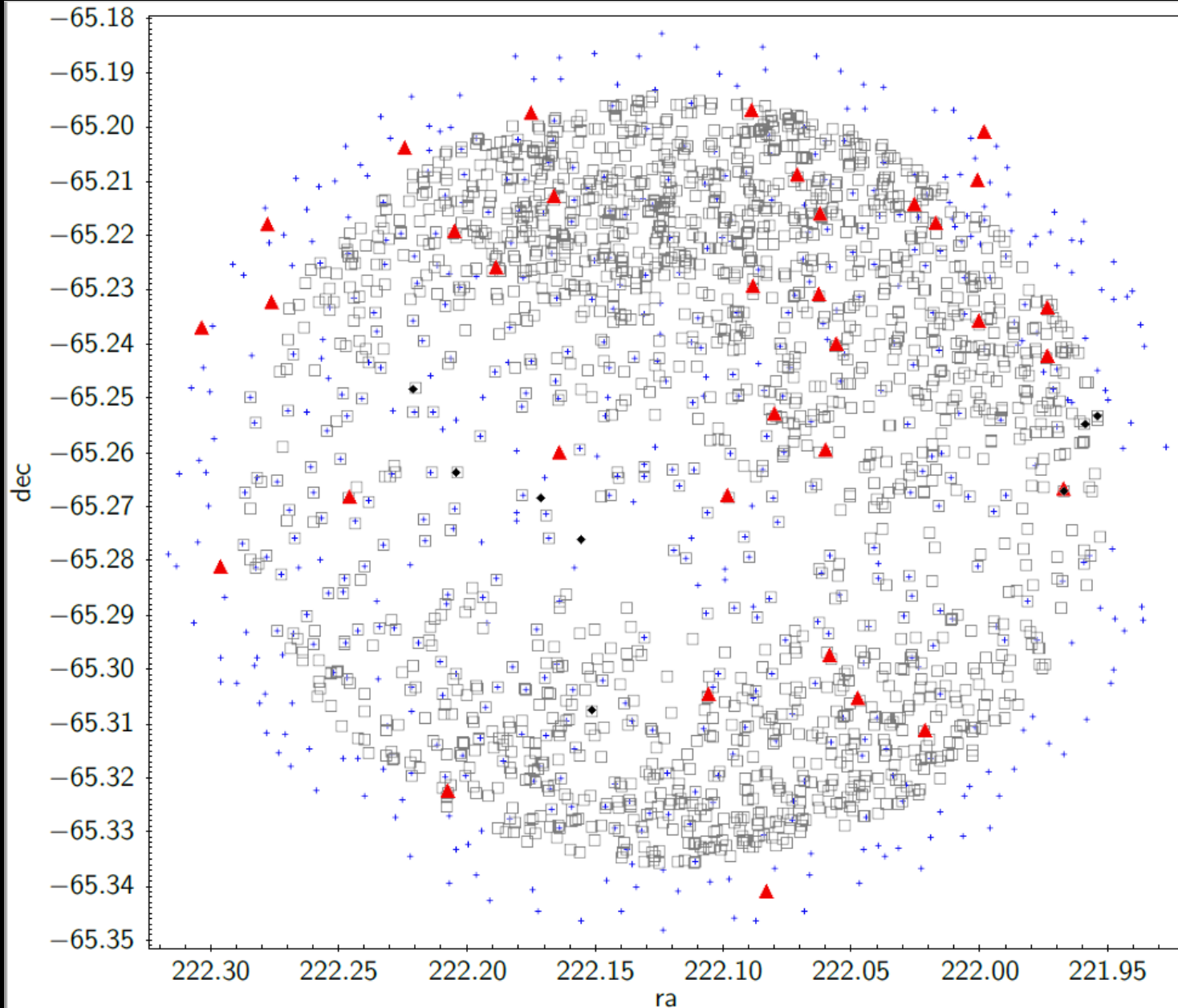- Selection cuts Kang et al. (2017)

WISE & 2MASS Selections

- Class II Candidate, J144752.17-651601.1, as previously identified by Whittet et al. (2007)

- Class III Candidate, J144834.41--651145.4 identified in this work

Gaia Association Survey

- RA vs DEC plot of sources detected by WISE and Gaia within 5'' of the central position of DC314.8−5.1.

- Blue crosses: positions of all WISE sources

- Grey squares: Gaia sources

- Red filled triangles: Sources with 2MASS colors indicative of stars with a potentially significant circumstellar disk component

- Black diamonds mark the WISE sources with colors consistent with Class II

Swift 0.3—10keV

- S indicates the Swift source
    - 14:48:16.72, -65:21:45.6
    - Position error: 6.9"
    - Off-axis angle: 5.8'
    - S/N: 1.633
    - Counts: 8
    - BG: 0.49
- C1&2 indicate YSO candidates
- HD 133079 (field star)
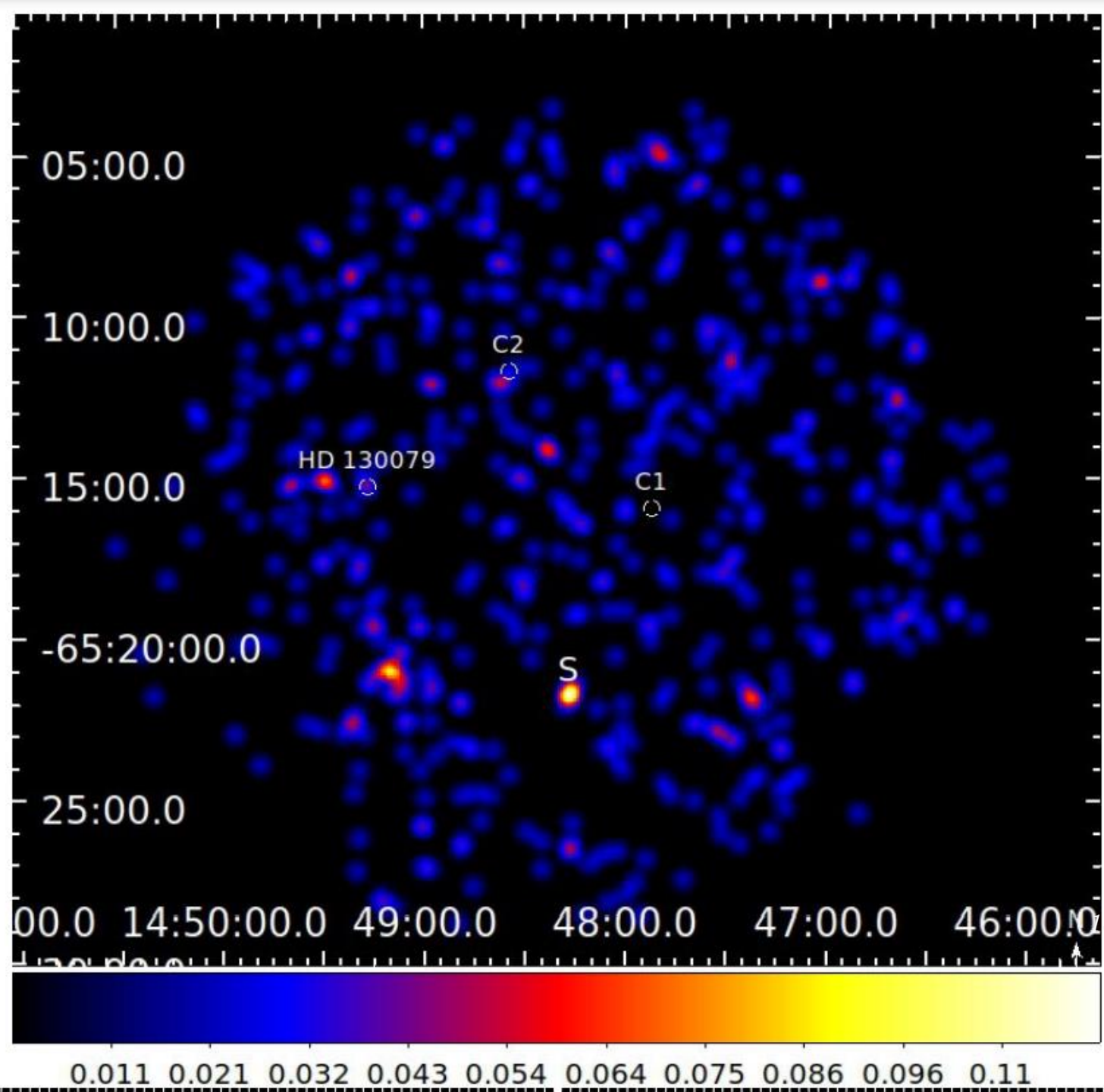
Swift Source

- J144815.66-652141.9

  - Separation 0.126 arcsec

  - Wise colors indicate that the object could be a background luminous infrared galaxy (LIRG), or a starburst galaxy

- J144818.35-652144.7

  - Separation 0.141 arcsec

 - WISE colors consistent with an average star forming galaxy
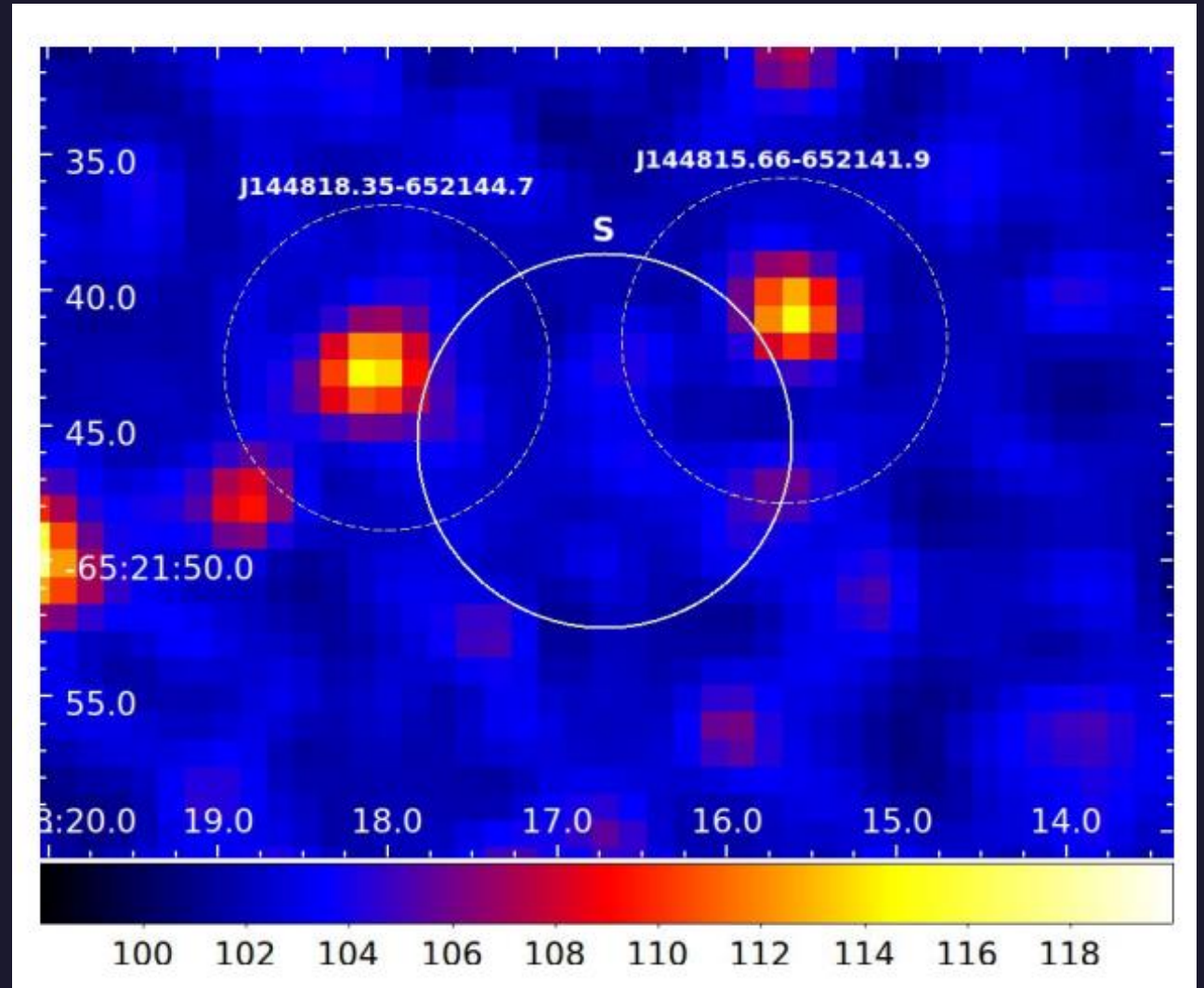
Gamma-ray Estimates

- Ackermann et al. (2018): TS map of unassociated, soft-spectrum sources FHESJ1501.0−6310. Green contours show the Planck dust optical depth at 353GHz.

- Sources detected down to a level of $\sim 10^{-10} erg\ s^{-1}$
  - Detections being indicated by a minimum sigma 5

- Basic estimates for DC 314.8-5.1 yield

  - $F_\gamma \simeq 2 \times 10^{-13} \frac{\frac{M}{10^5 M_\odot}}{\left(\frac{D}{kpc}\right)^2} \left(\frac{E_\gamma}{1TeV}\right)^{-1.7}$ (Gabici 2013)

 - $F\_\gamma \sim 2 \times 10^{-10}\ cm^{-2} s^{-1}$

  - For $E_\gamma = 1\ GeV$
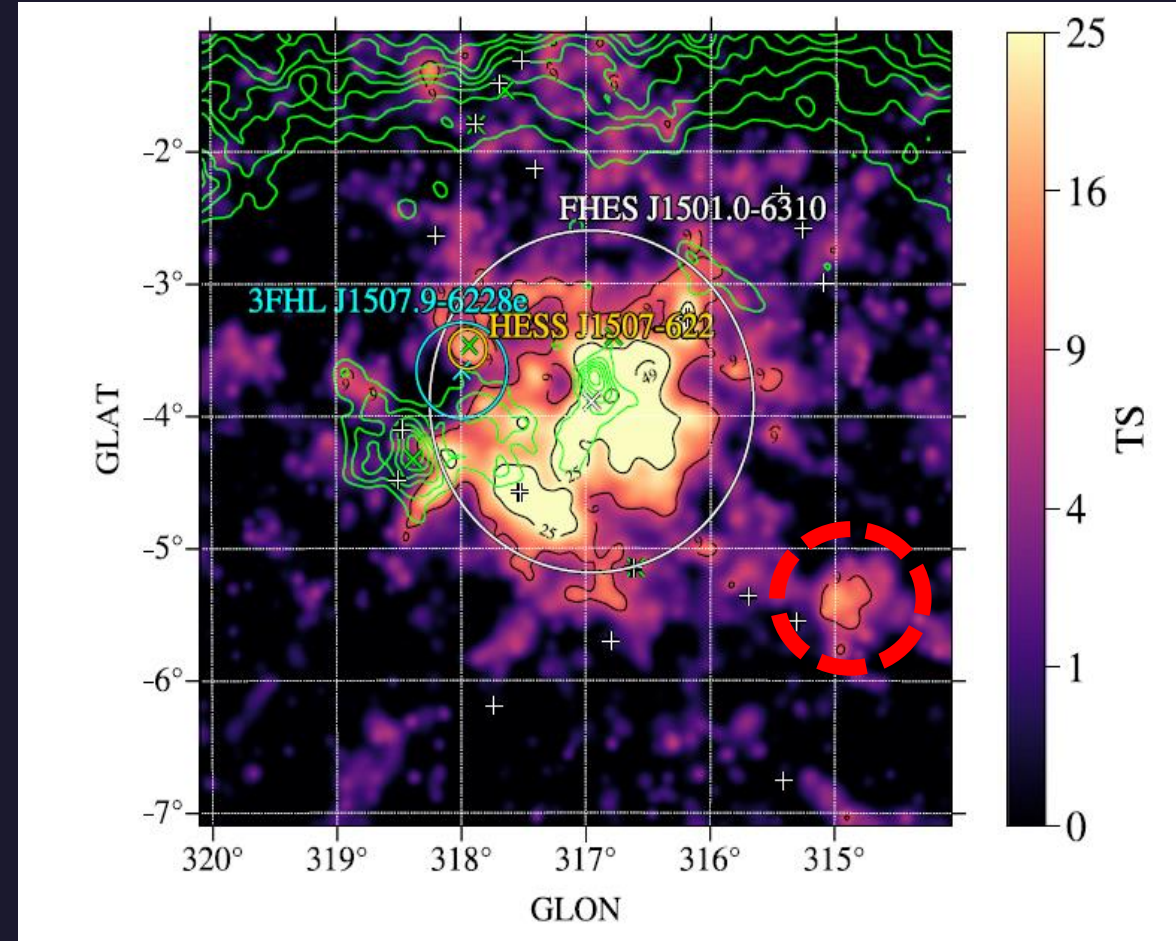
Multiwavelength Study Conclusions & Future Work

1. We probe the PMS population down to a luminosity level of $\leq 10^{31}$ erg s−1.

    !! This level only includes the brightest PMSs, and so deeper x-ray observations are needed to explore the presence of less luminous objects.

2. The SED of the DC 314.8−5.1 system including the incident star HD 130079, confirms the presence of a hot dust (with temperatures up to 200 K), in addition to the dominant 14 K gas component.

3. The variation in estimates for the mass of the cloud, ranging from $\cong 10 M_{\odot}$ based on the Planck photometry for the core of the globule, up to $\geq 50 M_{\odot}$ following from the visual extinction characteristics, point out that the discrepancy may be due to the poorly constrained dust opacity for this particular system, affecting the photometric estimate.

4. The cloud should be detected in high-energy γ-rays with Fermi-LAT, given the estimate for the total mass of the globule ~$160 M_{\odot}$ is correct.

    !! Dedicated Fermi analysis should detect this source and so indicate the level of detection for other quiescent molecular clouds

Thank You
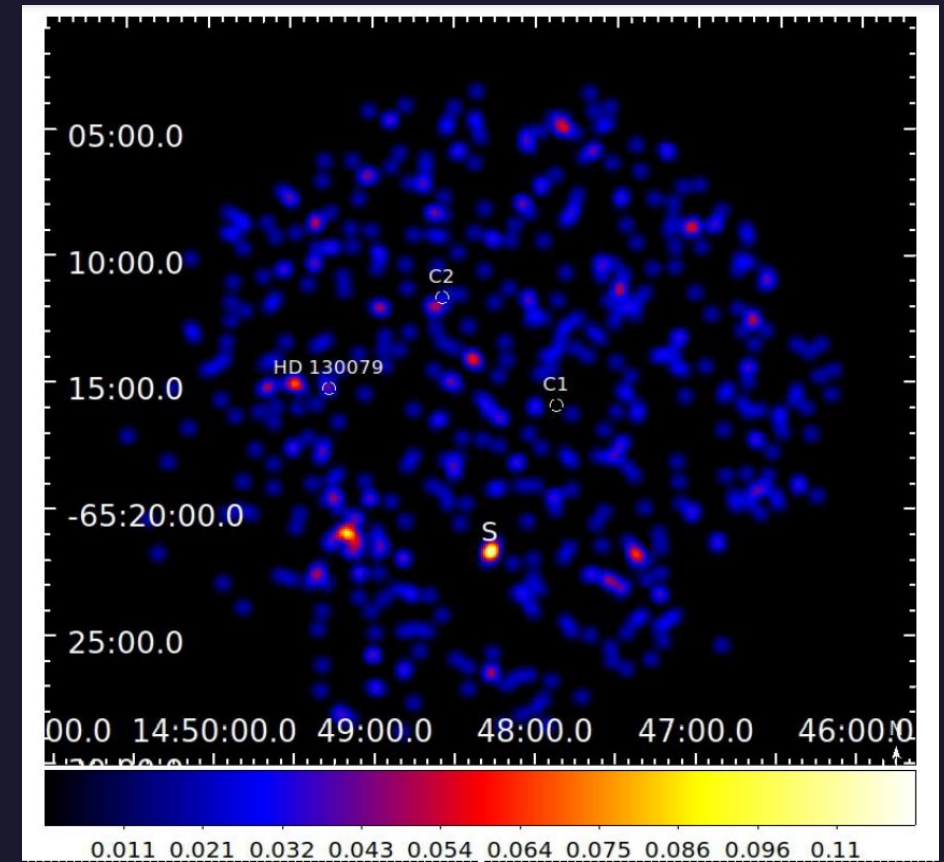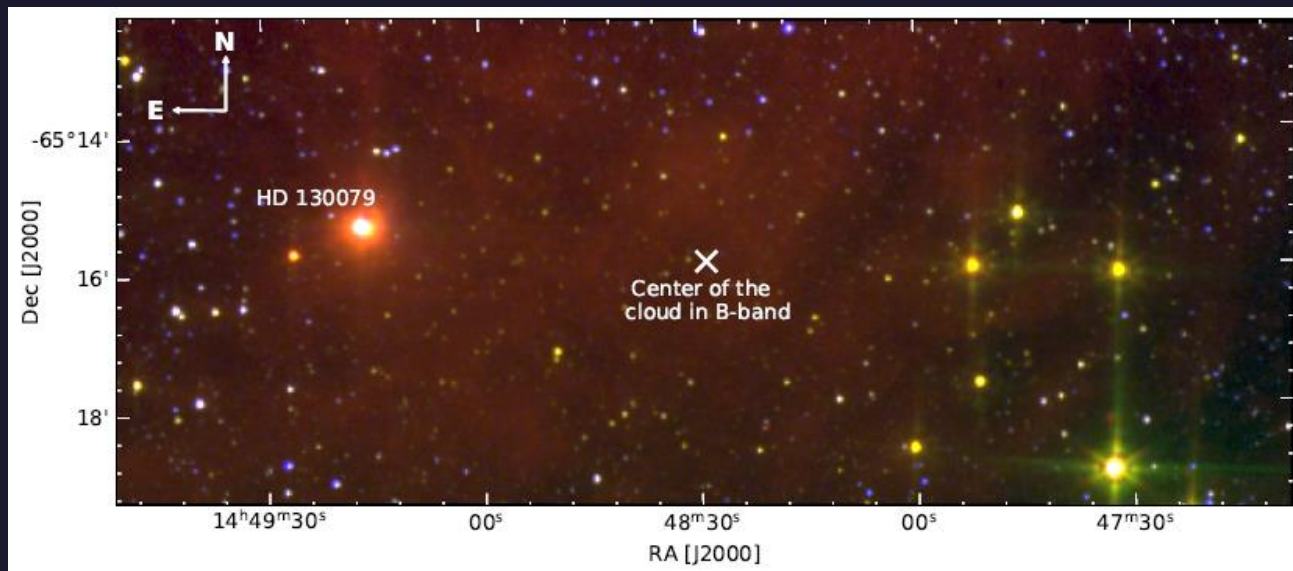
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