



Ionized Jet Candidates Associated with Young High Massive Stars

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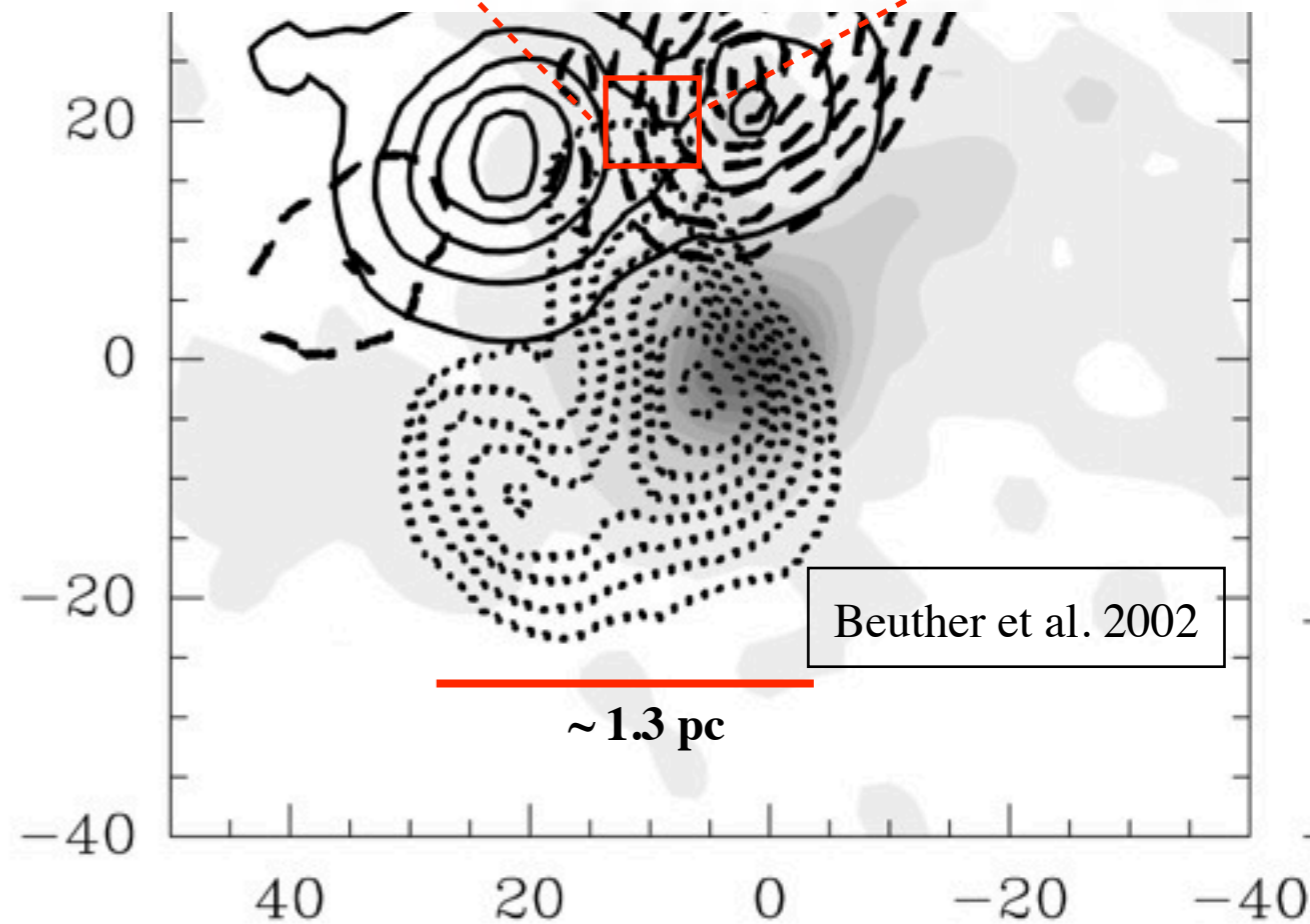
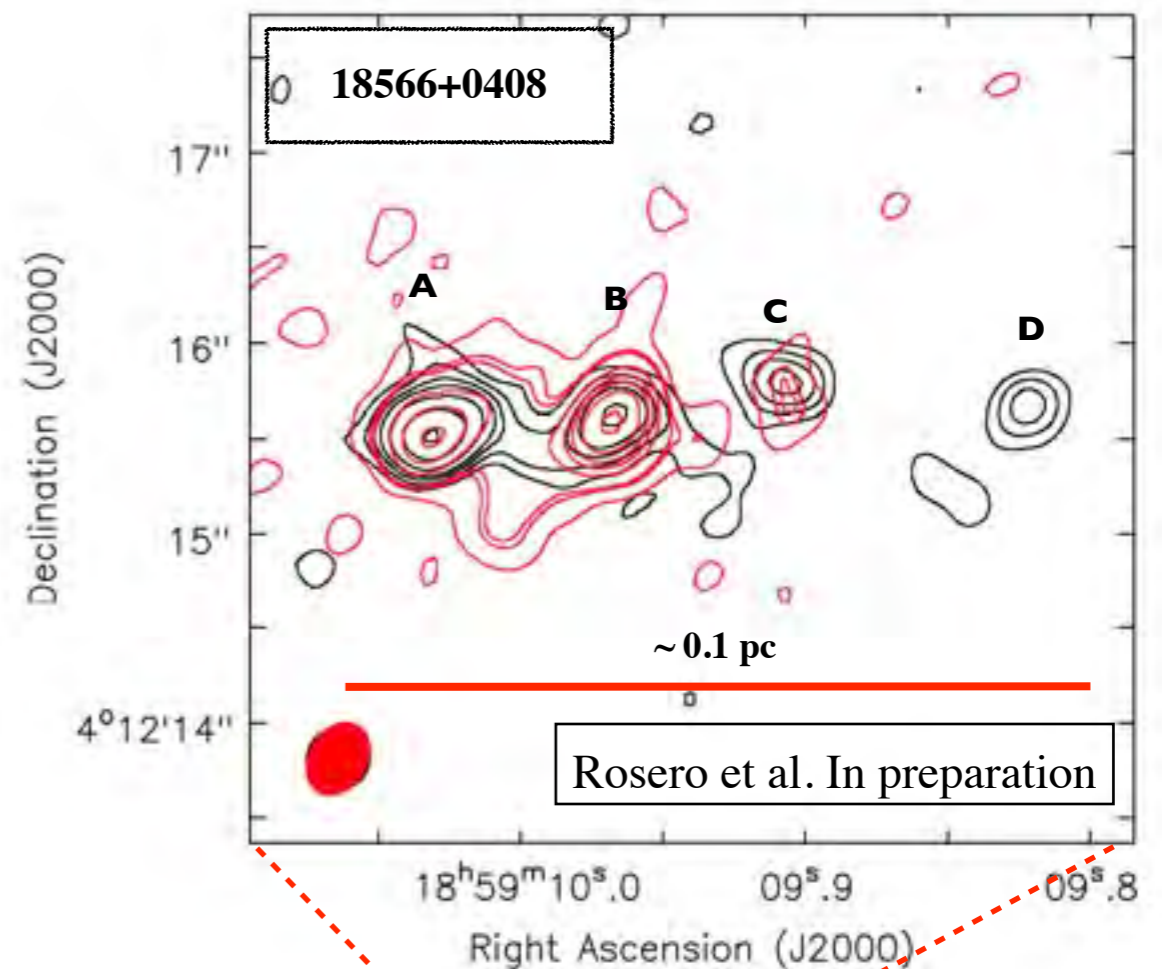
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Thermal Jets

- *Ionized jets* are predicted to occur at the base of the molecular outflow
- Small number of *ionized jets* from young massive objects (YMOs) detected to date
- Detections of *ionized jets* and disks help to complete the picture of massive star formation



Motivation

- Are jets a common phenomena among high mass YSOs?
- Is there are a common origin of jets in YSOs of different luminosities?
- Does the association of cores with radio continuum indicate an evolutionary sequence?

Motivation

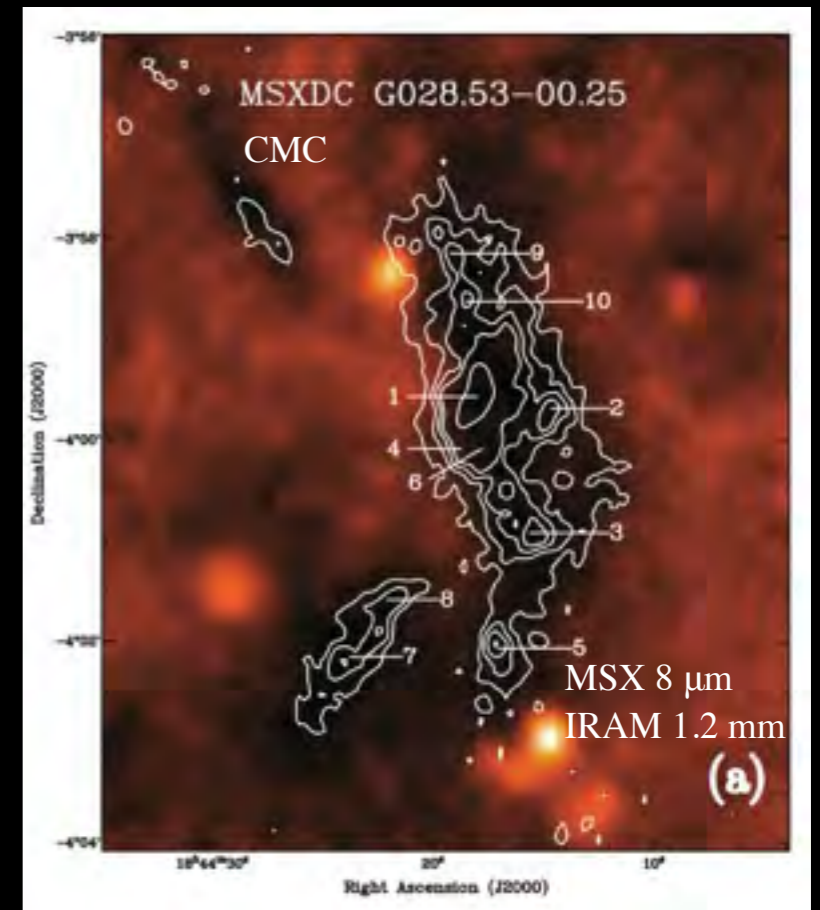
Previous Work

Evolutionary sequence of IR sources and their association (or not) with radio continuum (e.g., Molinari et al. 1996, 1998, 2000; Rathborne et al. 2006; Chambers et al. 2009)

Jets occurrence rate towards YMOs of $L > 2 \times 10^4 L_{\odot}$ is $\sim 38\%$ (Guzmán et al. 2012)

This Project: Sample Selection

- **CMCs:** mm compact cores in IRDCs (Rathborne et al. 2006)
- **CMC-IR:** mm compact cores in IRDCs associated with 24 μm point sources (Rathborne et al. 2006 and Chambers et al. 2009)
- **HMCs:** Heated by luminous, embedded protostar (Sridharan et al. 2002)



Rathborne et al. 2006

In addition some cores are associated with:

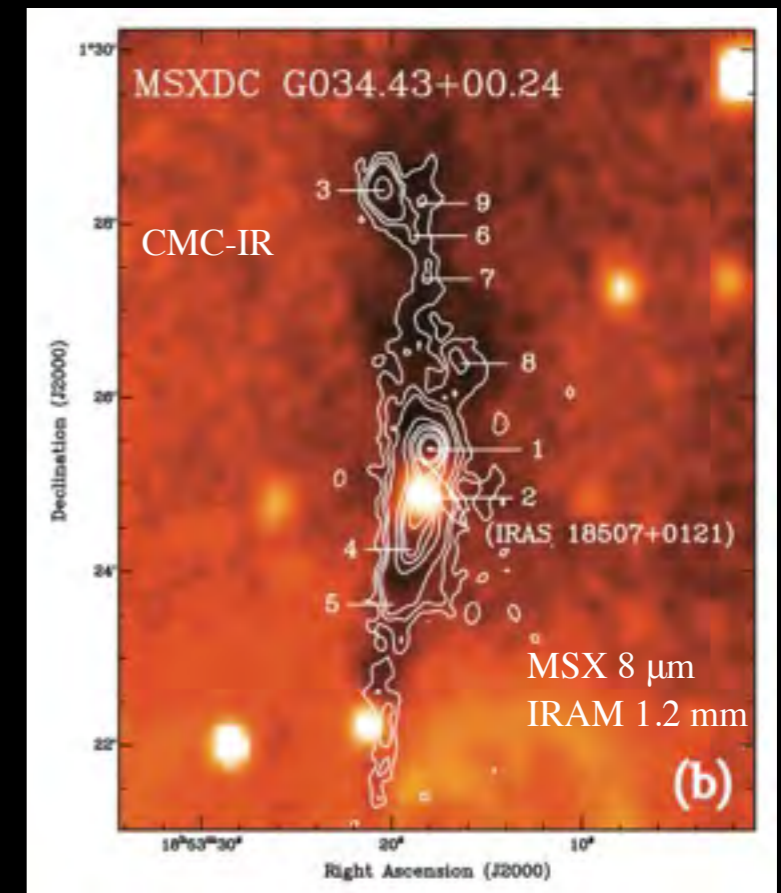
- Maser (CH_3OH and H_2O) emission
- Outflows activity

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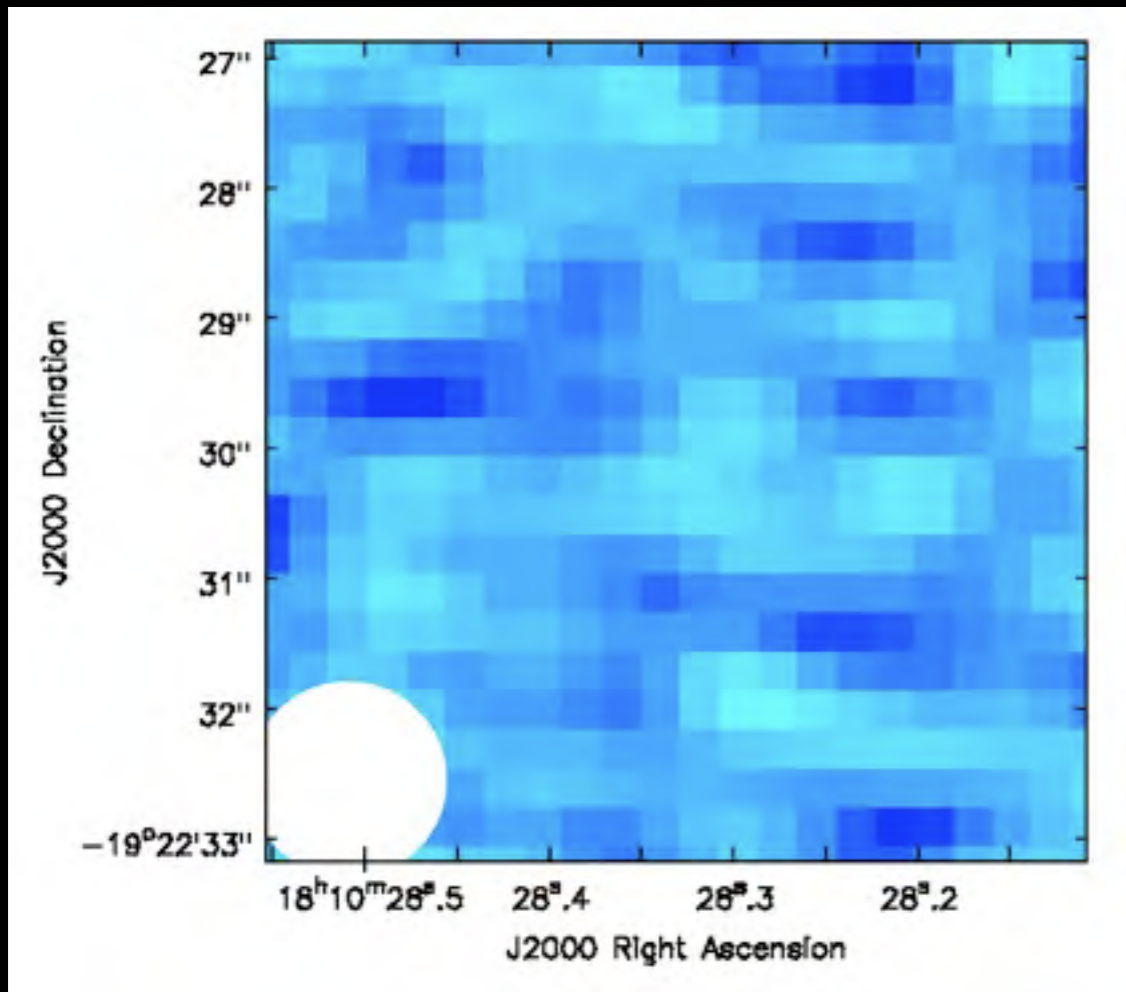
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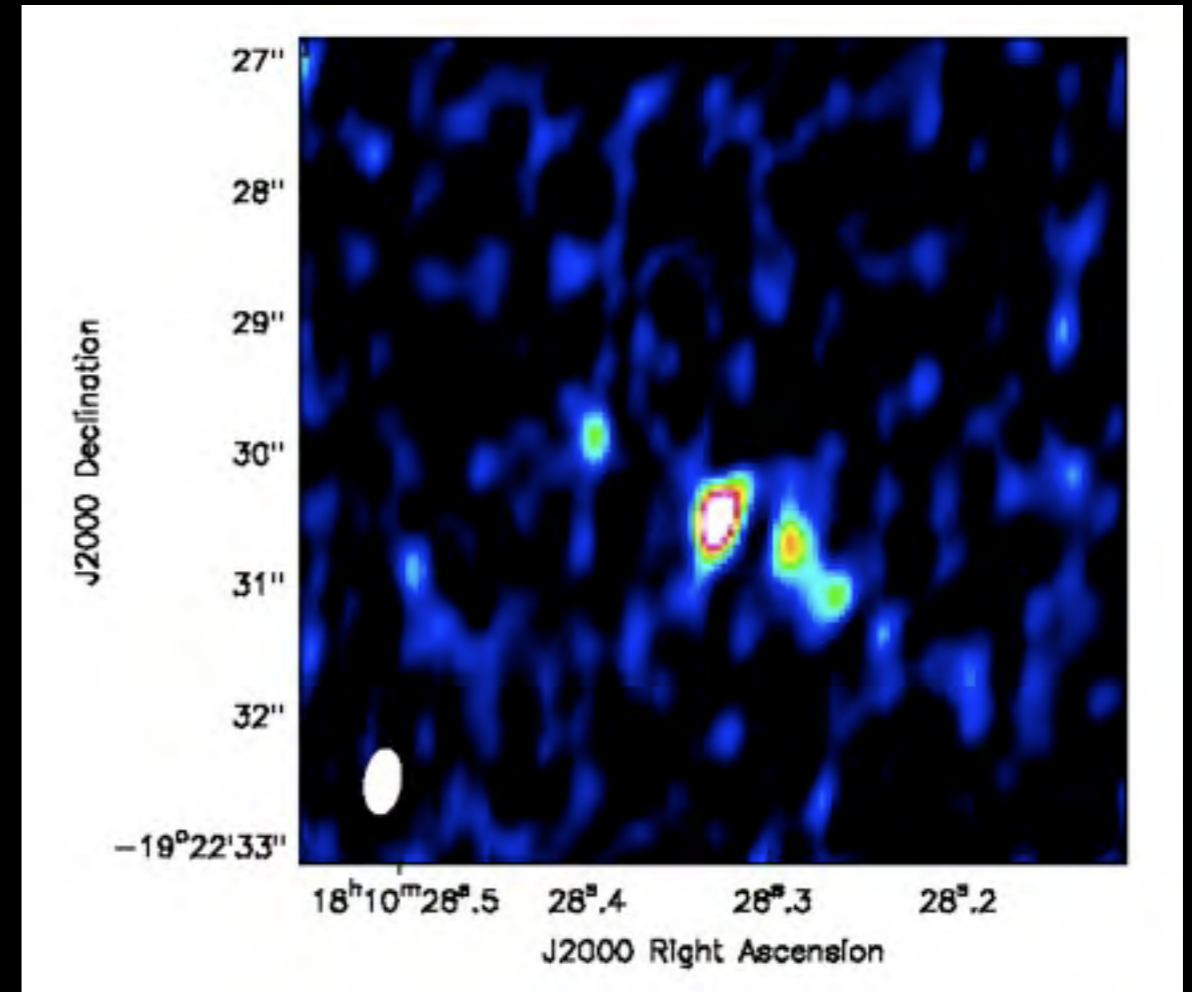
Rathborne et al. 2006

VLA Survey: Sensitivity

Previous Studies



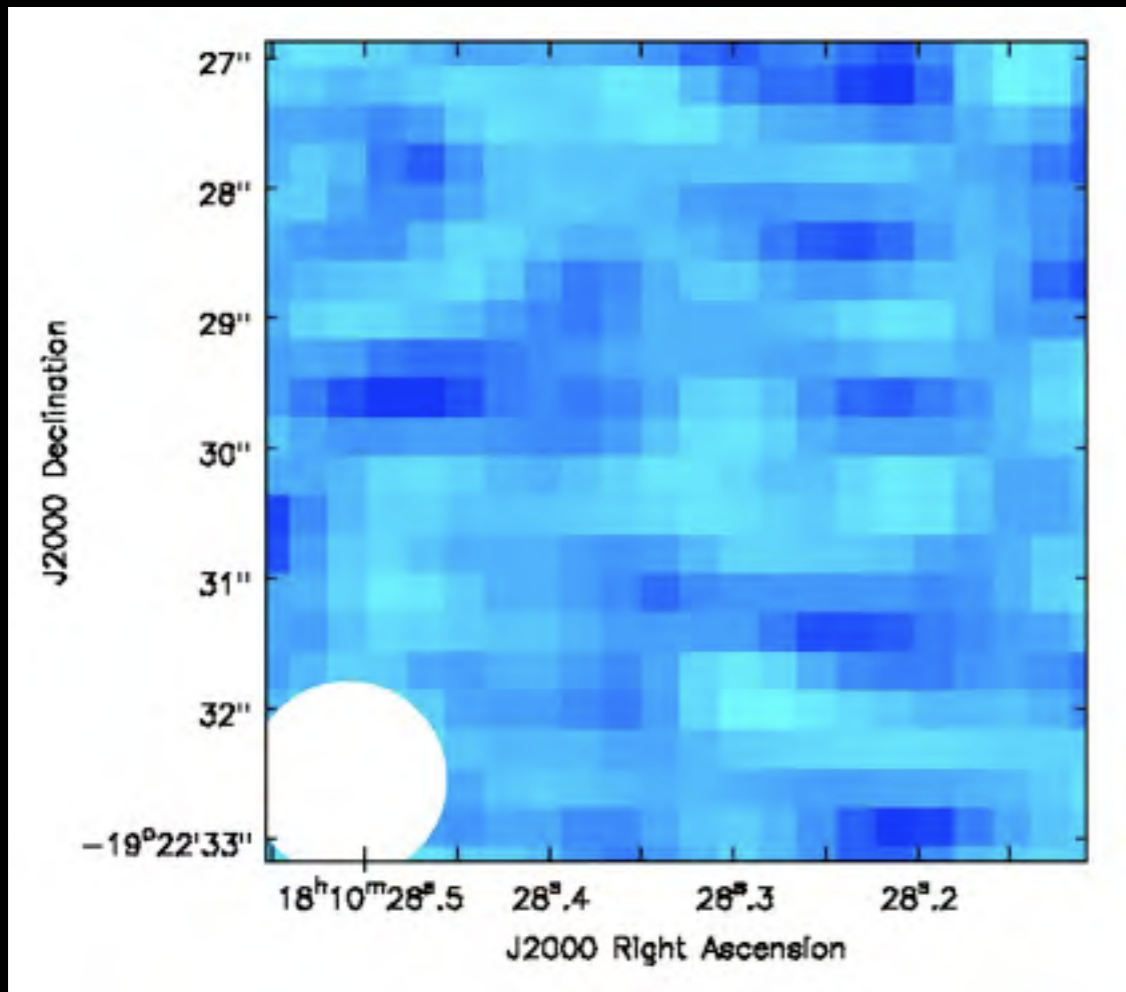
This Survey



Center Frequency (GHz): 4.9, 7.4, 20.9, 25.5
rms: 3 - 10 μ Jy/beam
Resolution $\sim 0.5''$

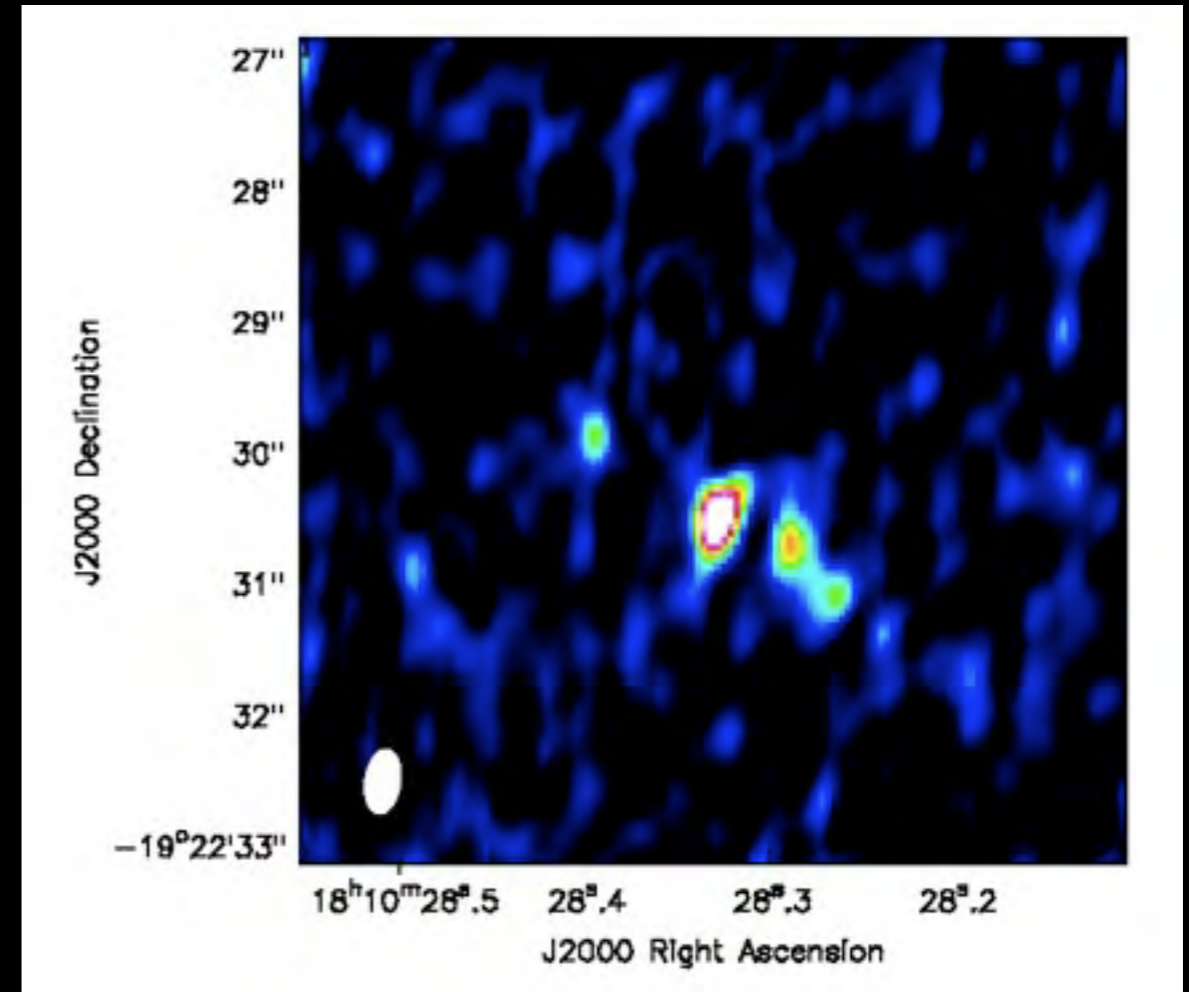
VLA Survey: Sensitivity

Previous Studies



5 GHz
rms ~ 0.4 mJy/bm
Resolution ~ 1.5''
B configuration

This Survey

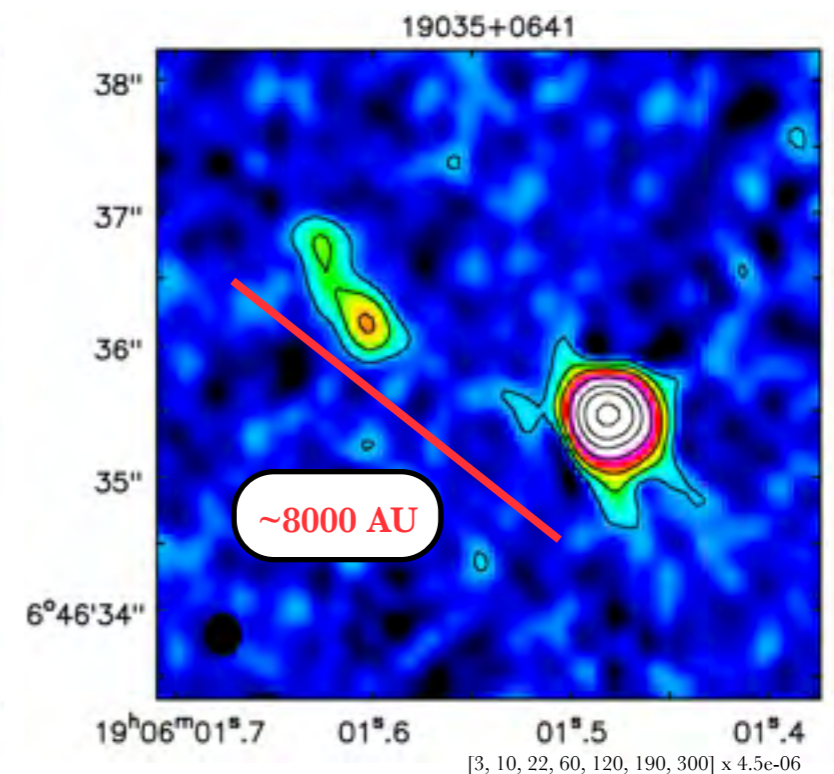
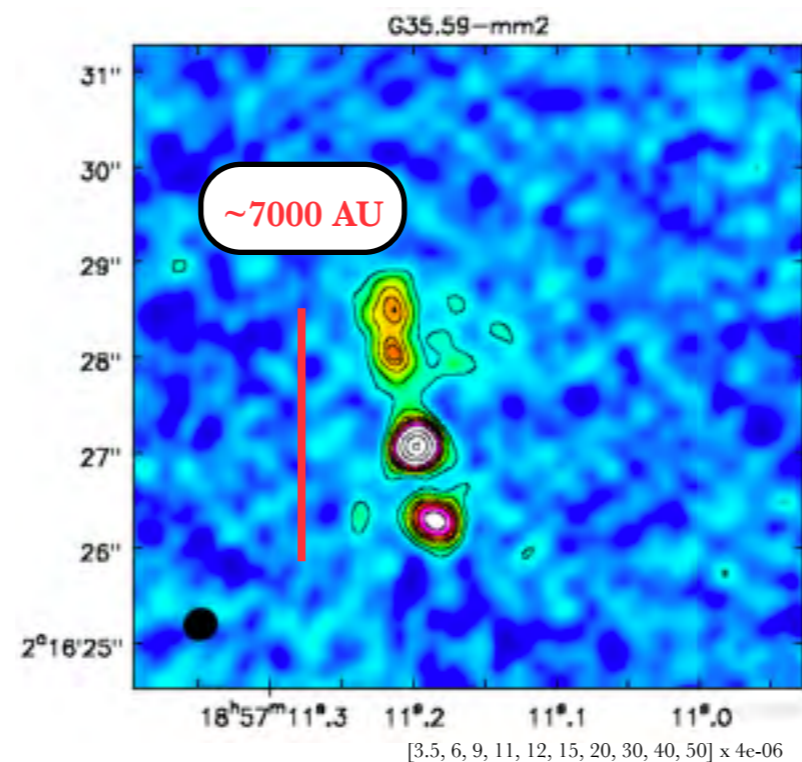
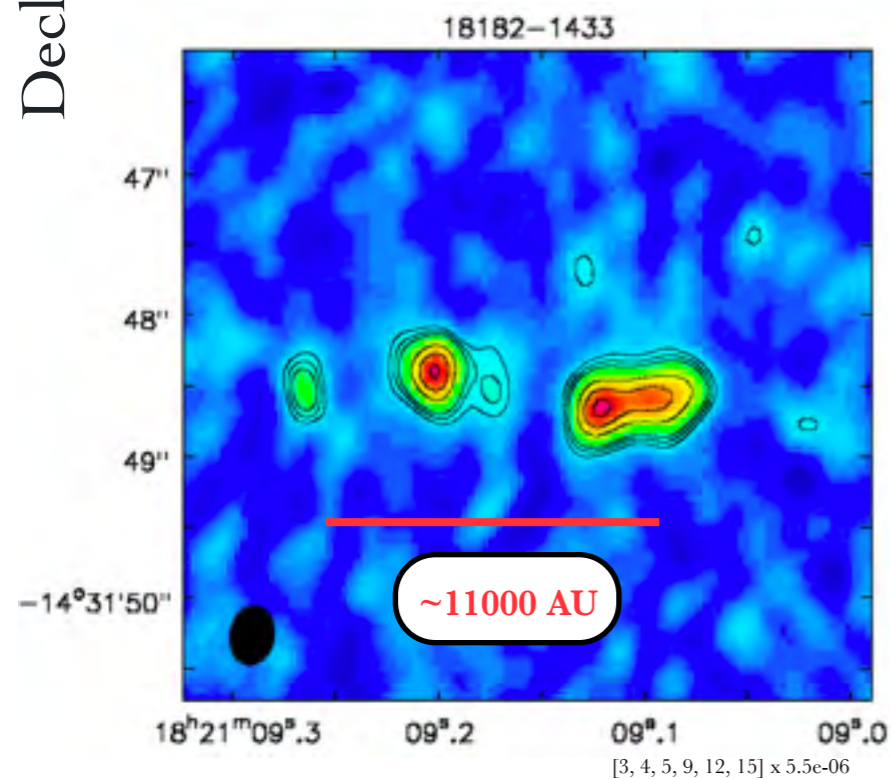
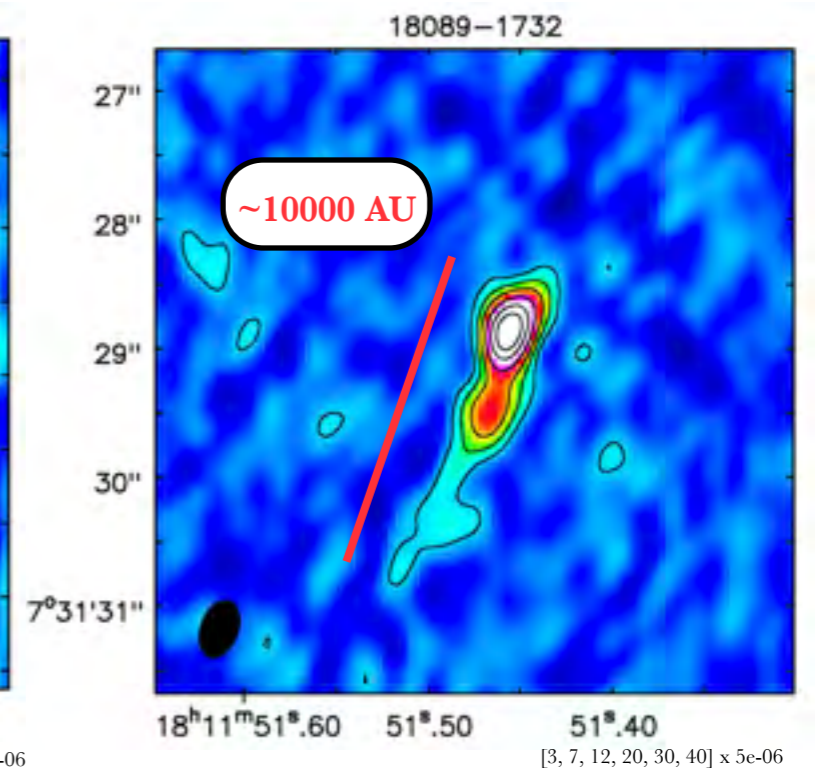
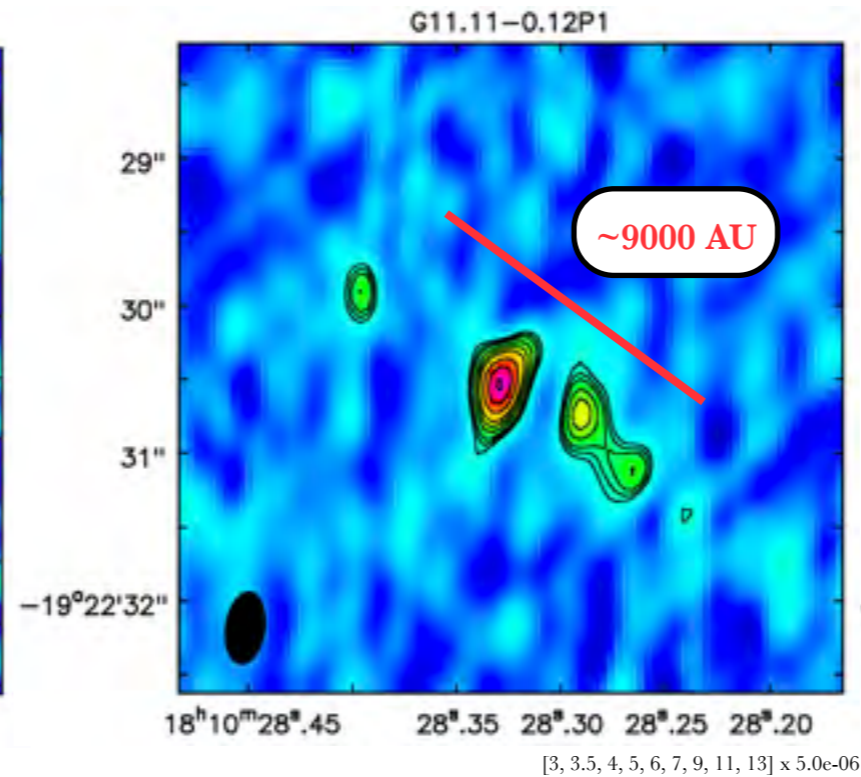
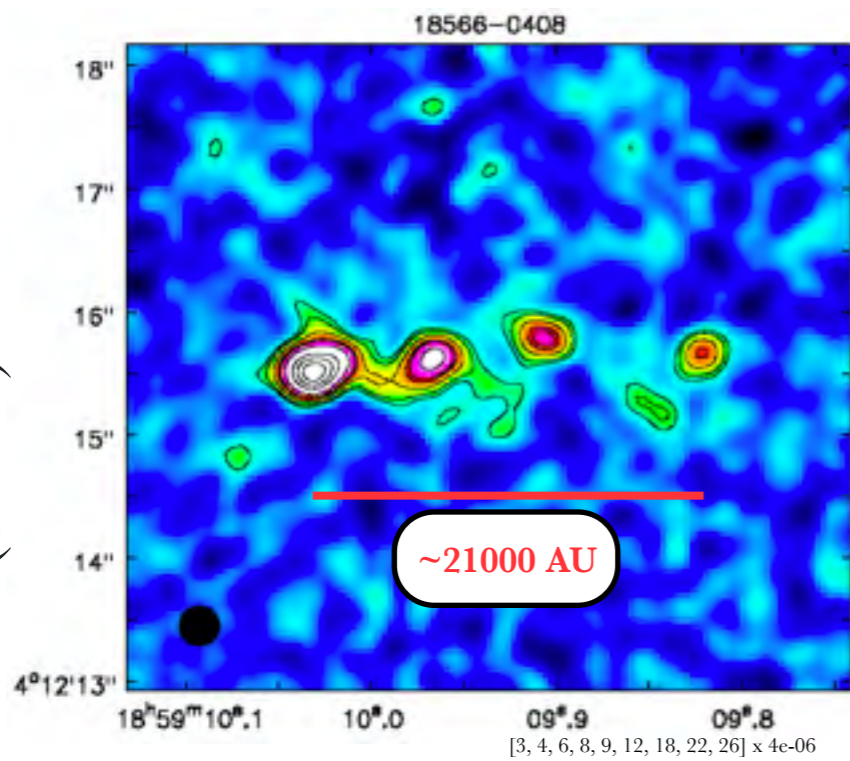


4.9, 7.4 GHz
rms ~ 5 μ Jy/bm
Resolution ~ 0.4''
A configuration

VLA Massive Protostar Survey: Jet candidates

C-band images, $\sim 5 \mu\text{Jy}/\text{beam rms}$, $\sim 0.4''$ angular resolution

Declination (J2000)

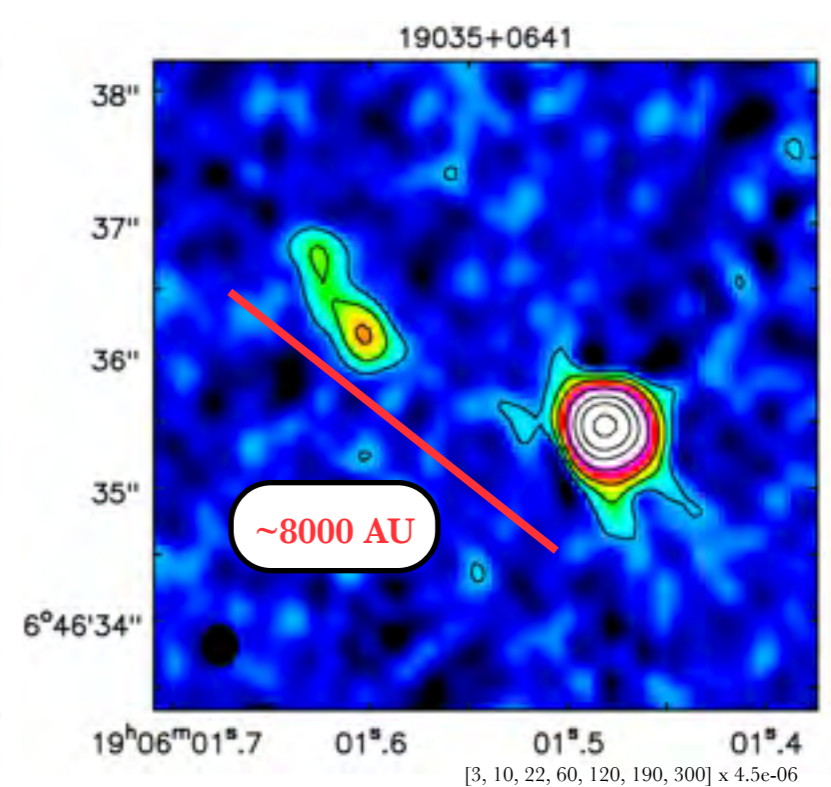
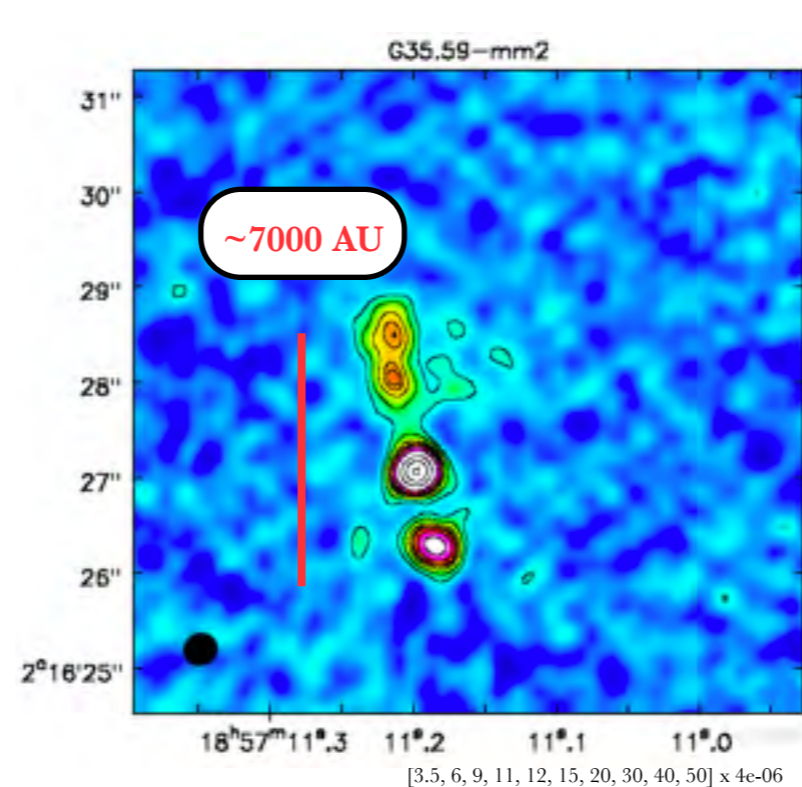
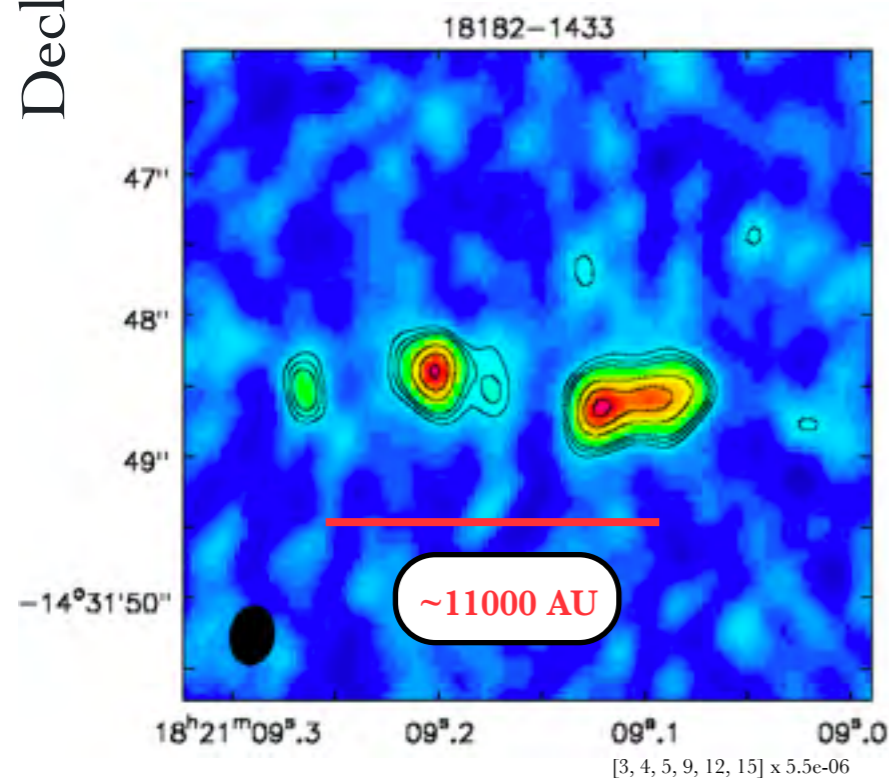
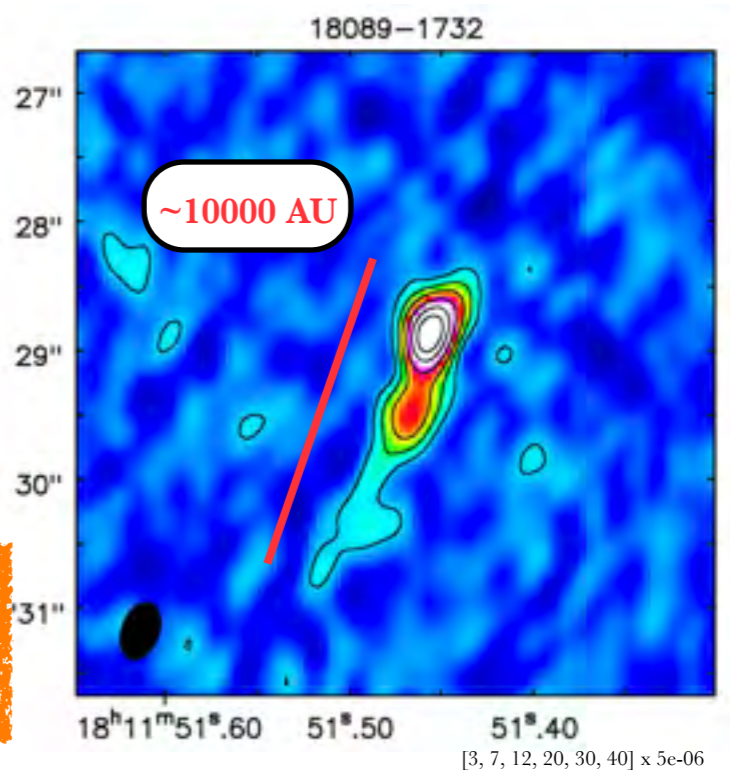
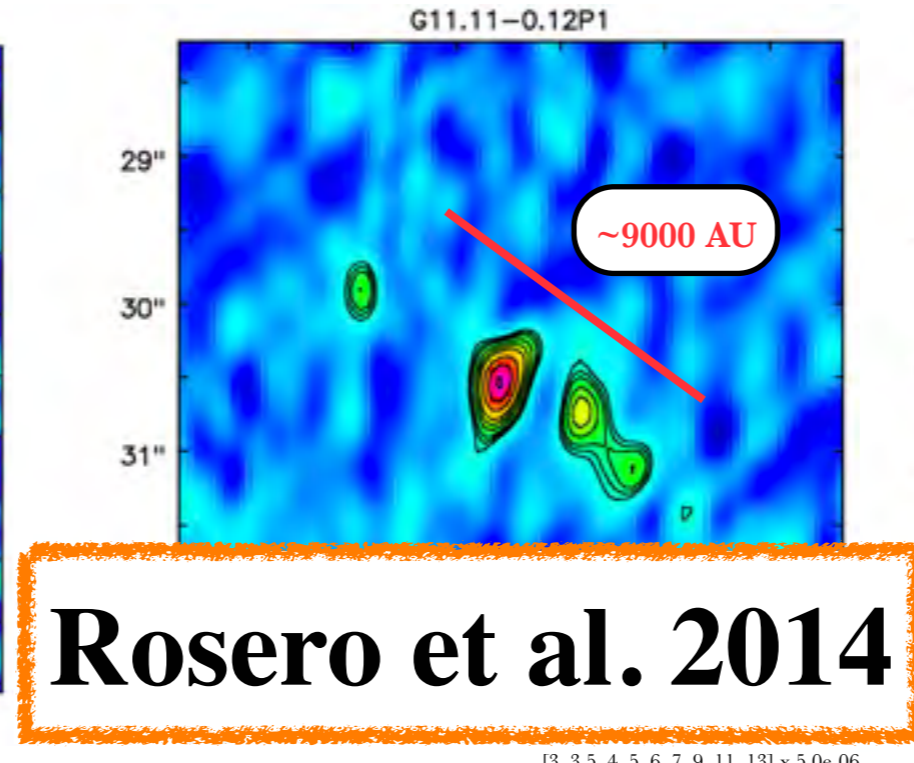
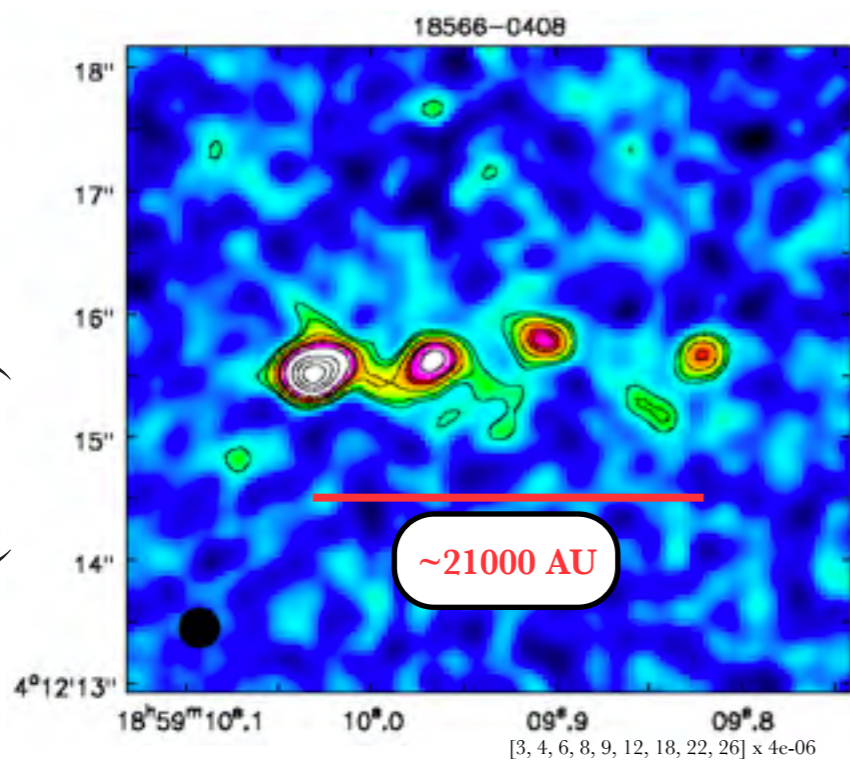


Right Ascension (J2000)

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Right Ascension (J2000)

Survey: Preliminary Results

- 56 regions
- Detection criterion: $I_\nu > 5\sigma$
- Detections:
 - 1/18 CMC: 6%
 - 8/15 CMC-IR: 53%
 - 21/23 HMC: 91%

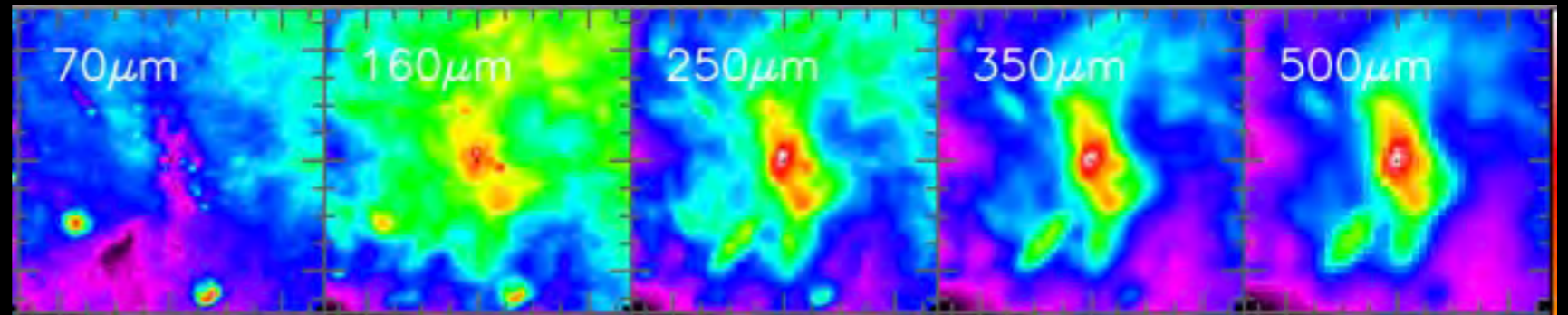


Age?

HI-GAL Data: Luminosities

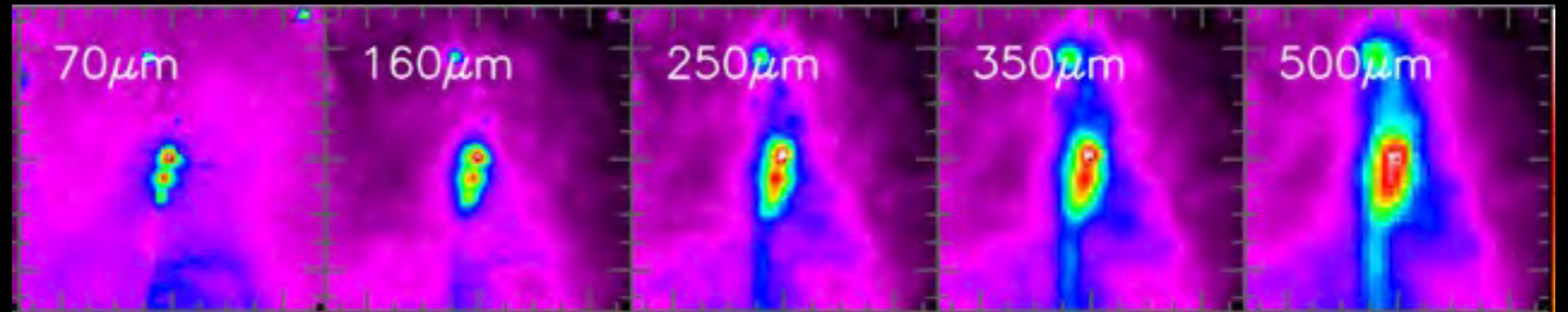
G28.53-mm1

CMC



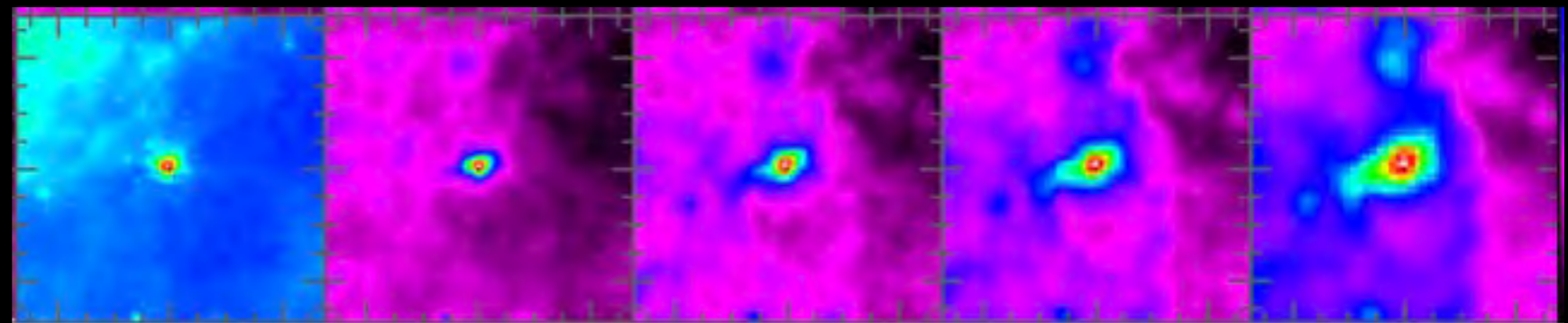
G34.43-mm1

CMC-IR



IRAS 18566+0408

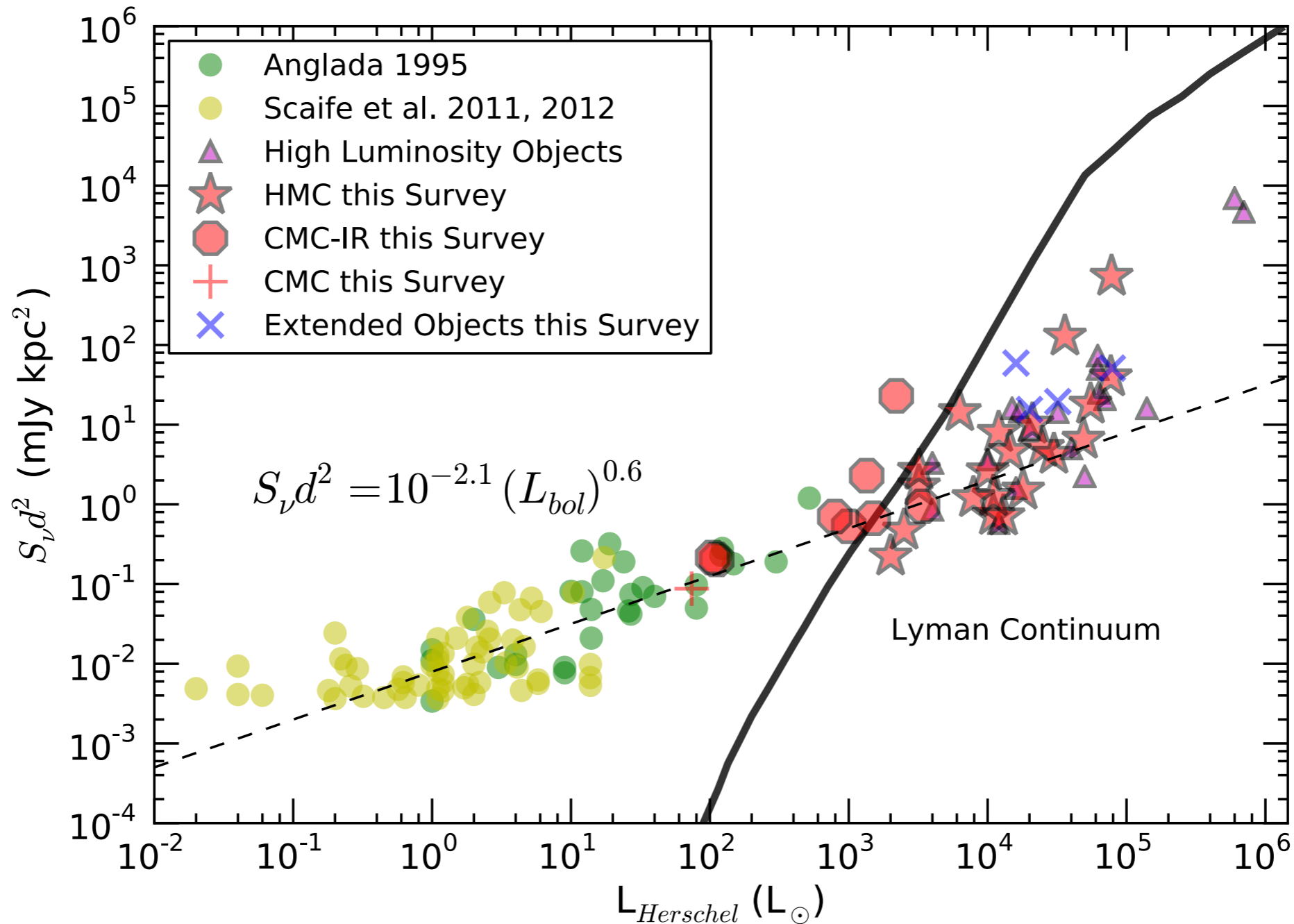
HMC



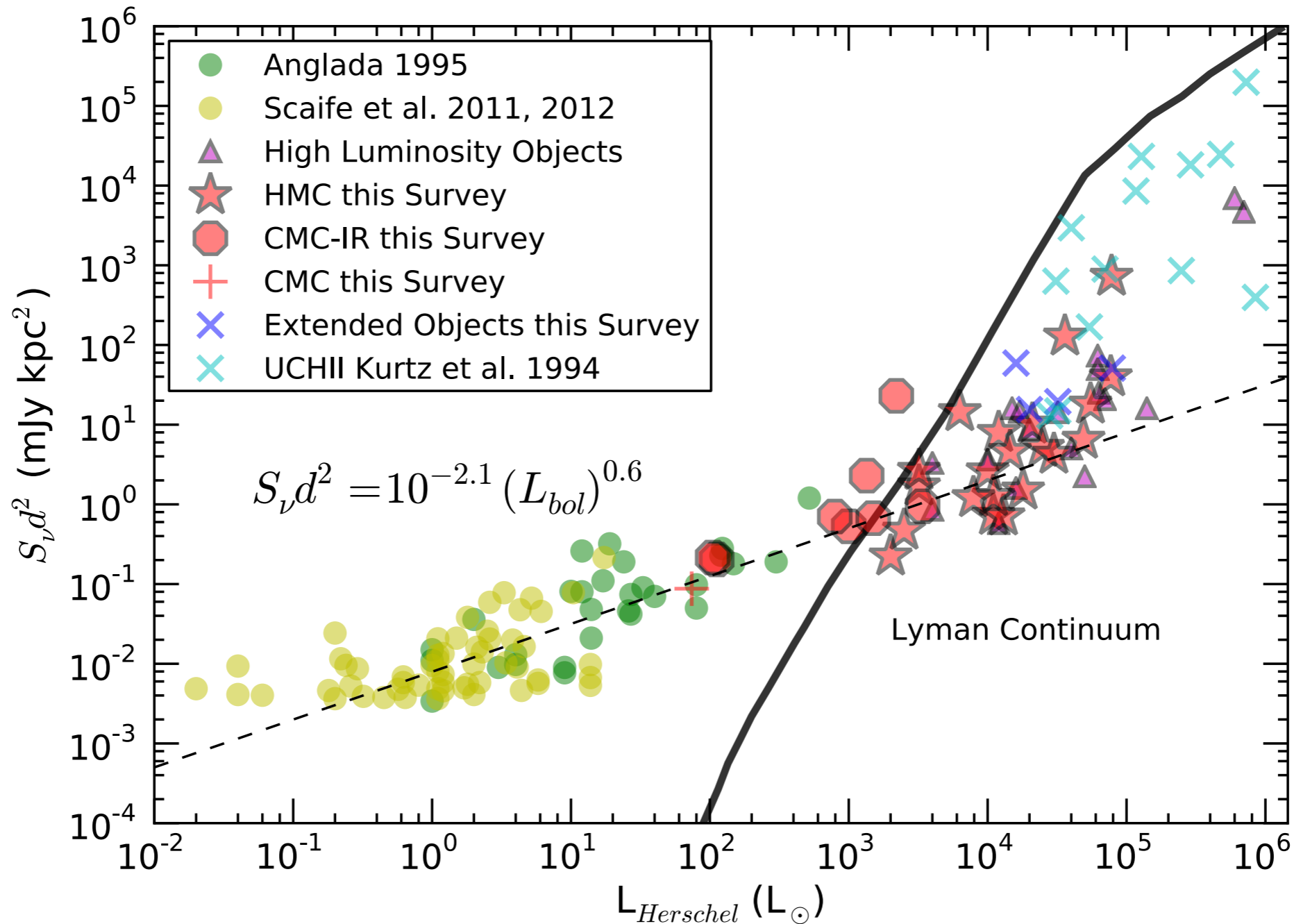
Resolution $\leq 30''$

Credit: S. Molinari; R. Cesaroni

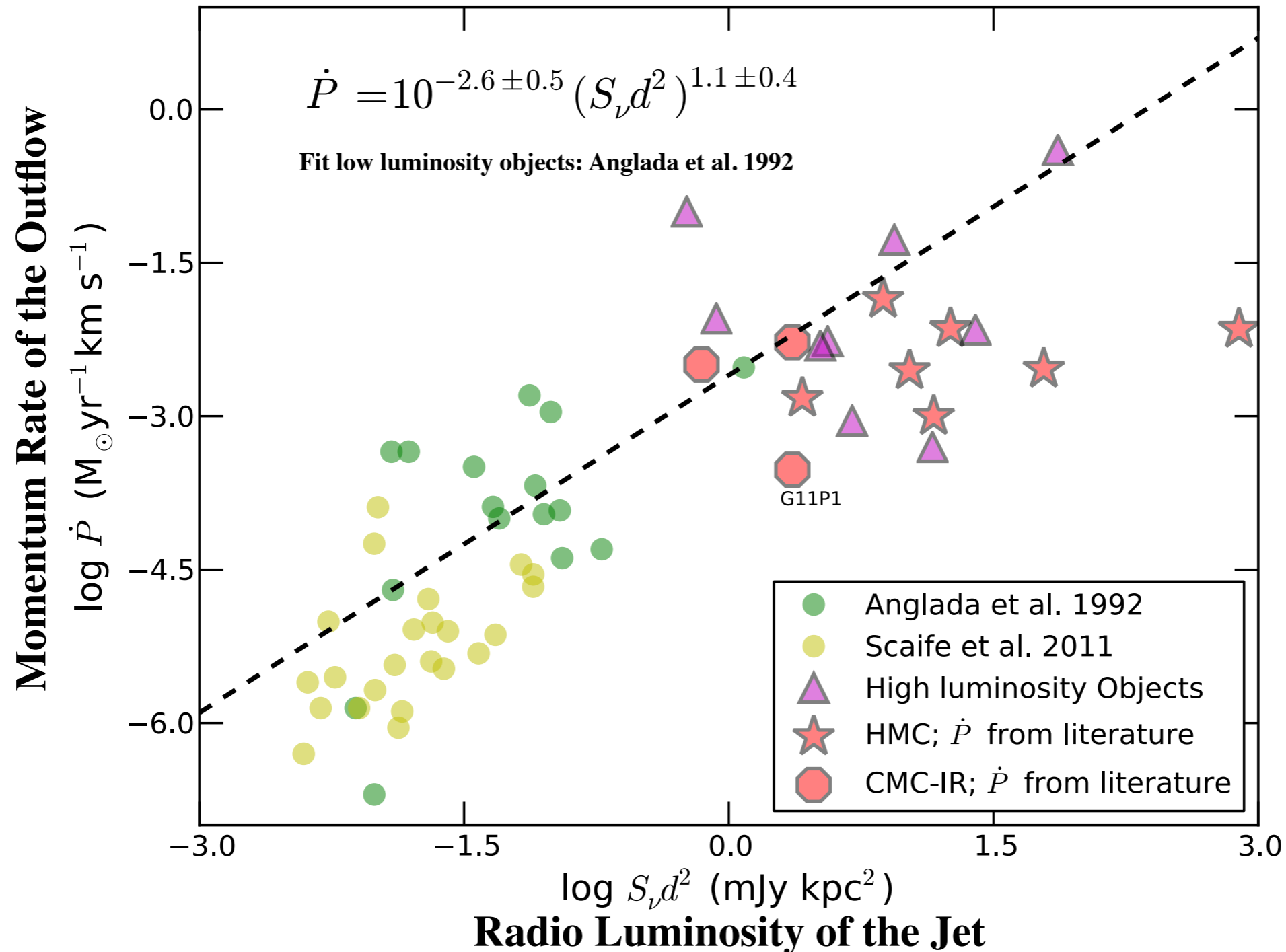
Radio Continuum vs Bolometric Luminosity correlation



Radio Continuum vs Bolometric Luminosity correlation



Radio continuum vs Molecular outflow correlation





Summary

- Starless cores: sensitivity issue or age stage?
- High detection rate of radio continuum towards cores associated with IR, some with multiple radio components
- Ionized jets might have a common origin among YSOs of any given luminosity
- Conclusive results need kinematic information

IRDC: Mass of the Cores

