ALMA Observation of HOPS 136

Group 3. Sung-Yong Yoon

ALMA Summer School
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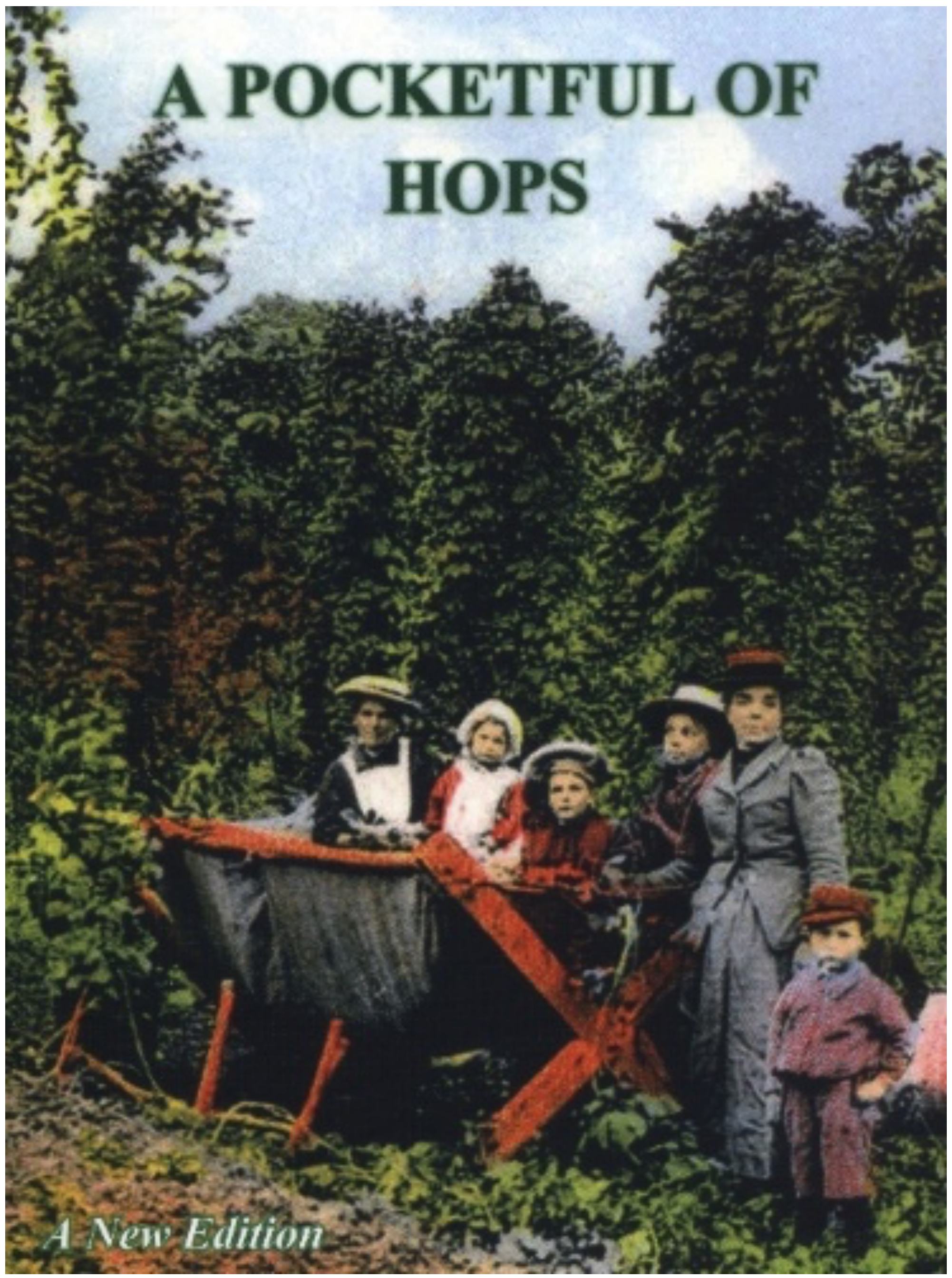
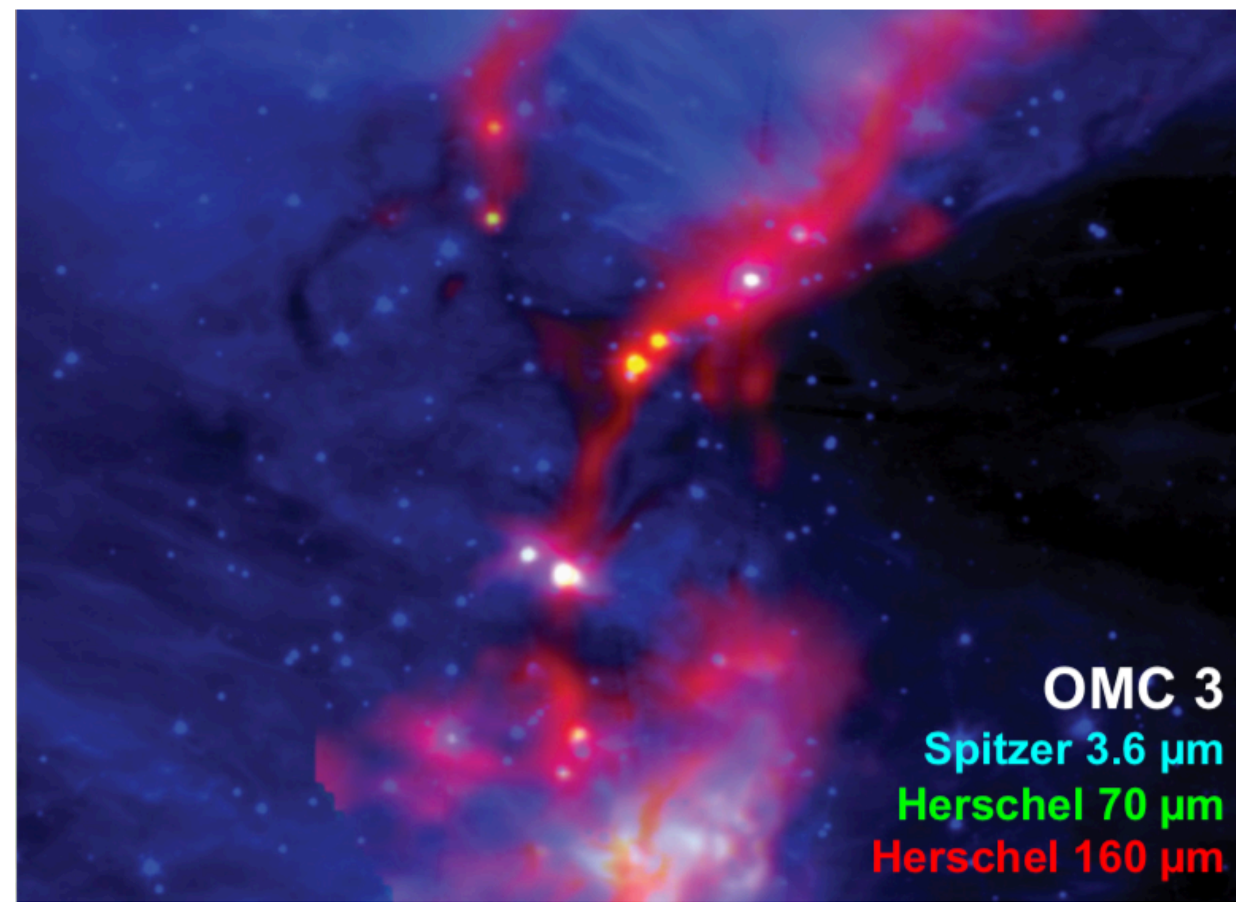
HOPS?



HOPS: Herchel Orion Protostar Survey

- 200 hour Open-Time Key Program of the Herschel Space Observatory
- Observe the Spitzer-identified Orion protostars with PACS
  - Imaging at 70 and 160 μm of >300 protostars
  - Spectroscopy from 55 to 200 μm of 33 protostars



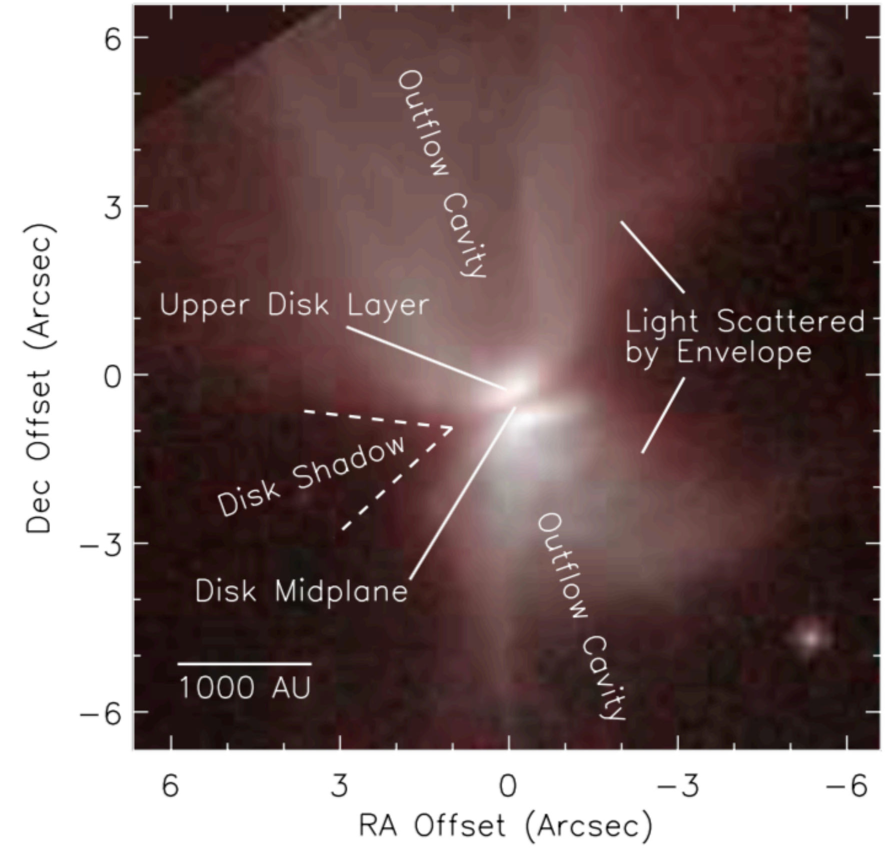
HOPS 136

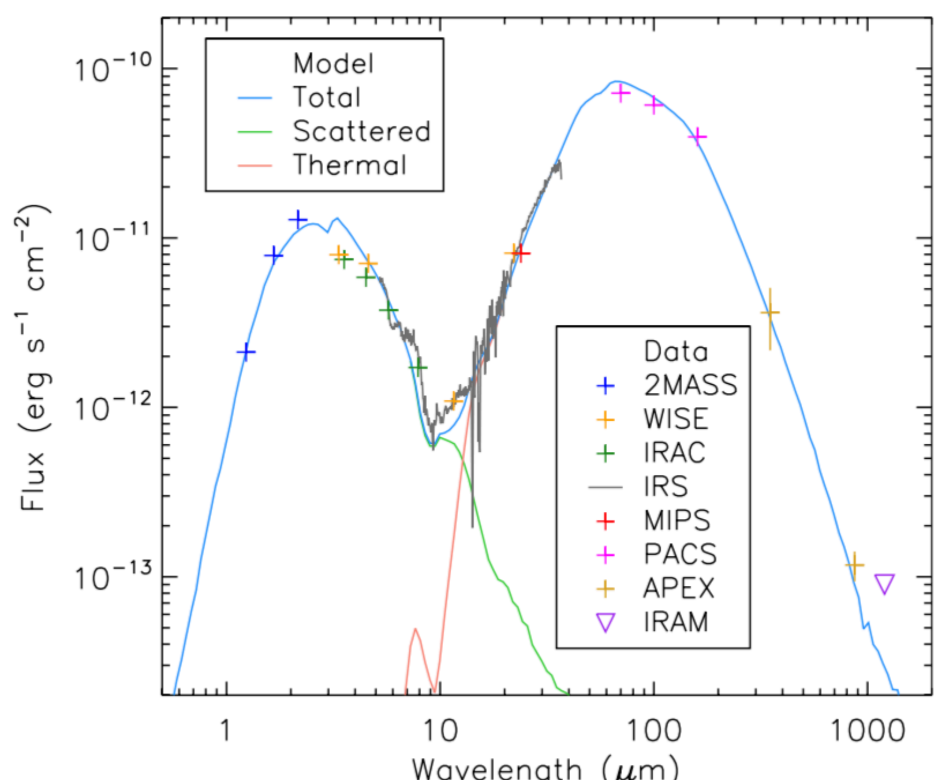
- Observed with 2MASS, WISE, *Spitzer*, *HST,* and *Herschel*

- Located in L 1641 region of Orion A (~ 430 pc)

- Class I object

- Edge-on inclination (90°)

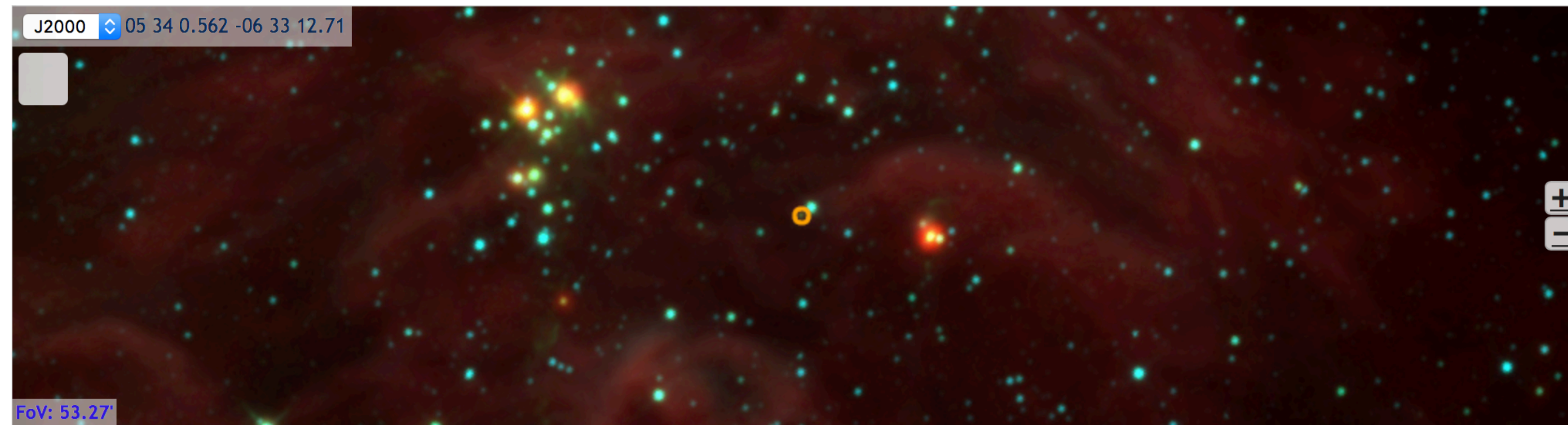




Fischer+ 2014

ALMA Observation of HOPS 136

- Band 6
- Continuum (~1.3 mm), ^{12}CO J=2-1, ^{13}CO J=2-1, $C^{18}O$ J=2-1
- 12 m - extended array
  - 54 antennas
  - $\theta \sim 1''$
- 7 m - compact array
  - 9 antennas
  - $\theta \sim 5''$



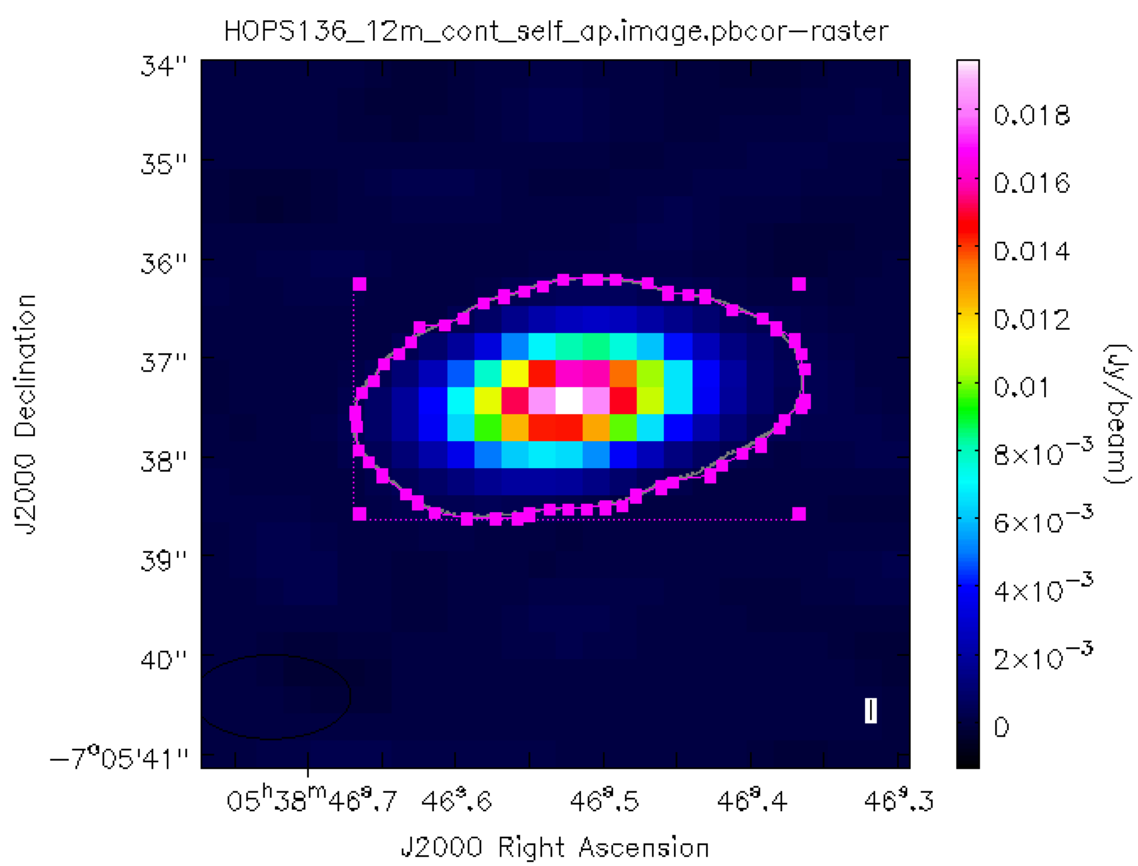
Project title
Mapping the Envelopes of Edge-On Orion Protostars

PI name
Fischer, William

Proposal abstract
The observational characterization of the structure, infall, and rotation of protostellar envelopes is a crucial step in understanding the formation of stars and circumstellar disks and how the properties of a protostar may influence the initial conditions of planet formation. We propose to use ALMA to measure envelope rotation in four Orion protostars that are known to be nearly edge-on from HST imaging with the goal of measuring the angular momentum of the infalling envelope. The sources have been observed by the Spitzer, Hubble, and Herschel space telescopes as part of the Herschel Orion Protostar Survey; these data have been used to constrain the source properties by comparing radiative transfer models to the observed spectral energy distributions and images. The objects appear to be at a later stage of protostellar evolution, where the high angular momentum of the infalling material is leading to the formation of the outer circumstellar disk. The sources' edge-on inclinations, relatively low envelope densities, and relative isolation should lead to an unambiguous detection of their envelope rotation and a direct measurement of the angular momentum as a function of radius from the central protostars. From the distribution of angular momentum, we can constrain the initial angular momentum distribution and the subsequent evolution of the angular momentum during infall. Observing these well studied prototypical envelopes will serve as a launching point for future ALMA studies of disk and envelope structure in Orion, the most active star-forming region within 1 kpc of the Sun.

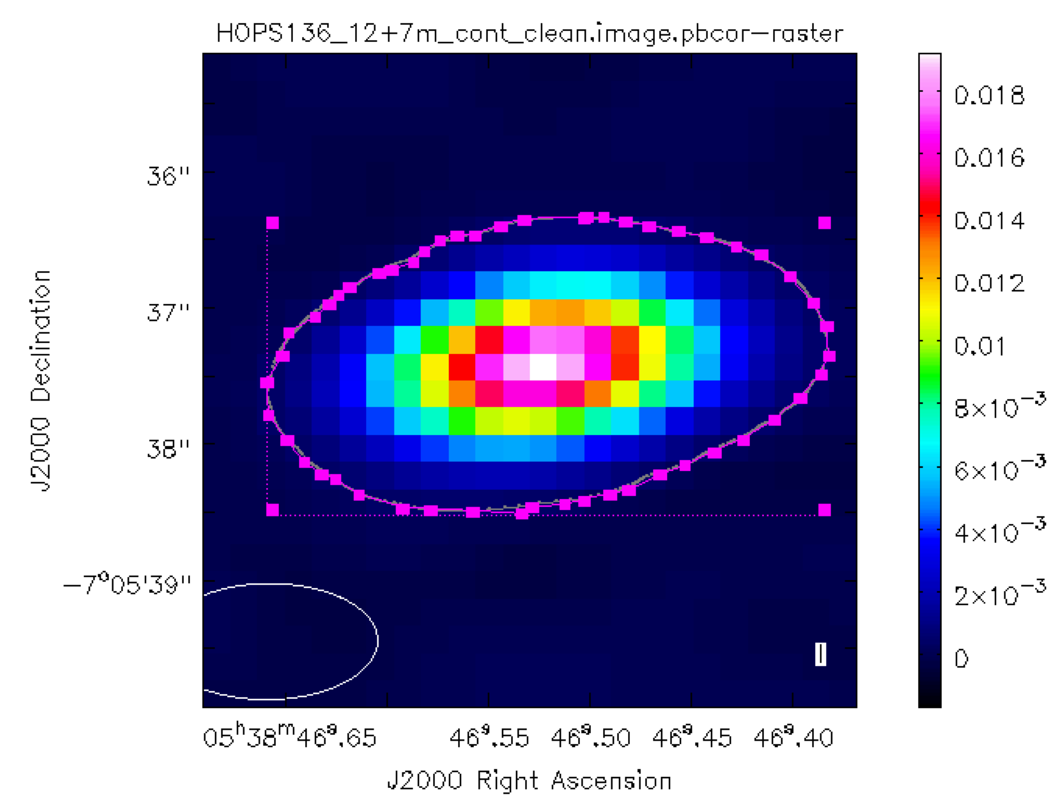
1.3 mm Continuum

12m



Flux density ~ 0.024 Jy

12m+7m



Flux density ~ 0.022 Jy

$$M_{\rm dust} = \frac{F_\nu \times d^2}{\kappa_\nu \times B_\nu(T_{\rm dust})},$$

Assuming Tdust ~ 20 K,

κ_ν ~ 2.3 cm^2 g^{-1},

and d ~ 430 pc,

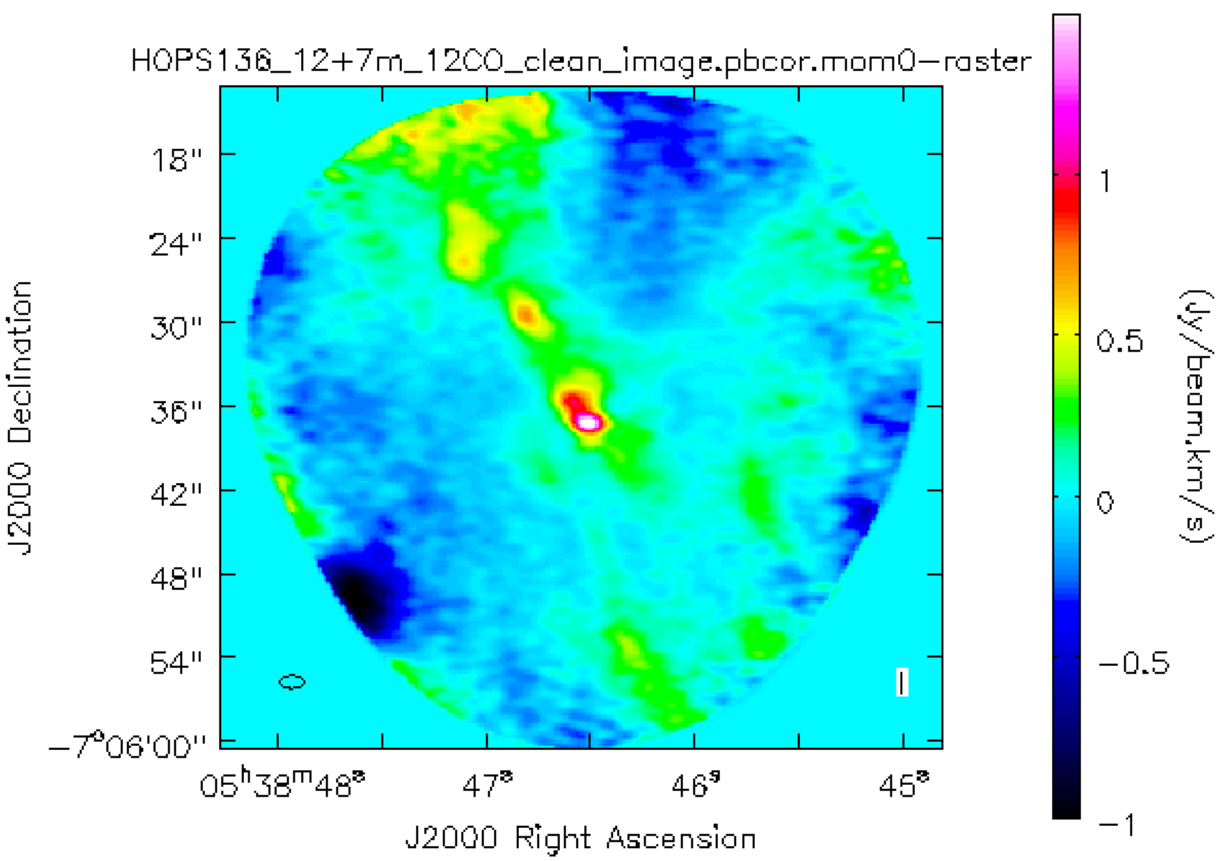
→

M_{dust} ~ 2.9×10^{-4} M$_\odot$

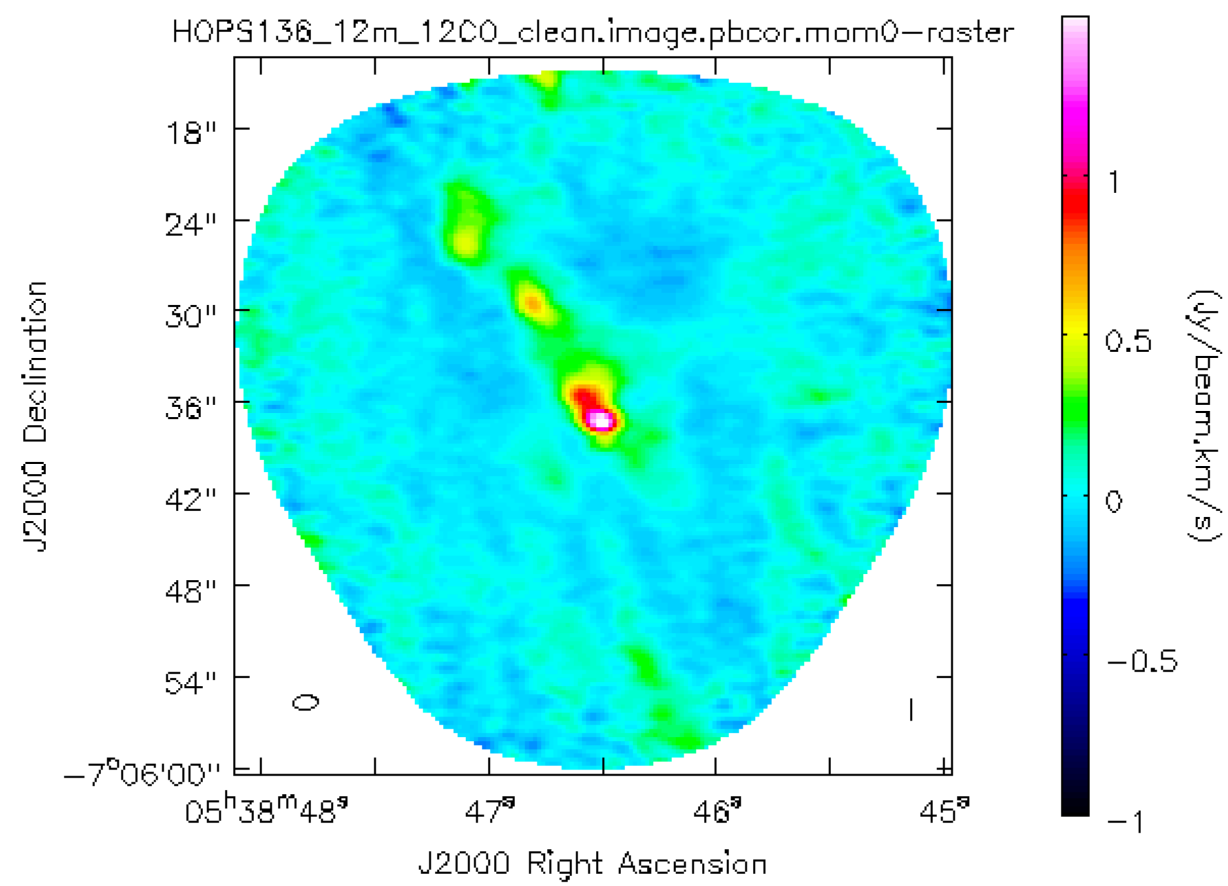
M_{disk} ~ 2.9×10^{-2} M$_\odot$
(Gas to dust ratio ~ 100)

^{12}CO J=2-1: moment 0

12m + 7m

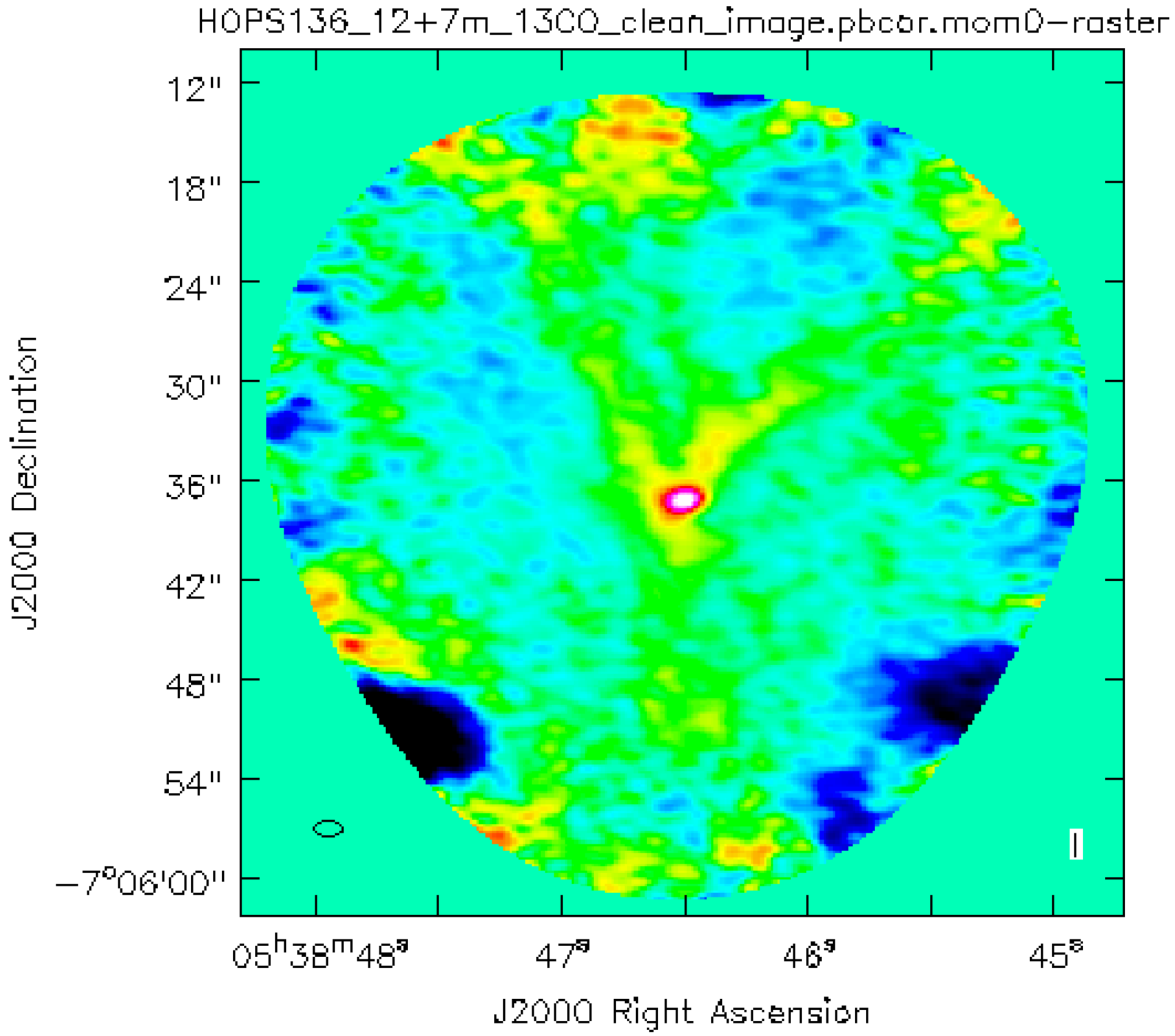


12m

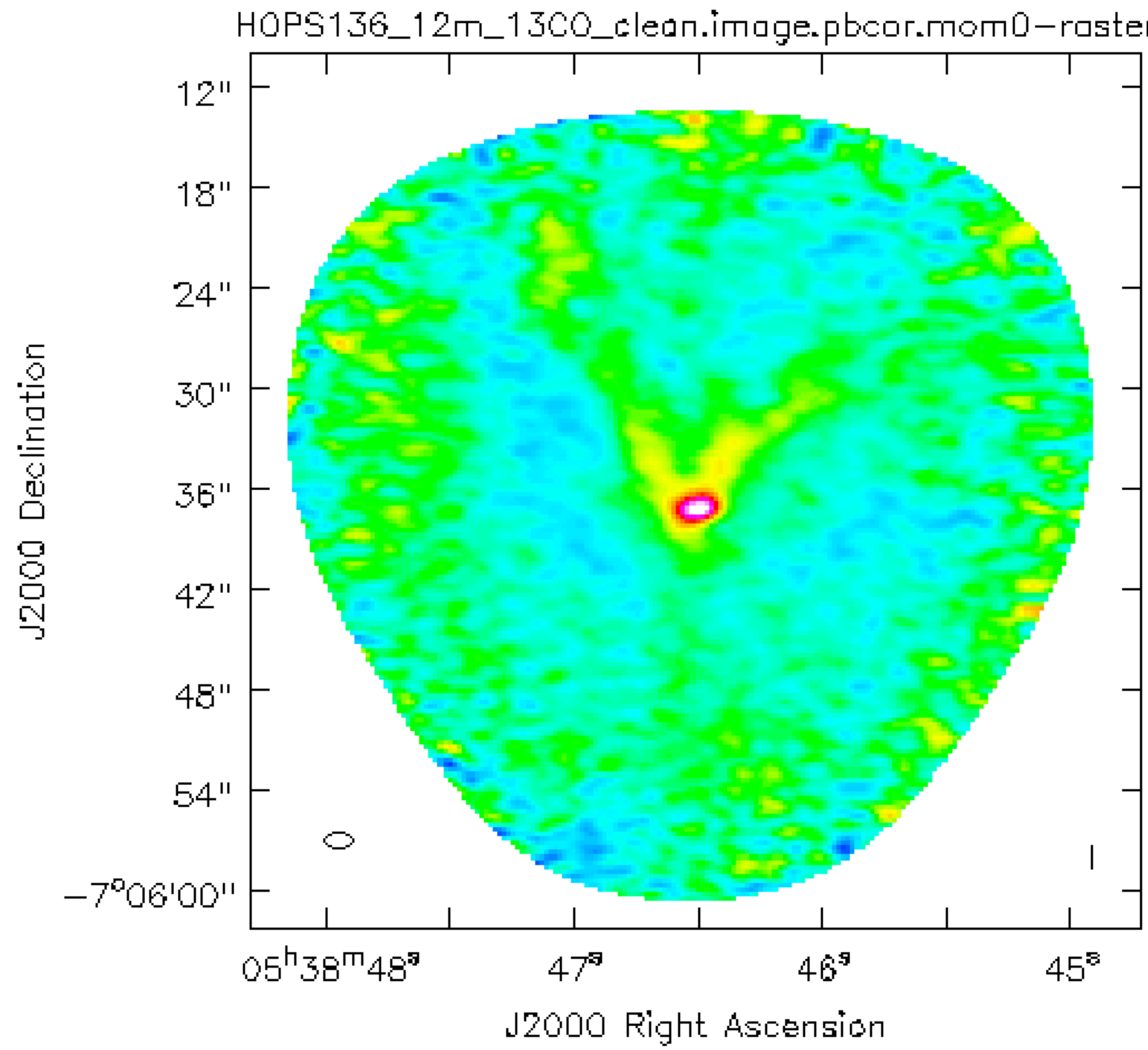


^{13}CO J=2-1: moment 0

12m + 7m

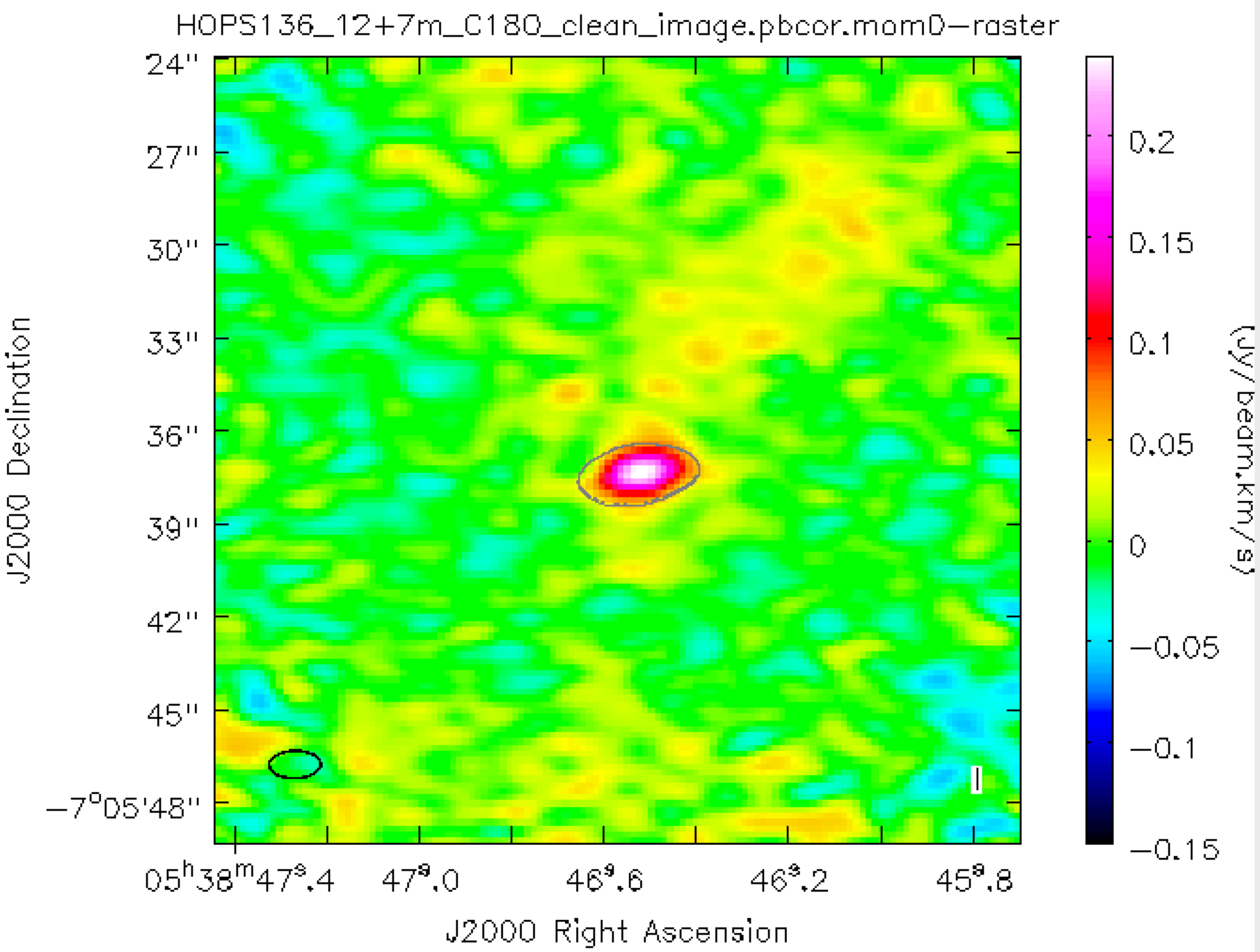


12m

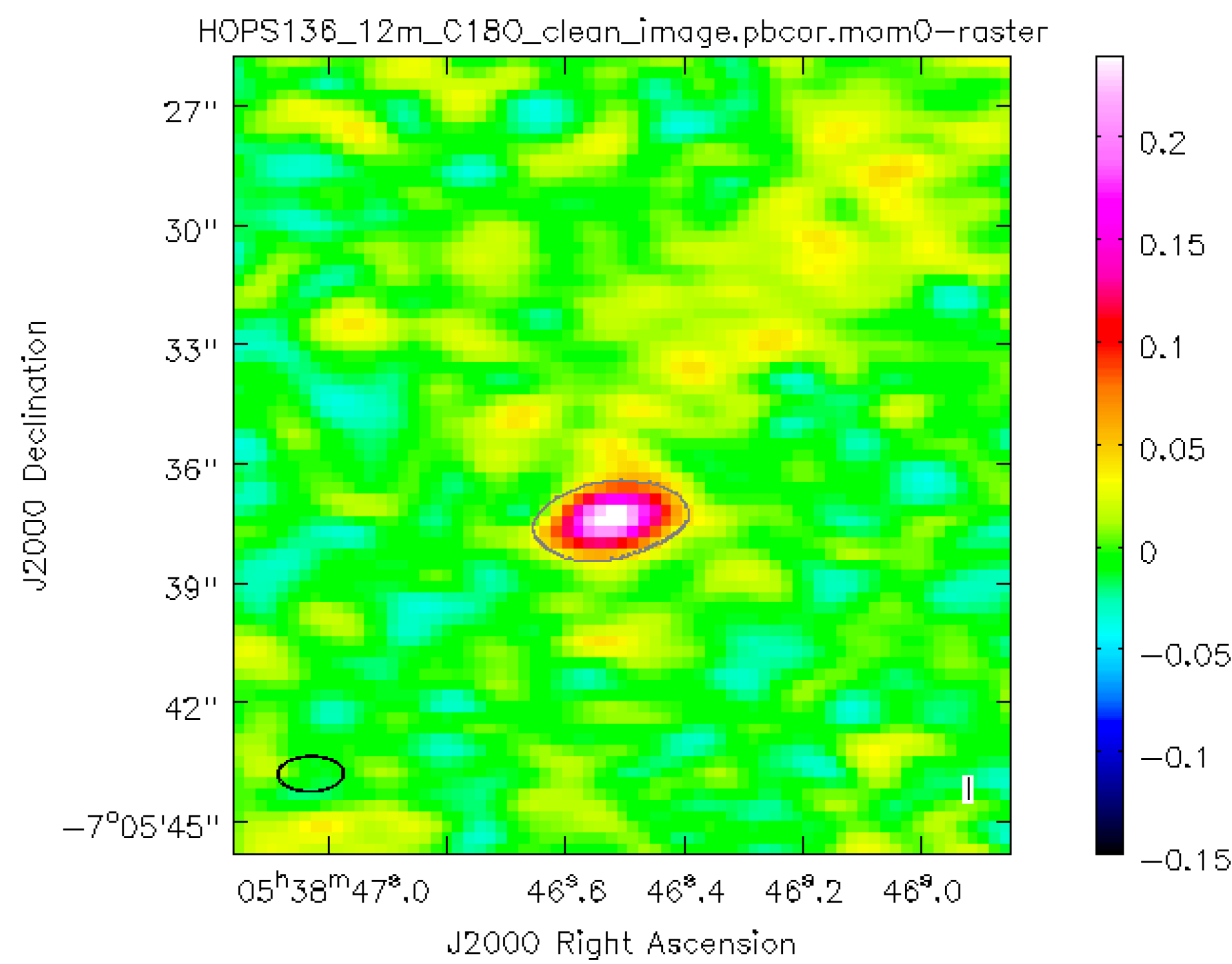


$C^{18}O$ J=2-1: moment 0

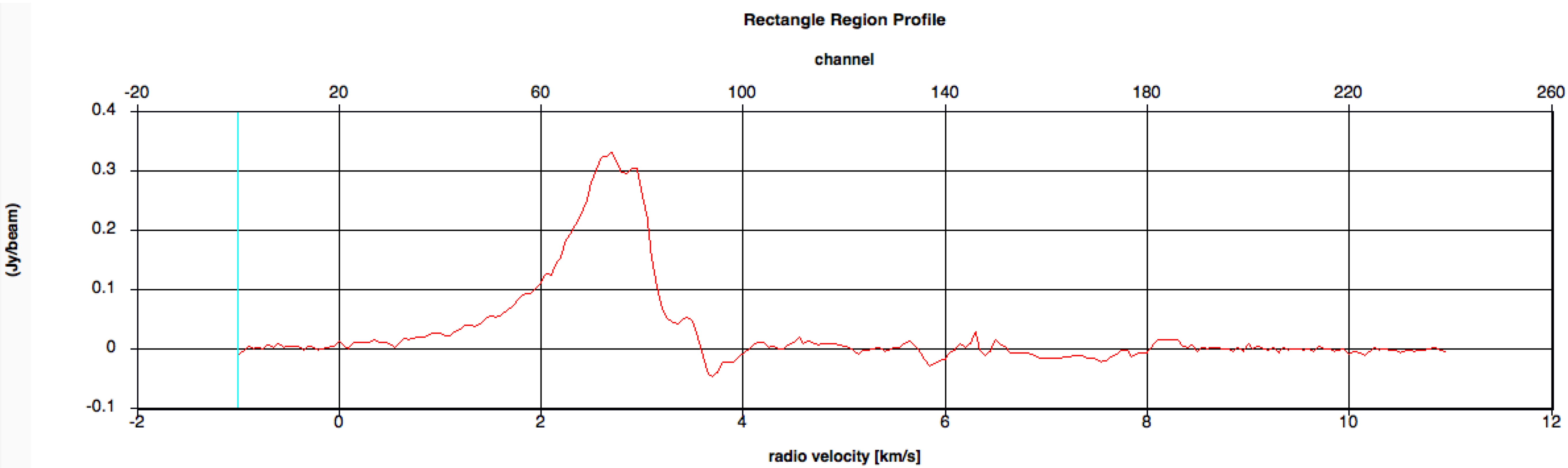
12m + 7m

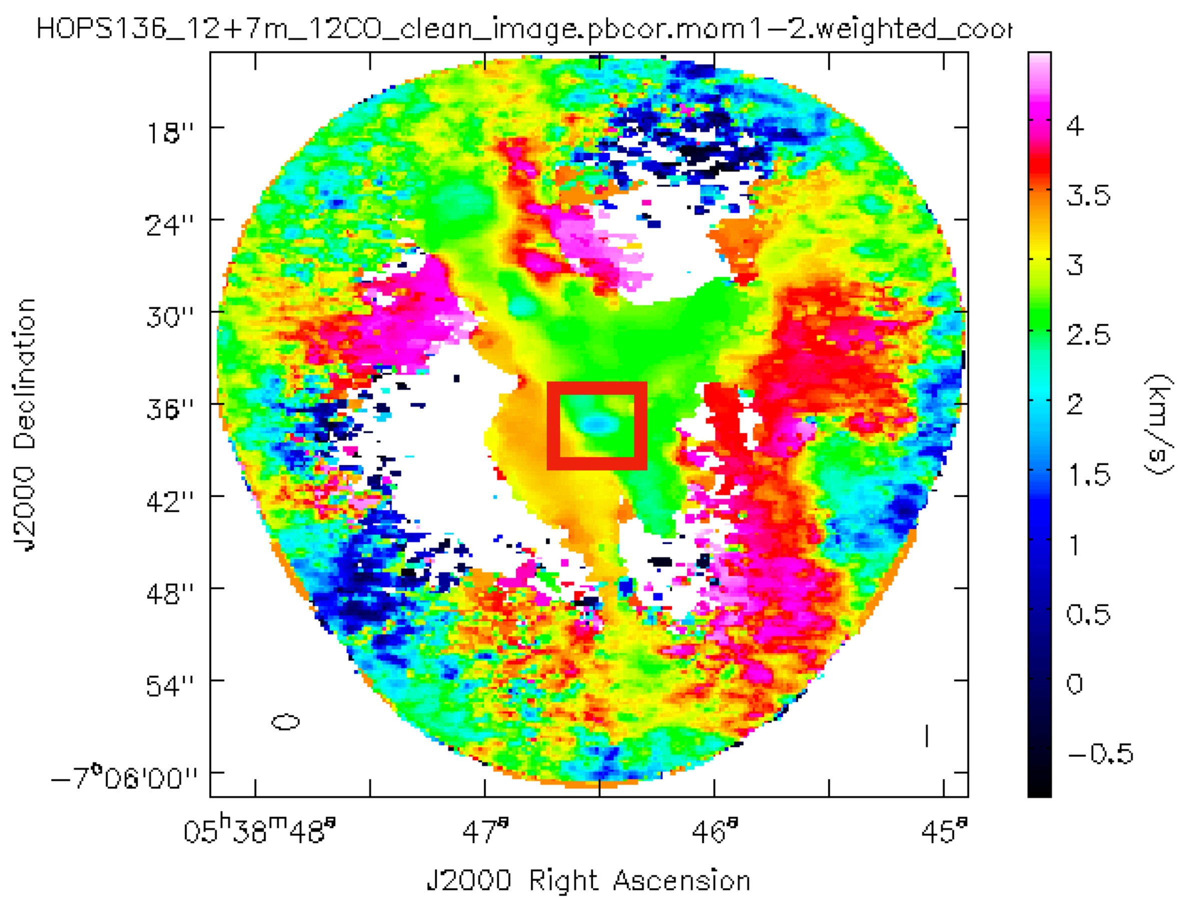


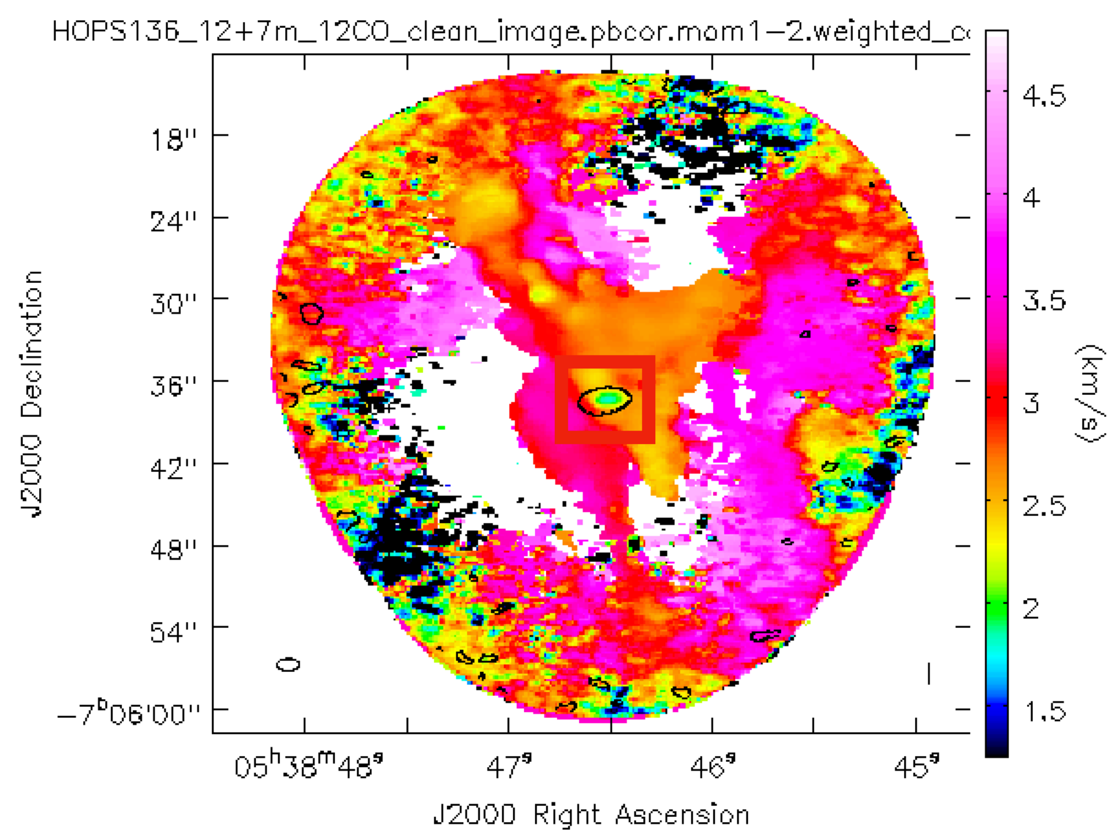
12m

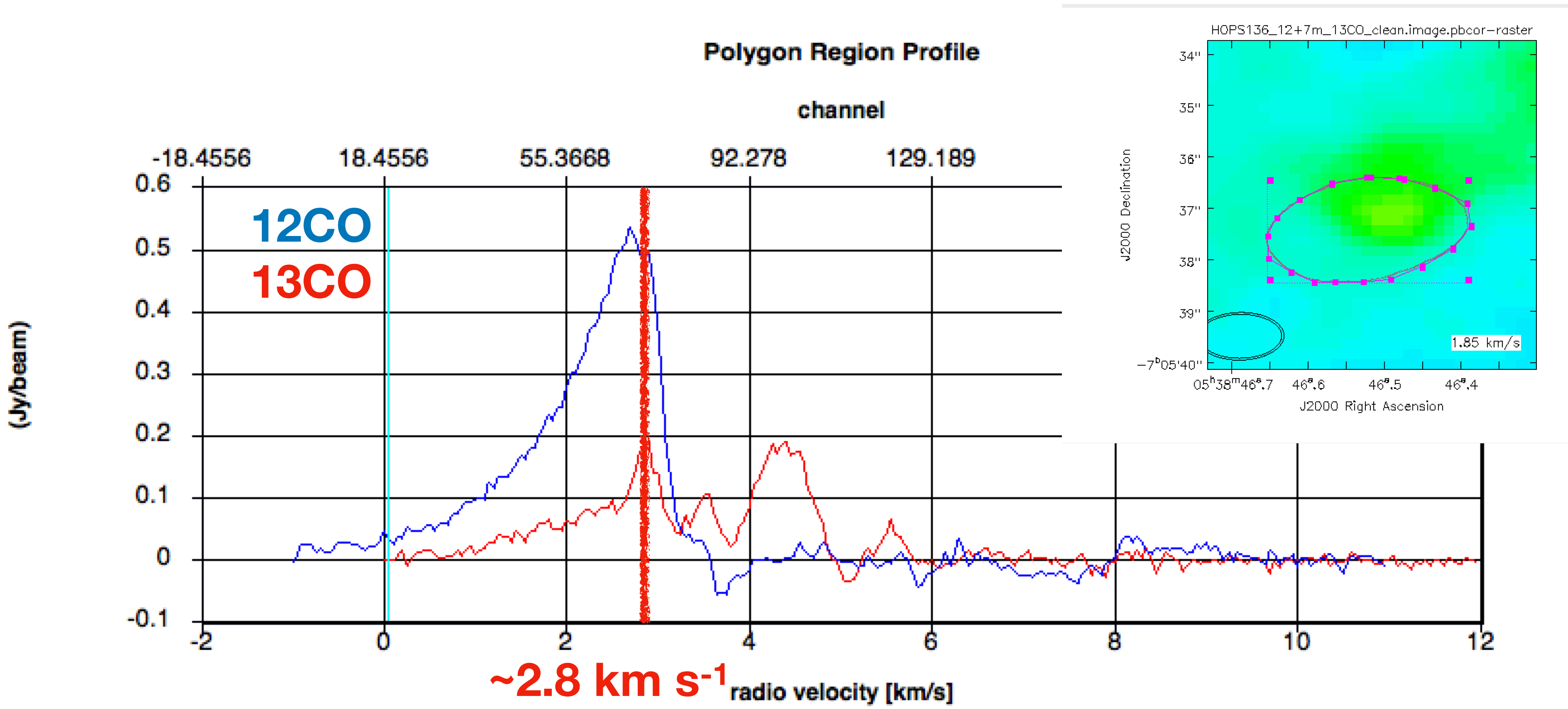


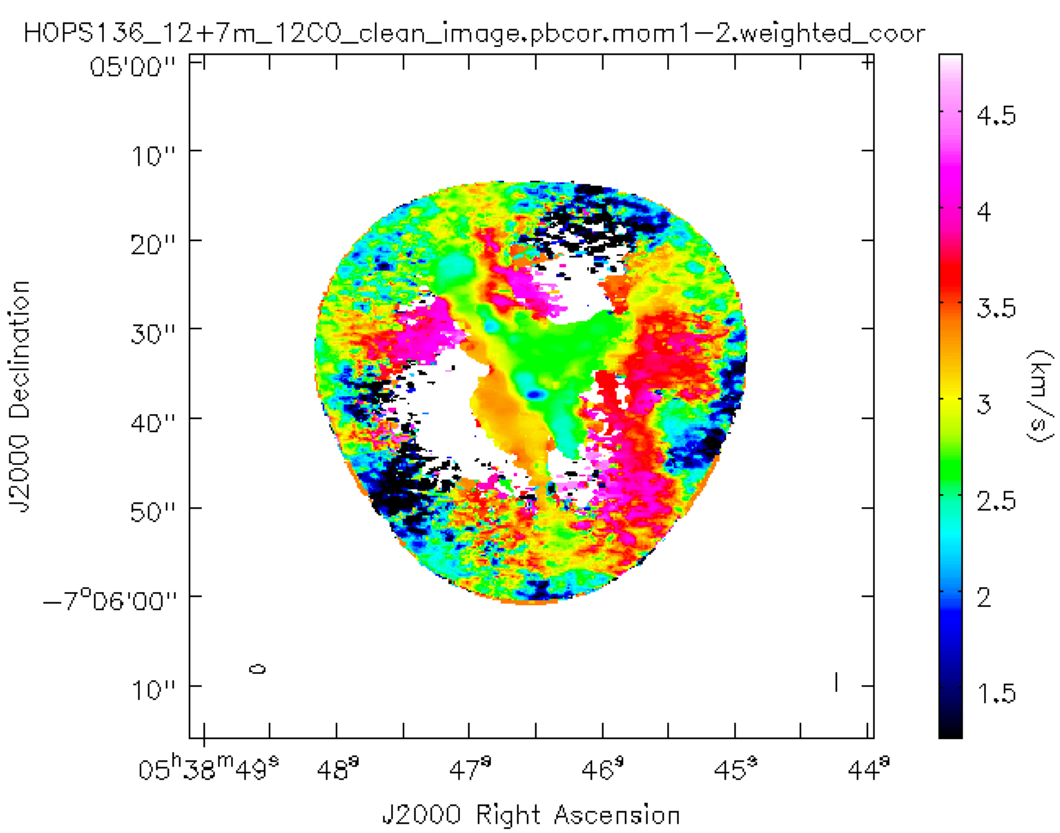
^{12}CO J=2-1: moment 1

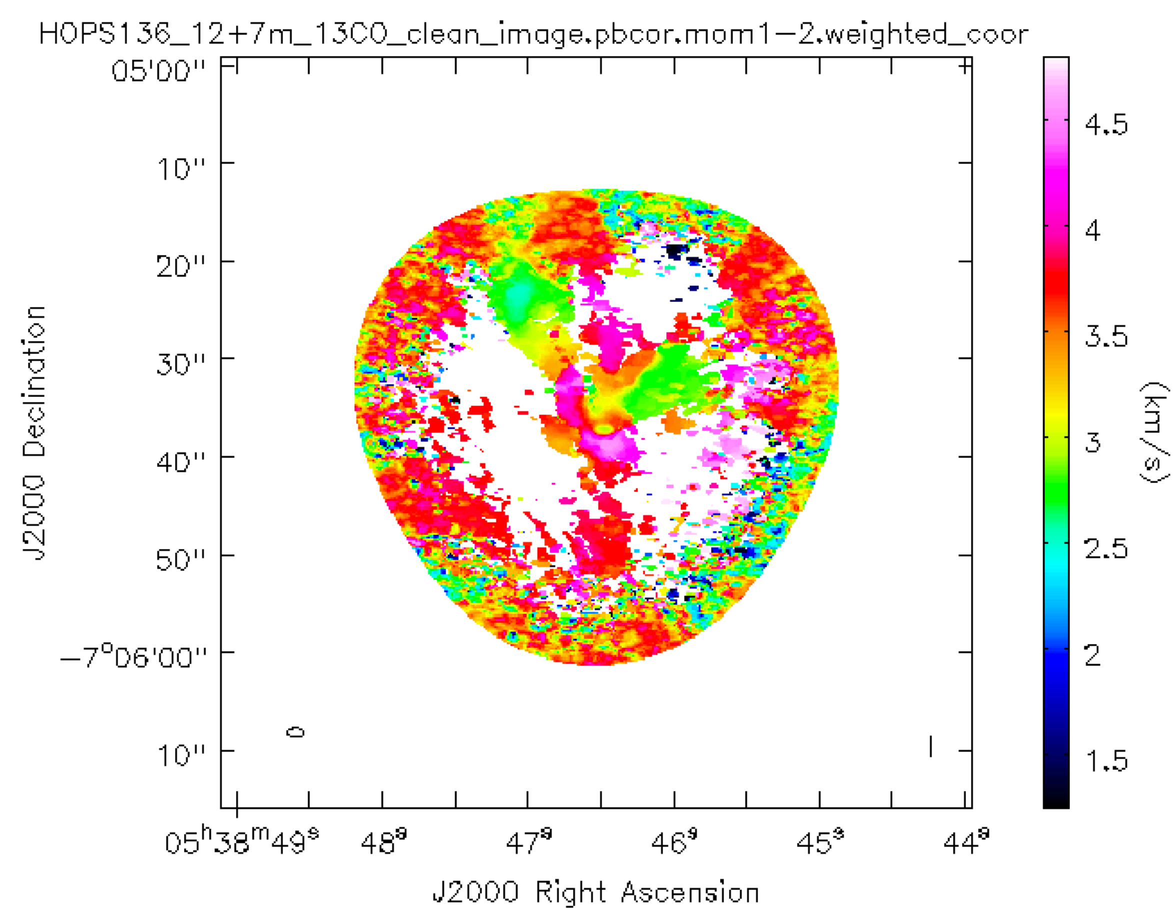




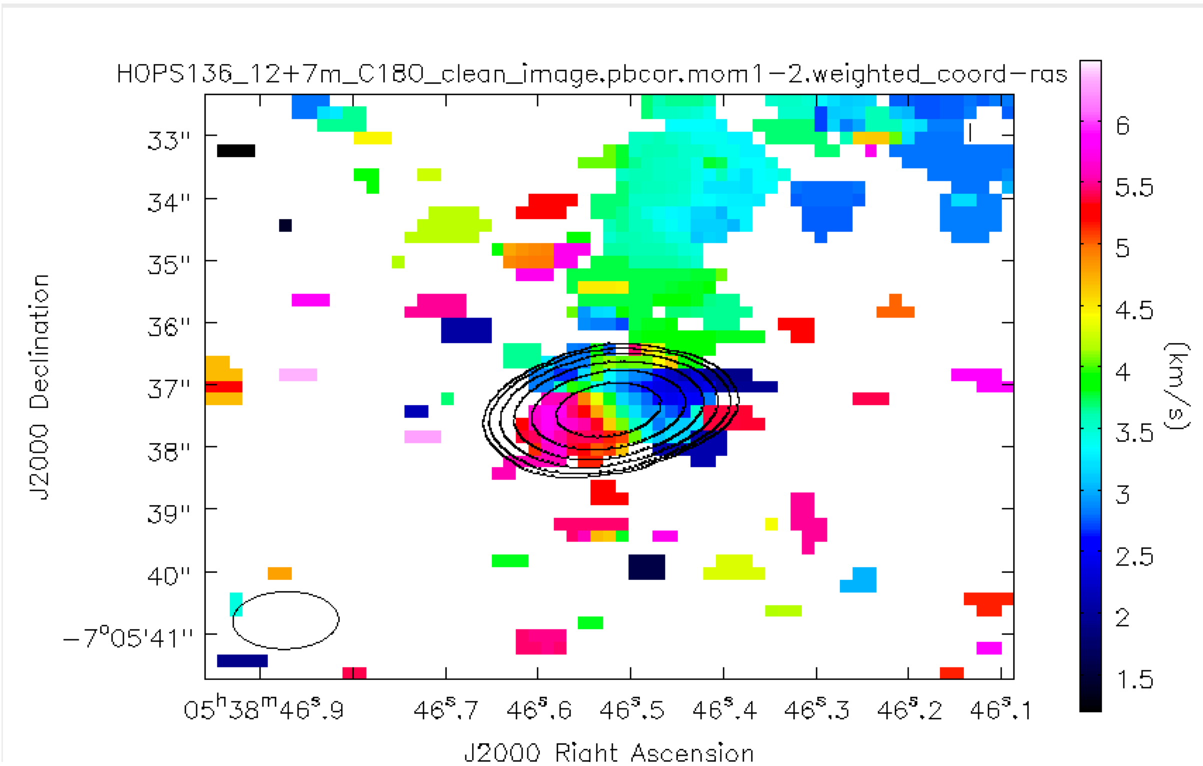


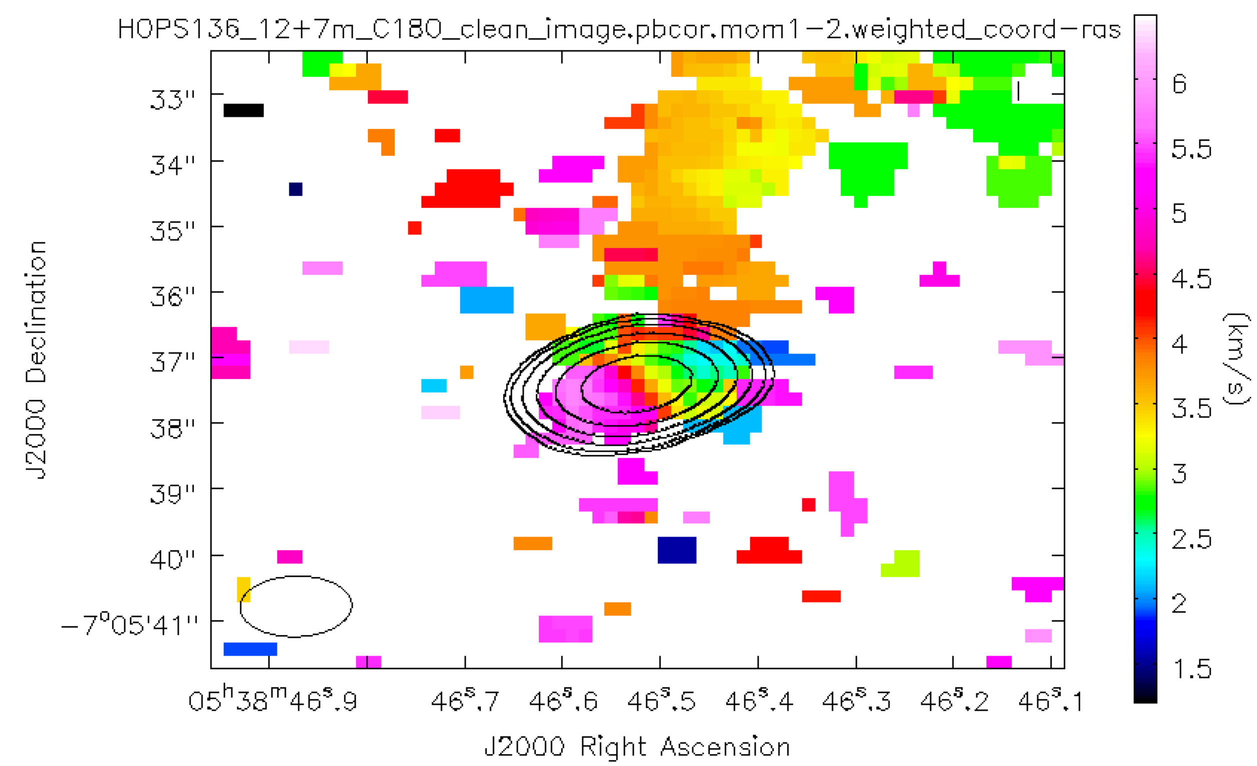

Polygon Region Profile
channel
-18.4556
18.4556
55.3668
92.278
129.189
(Jy/beam)
12CO
13CO
~2.8 km s-1
radio velocity [km/s]
HOPS136_12+7m_13CO_clean.image.pbcor-raster
J2000 Declination
J2000 Right Ascension
1.85 km/s

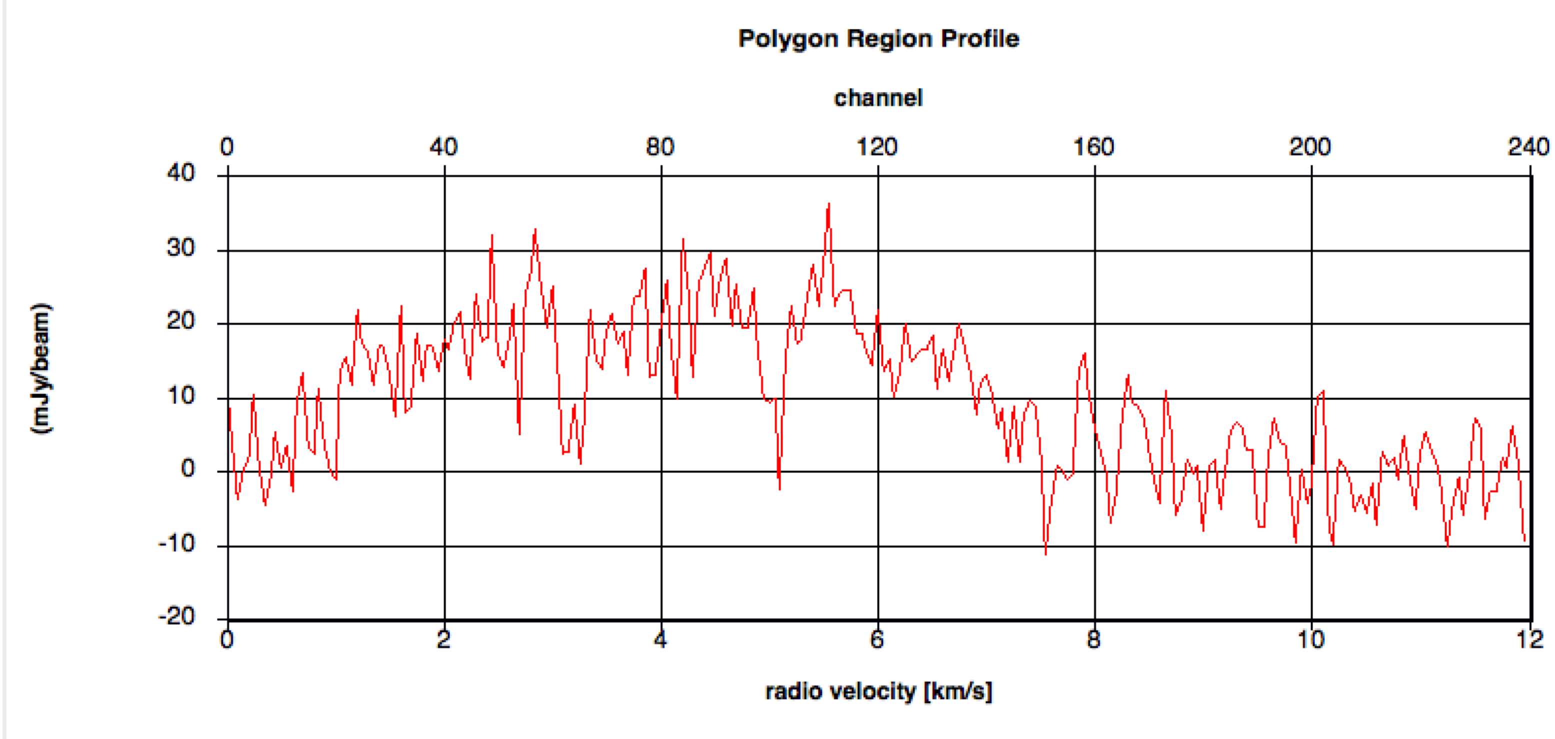

HOPS136_12+7m_12CO_clean_image.pbcor.mom1-2.weighted_coor
J2000 Declination
J2000 Right Ascension
(km/s)

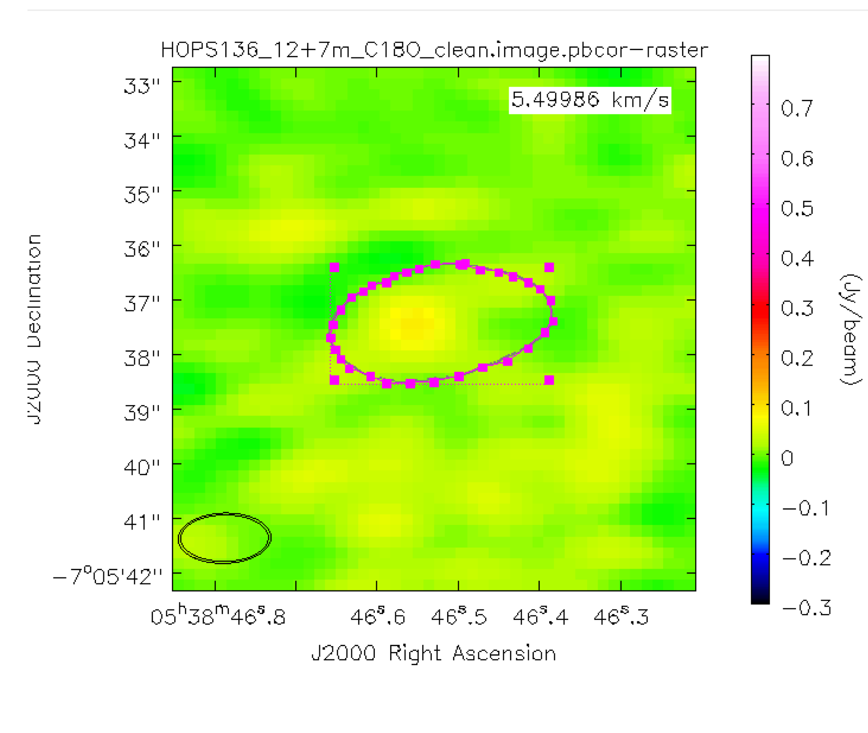

HOPS136_12+7m_13CO_clean_image.pbcor.mom1-2.weighted_coor
J2000 Declination
J2000 Right Ascension
(km/s)

$C^{18}O$: moment 1









PV diagram - $C^{18}O$