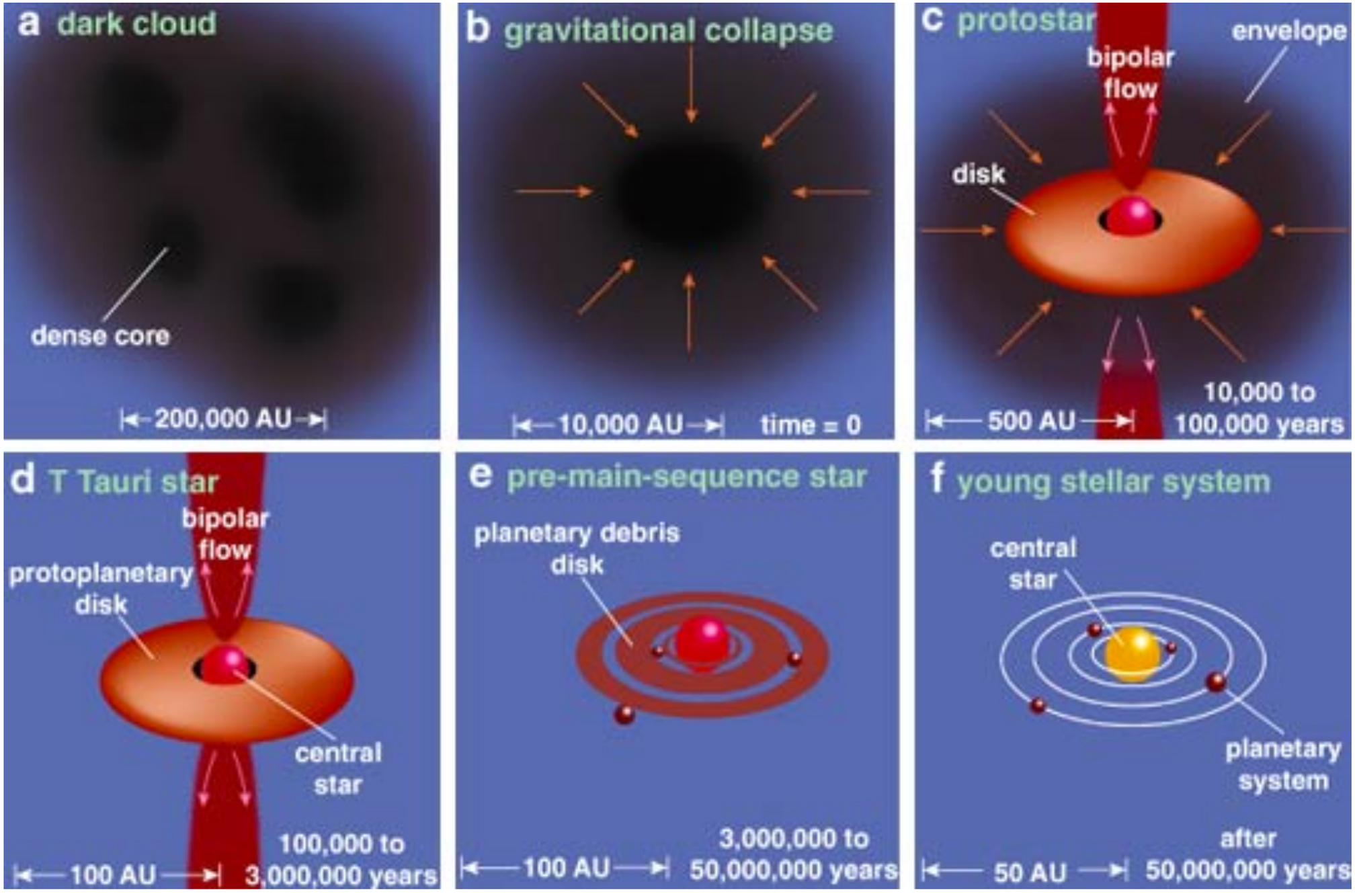
2017 ALMA SUMMER SCHOOL

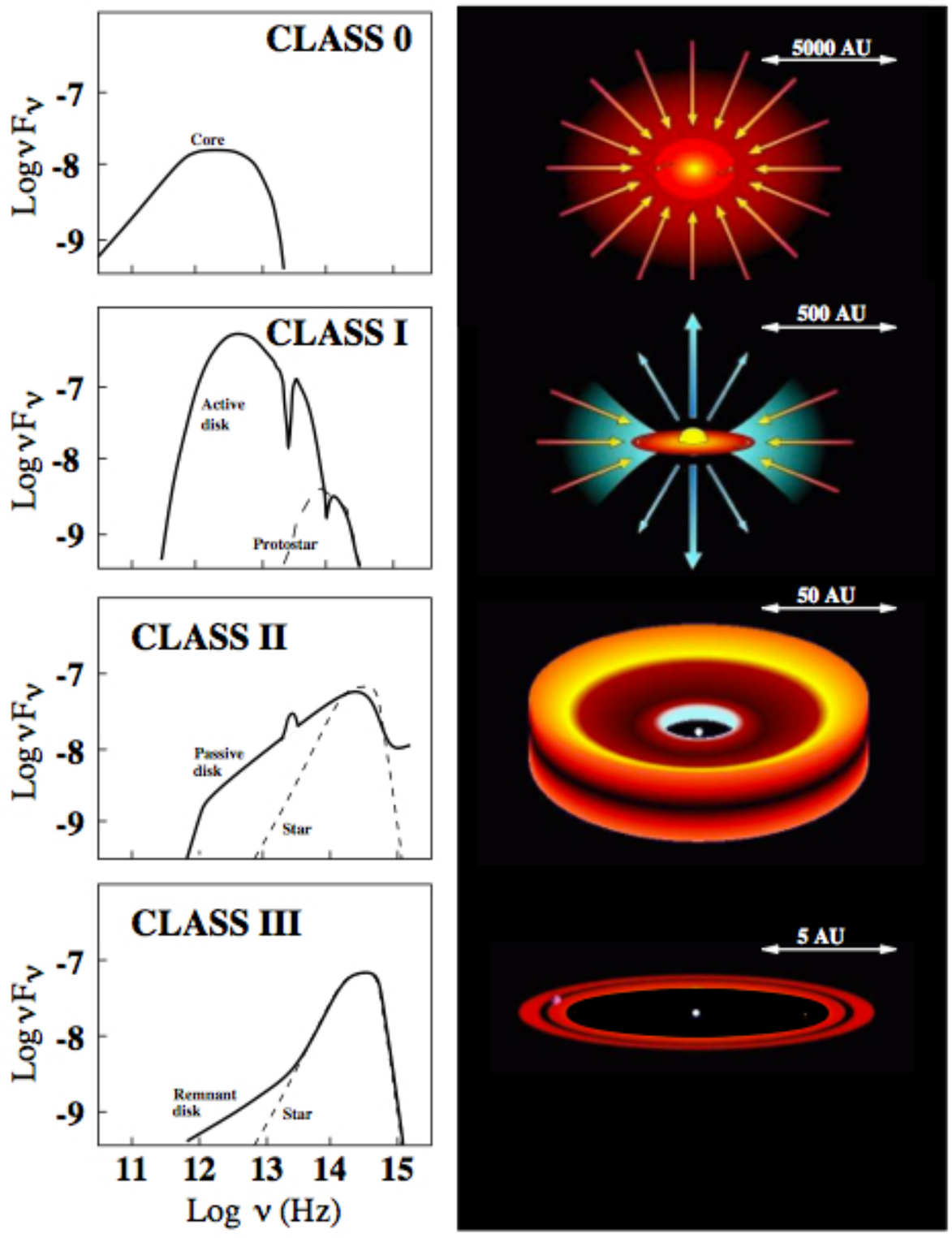
YSOs Outflow Study : HOPS 186

Jihye Hwang
UST(University of Science and Technology)
KASI(Korea Astronomy and Space science Institute)

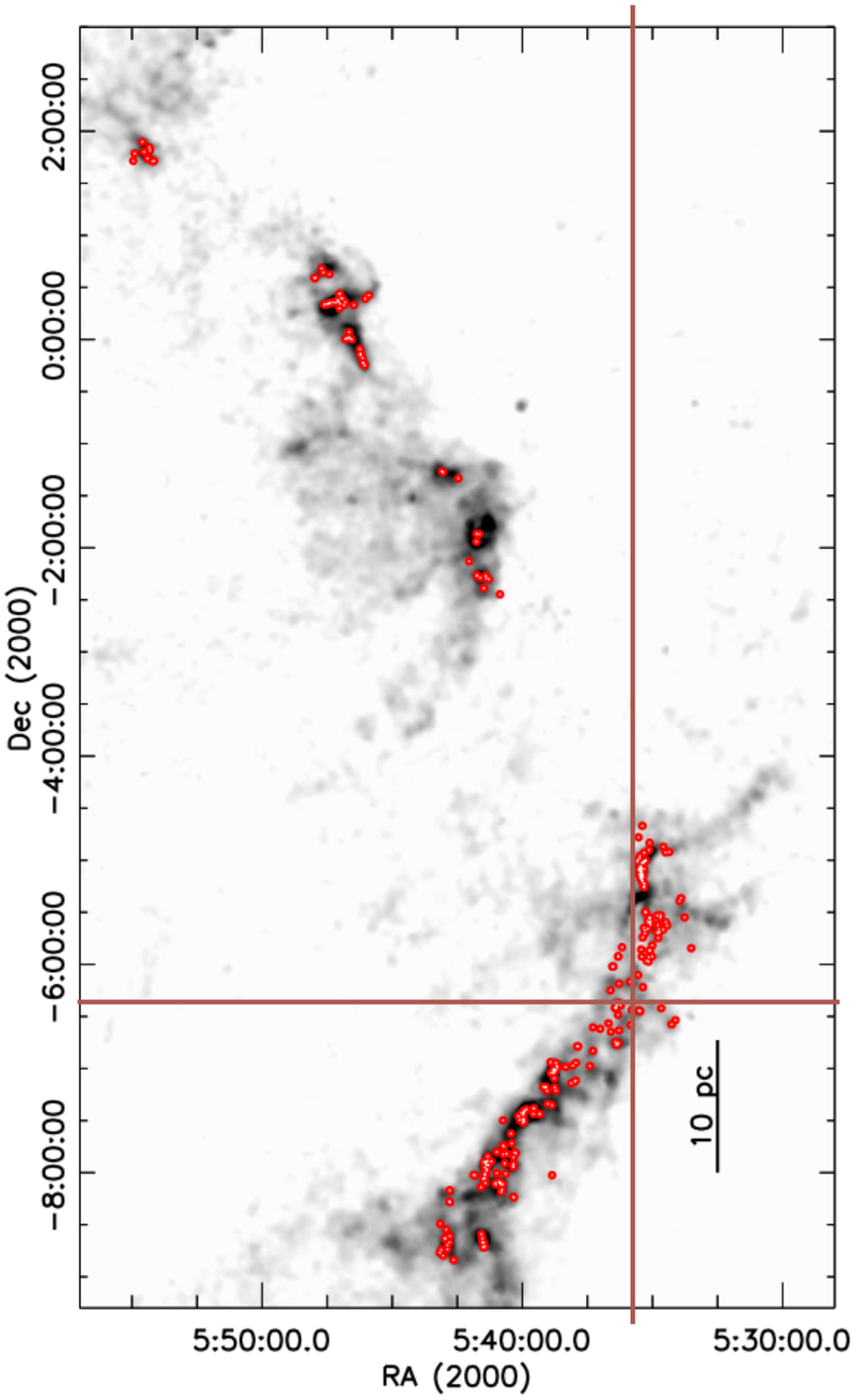
https://www.space.com/14034-gallery-amazing-orion-nebula-photos.html

- Overview star formation (Greene 2001)



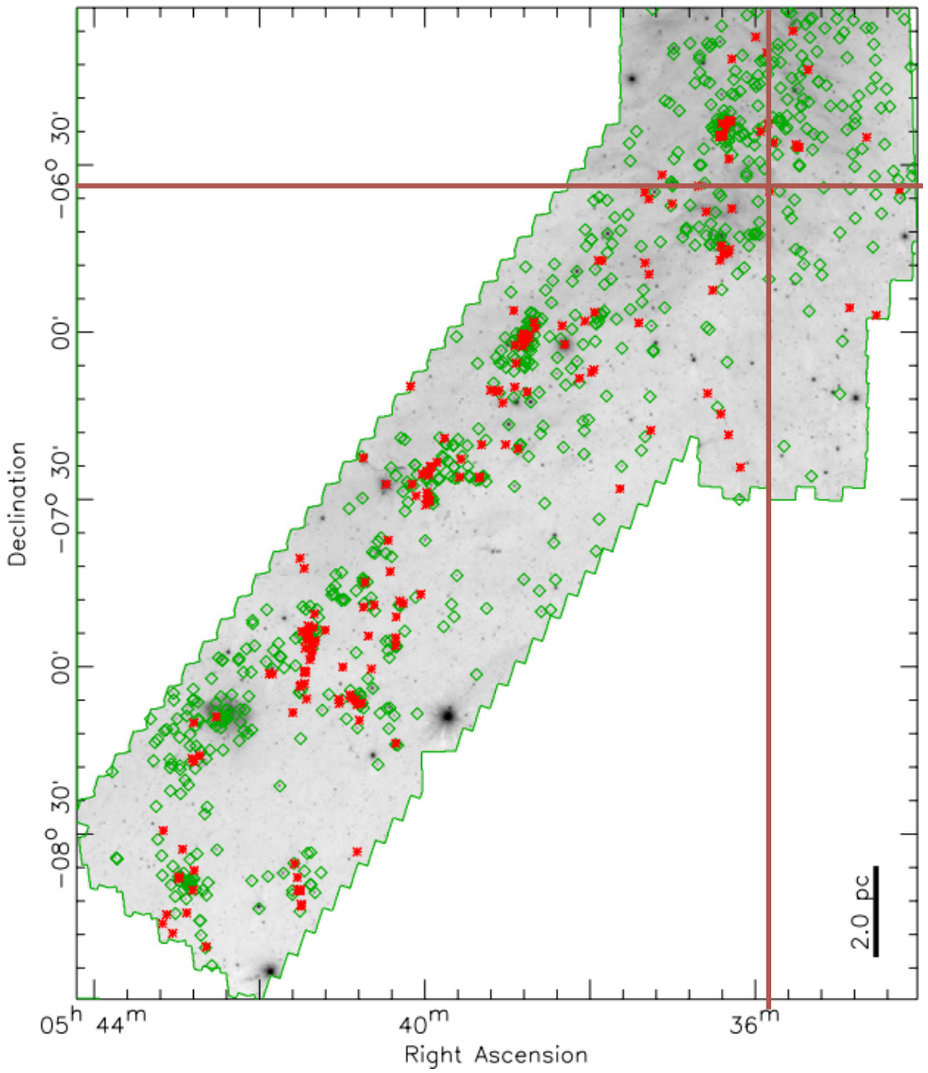


(Isella et al. 2006)



- HOPS 186 (YSO)
- Hershel Orion Protostar Survey
- Distance : 437±19 pc
- 05h 35m 47.278 -06d 26m 14.748

(Fischer et al. 2013)



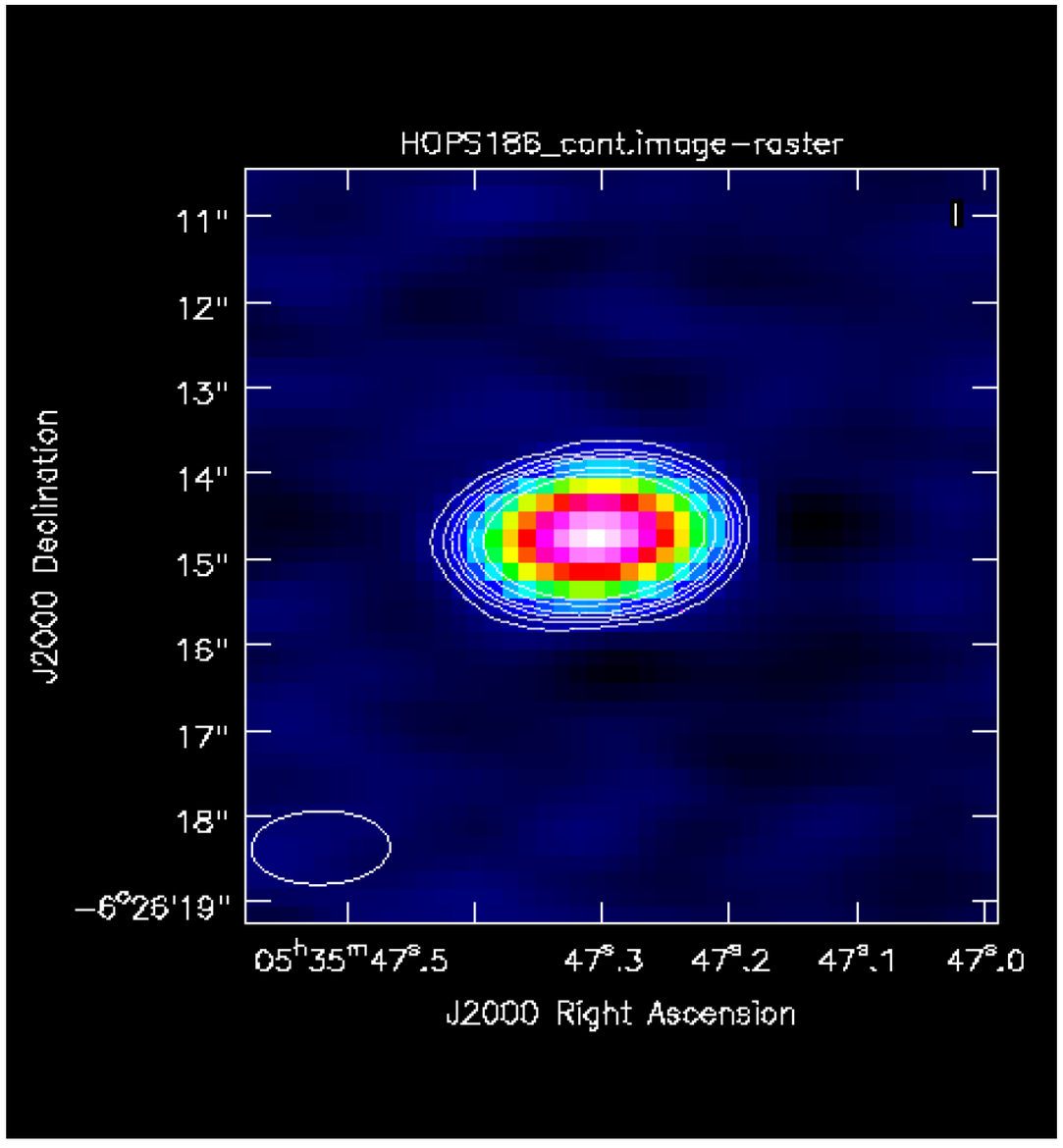
- HOPS 186 (YSO)
- Hershel Orion Protostar Survey
- Distance : 437±19 pc
- 05h 35m 47.278 -06d 26m 14.748

(Megeath et al. 2012)

https://www.eso.org/public/images/uhd_img_2250pc1-cc/

- 12m - 25, 7m - 9
- Band6 (211-275GHz)
- Continuum
- 12CO (230.54GHz)
- 13CO (220.40GHz)
- C18O (219.56GHz)

HOPS 186



- Size : 1.62 x 0.89 arcsec
- P.A. : -88.48 deg
- Rms : 0.1mJy/beam
- Flux : 18.19mJy
- Peak Flux : 17.68mJy
- Dust mass : $1.08 \times 10^{-2} M_{\odot}$

(Nurnberger et al. 1997)

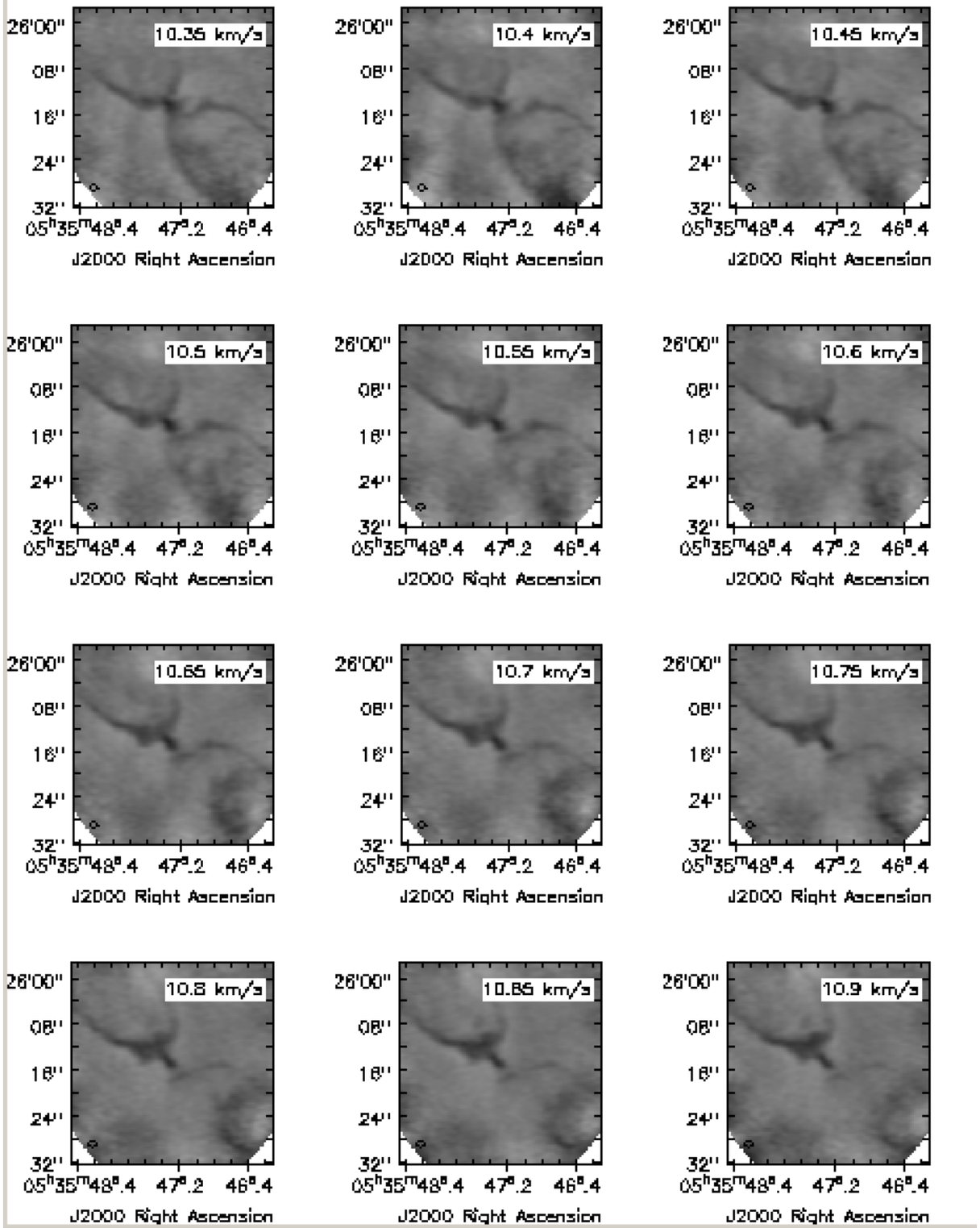
- Circumstellar disk mass calibration

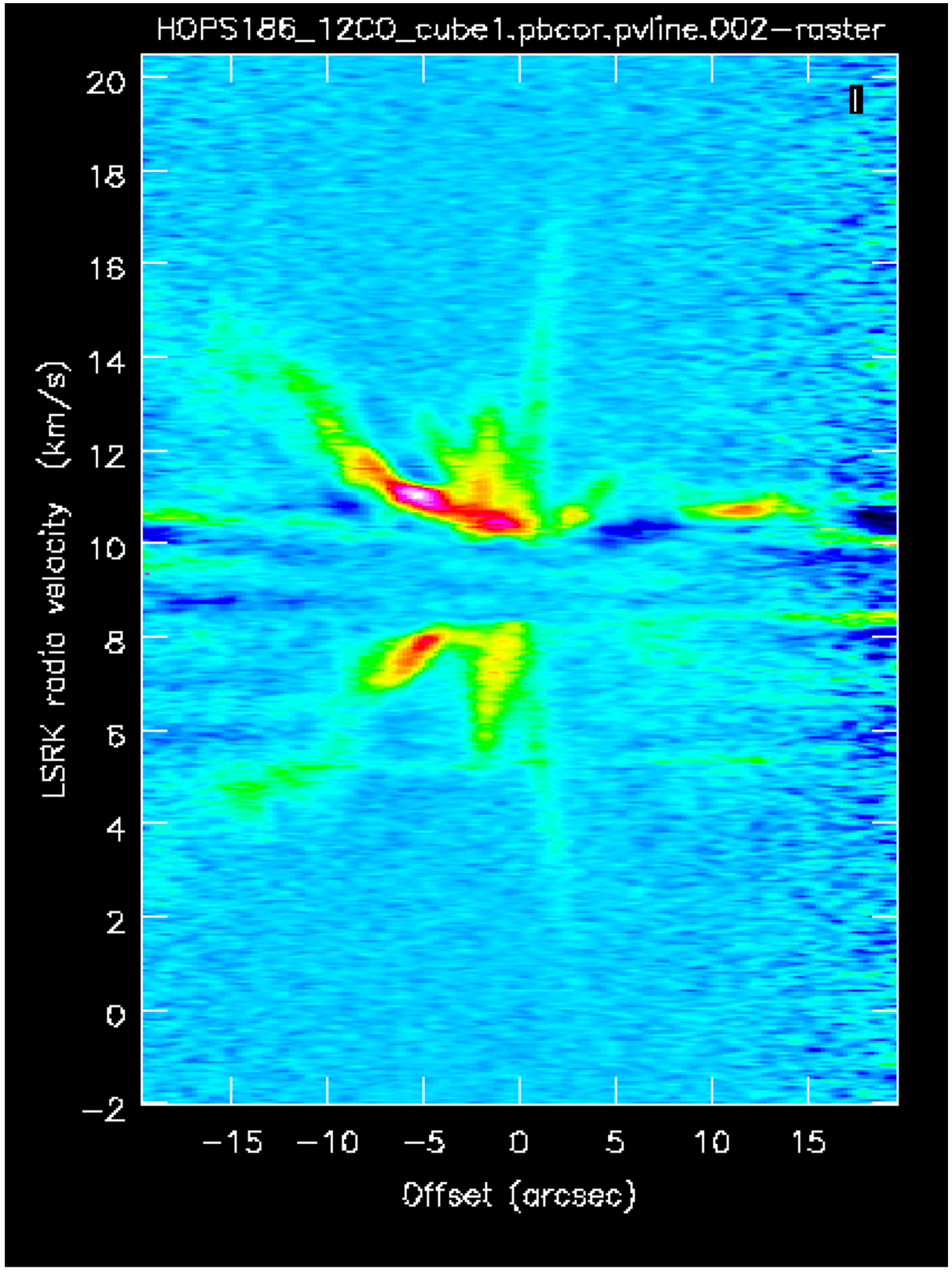
$$M_{disk} = \frac{S_{1.3mm} d^2}{B(T_{dust}) \kappa_{1.3mm}}$$

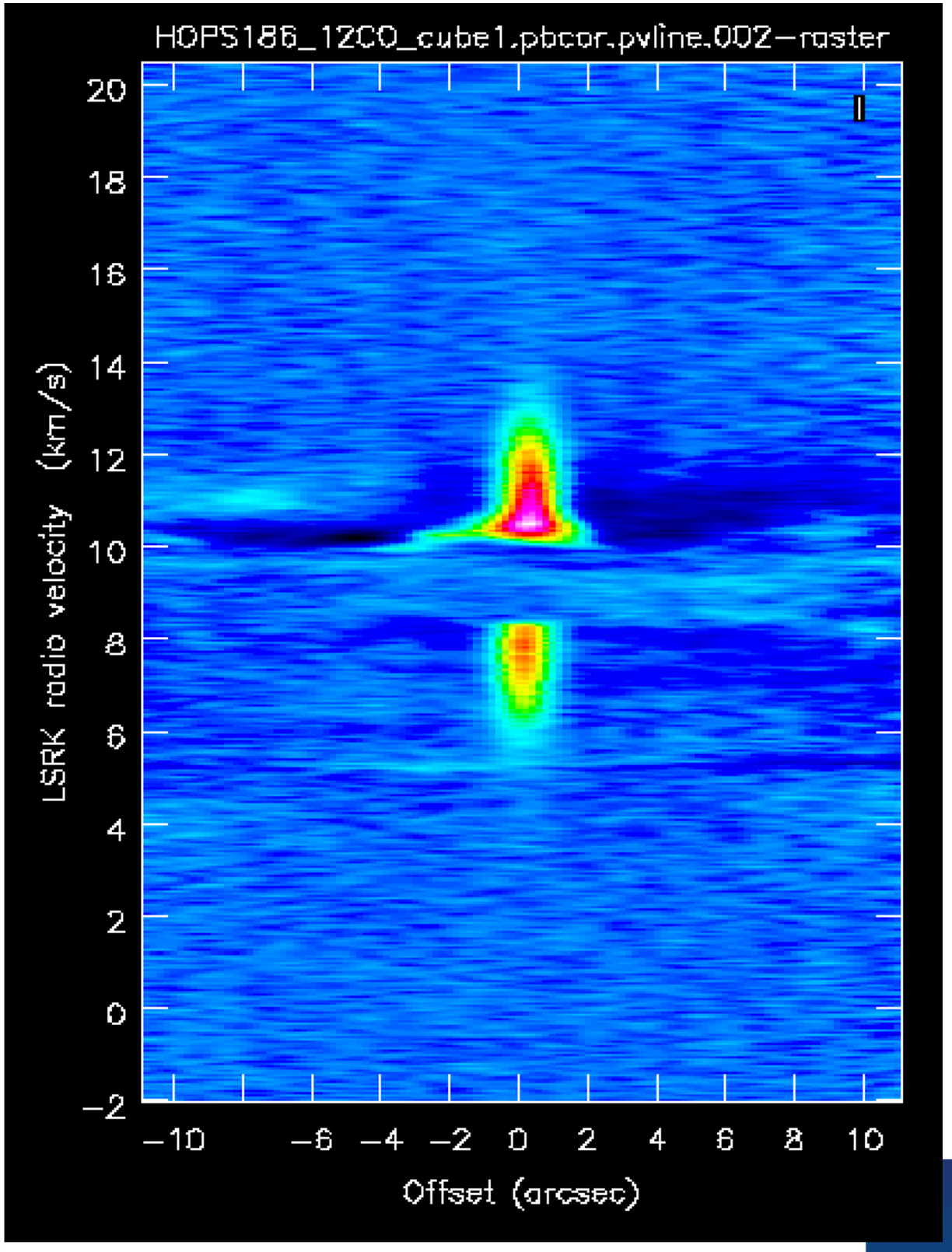
gas : dust = 100 : 1

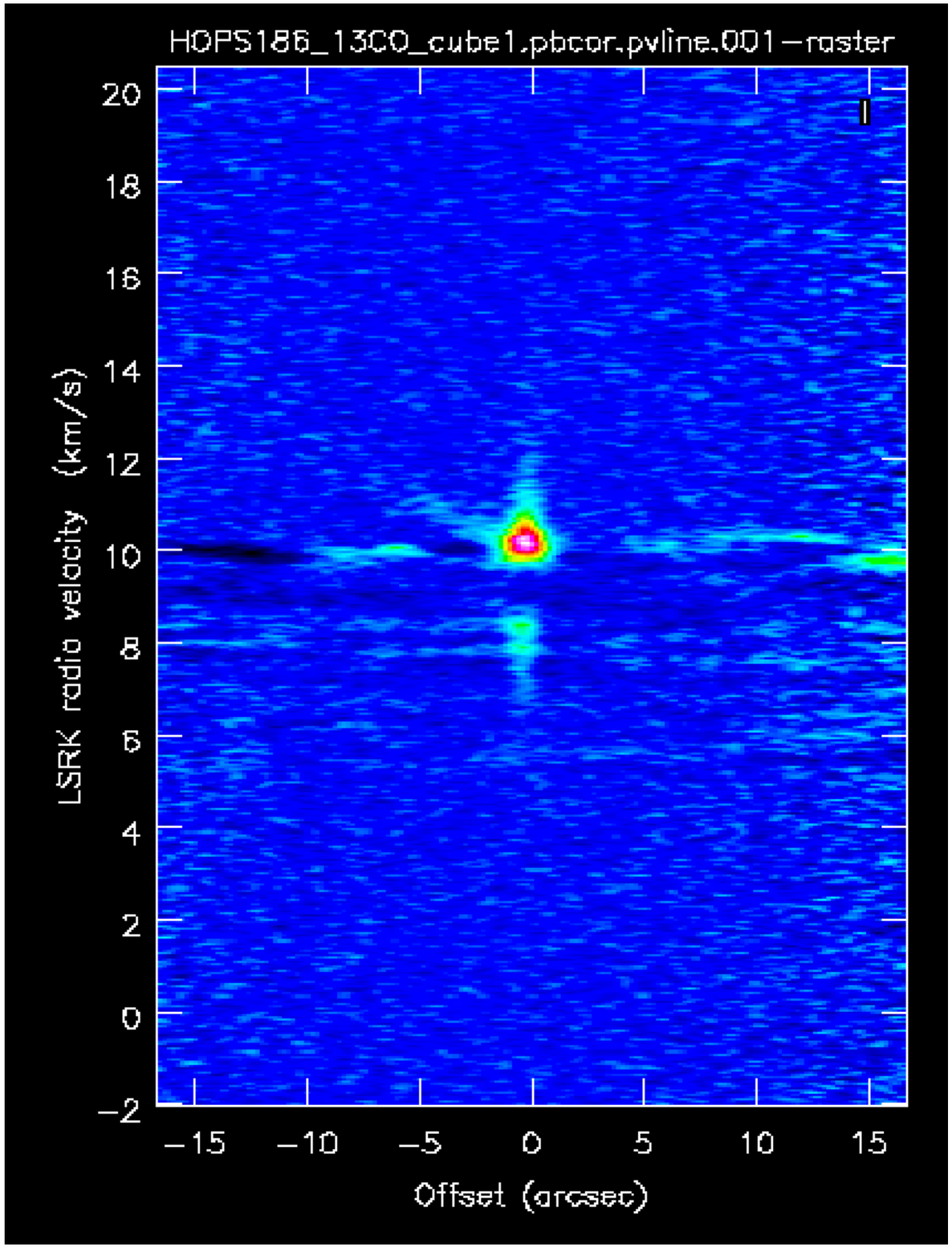
$$B(T_{dust}) = \frac{2h\nu^3}{c^2} \frac{1}{exp(h\nu_{obs}/kT_d) - 1}$$

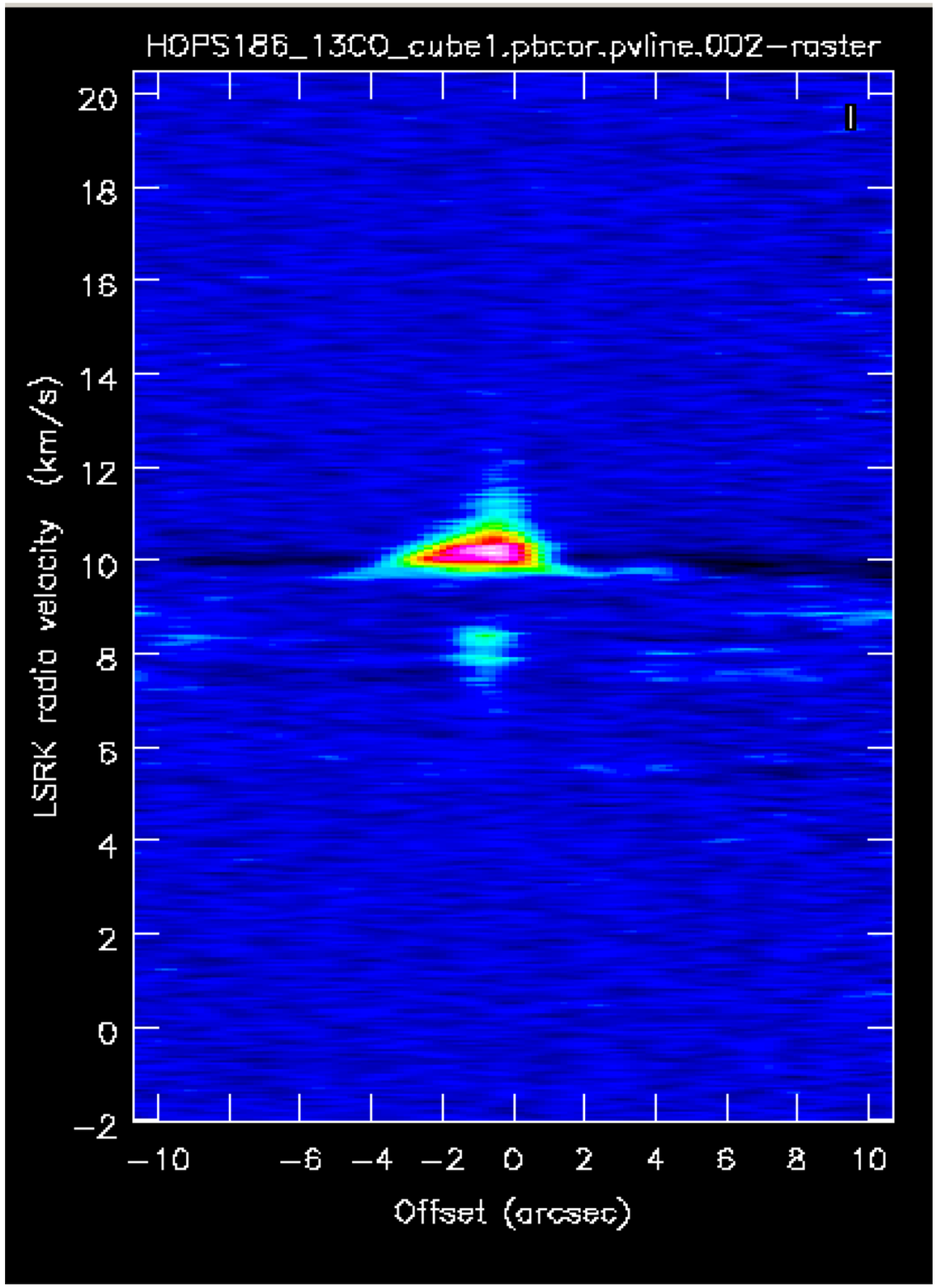
(Nurnberger et al. 1997)

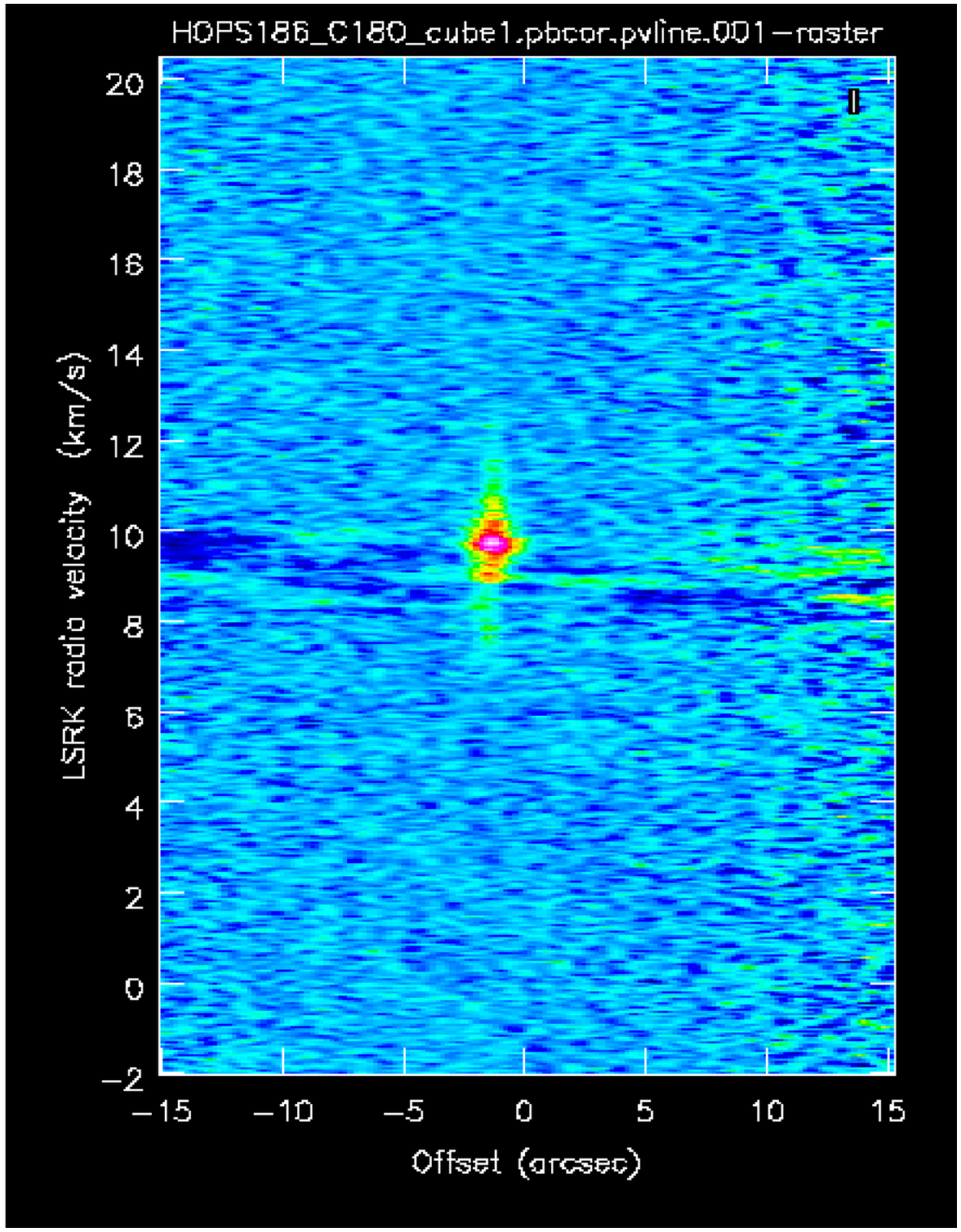

10.35 km/s
10.4 km/s
10.45 km/s
10.5 km/s
10.55 km/s
10.6 km/s
10.65 km/s
10.7 km/s
10.75 km/s
10.8 km/s
10.85 km/s
10.9 km/s
26'00"
08''
16''
24''
32''
05h35m48s.4 47s.2 46s.4
J2000 Right Ascension

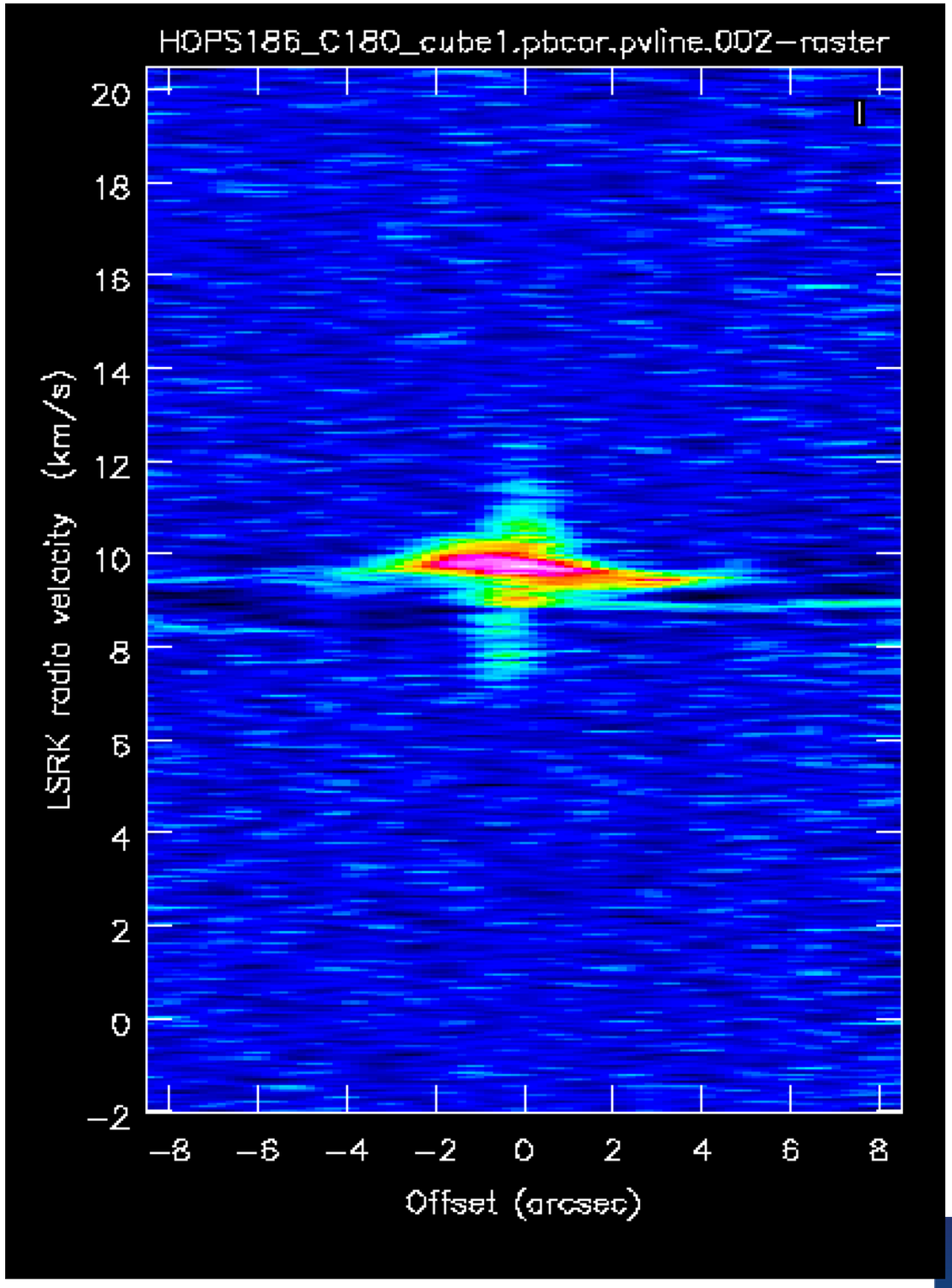

HOPS186_12CO_cube1.pbcor.pvline.002—raster
LSRK radio velocity (km/s)
Offset (arcsec)
20
18
16
14
12
10
8
6
4
2
0
−2
−15
−10
−5
0
5
10
15

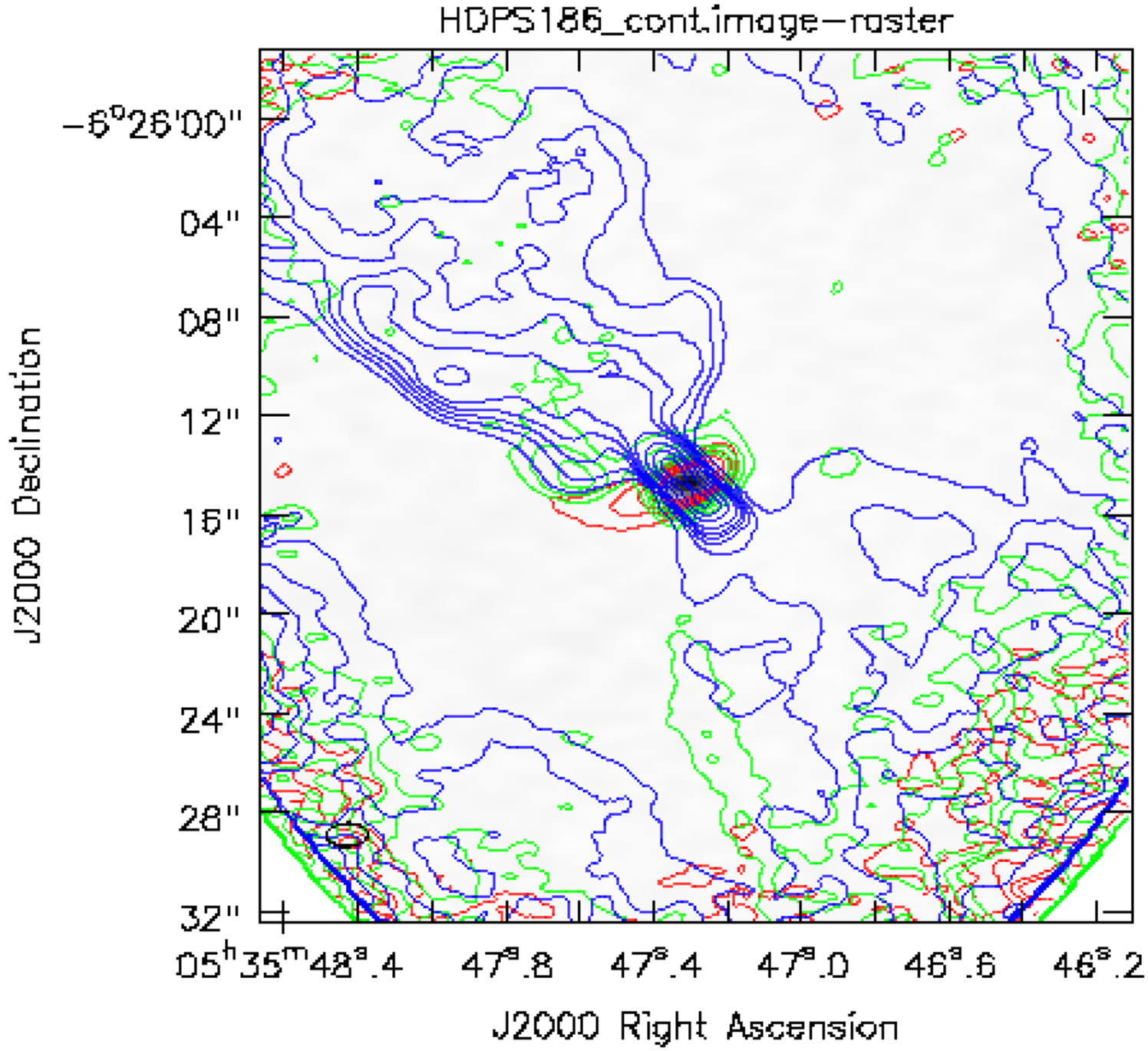

HOPS186_12CO_cube1.pbcor.pvline.002—raster
LSRK radio velocity (km/s)
Offset (arcsec)
20
18
16
14
12
10
8
6
4
2
0
−2
−10
−6
−4
−2
0
2
4
6
8
10

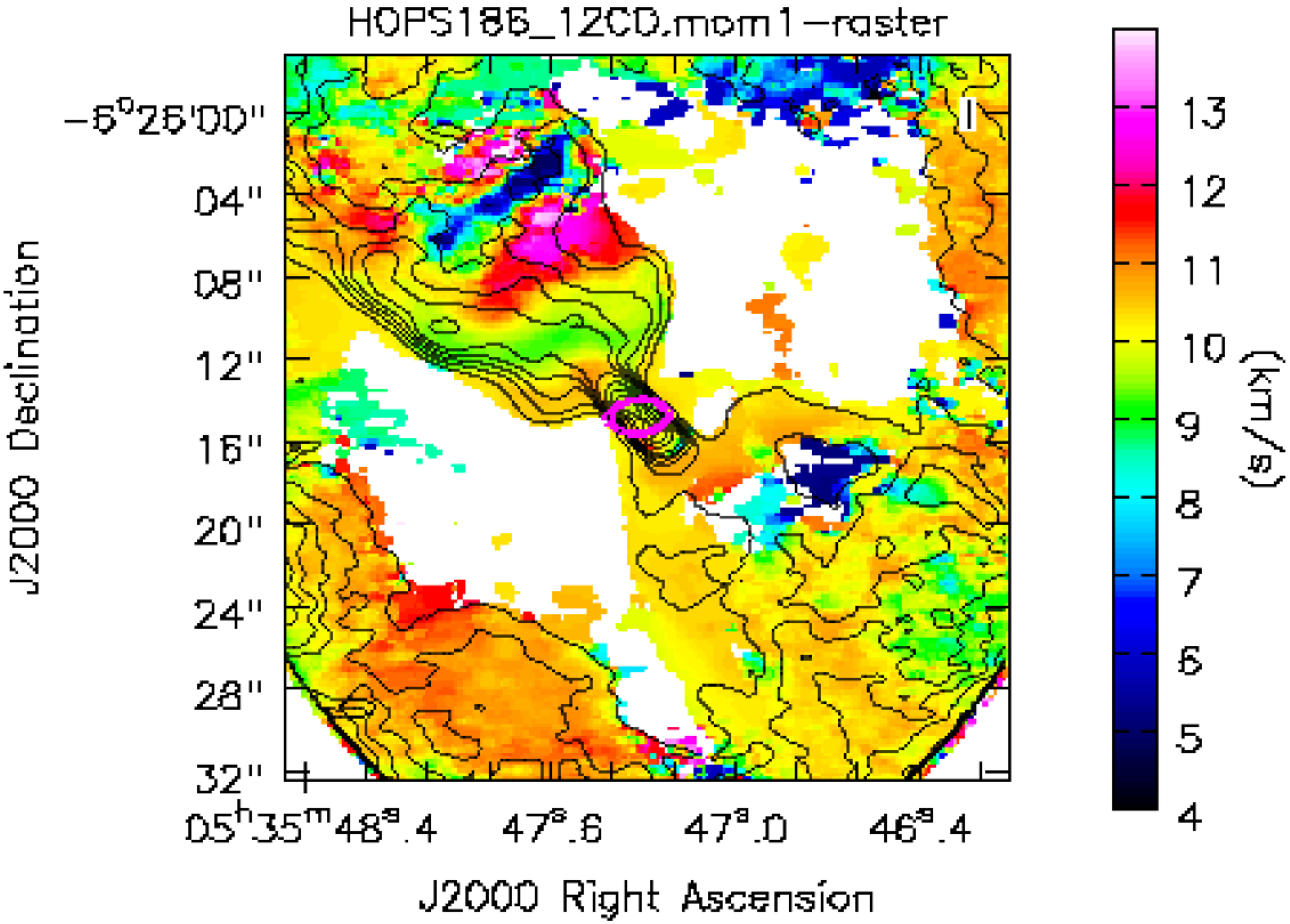

HOPS186_13CO_cube1.pbcor.pvline.001—raster
LSRK radio velocity (km/s)
Offset (arcsec)
20
18
16
14
12
10
8
6
4
2
0
−2
−15
−10
−5
0
5
10
15

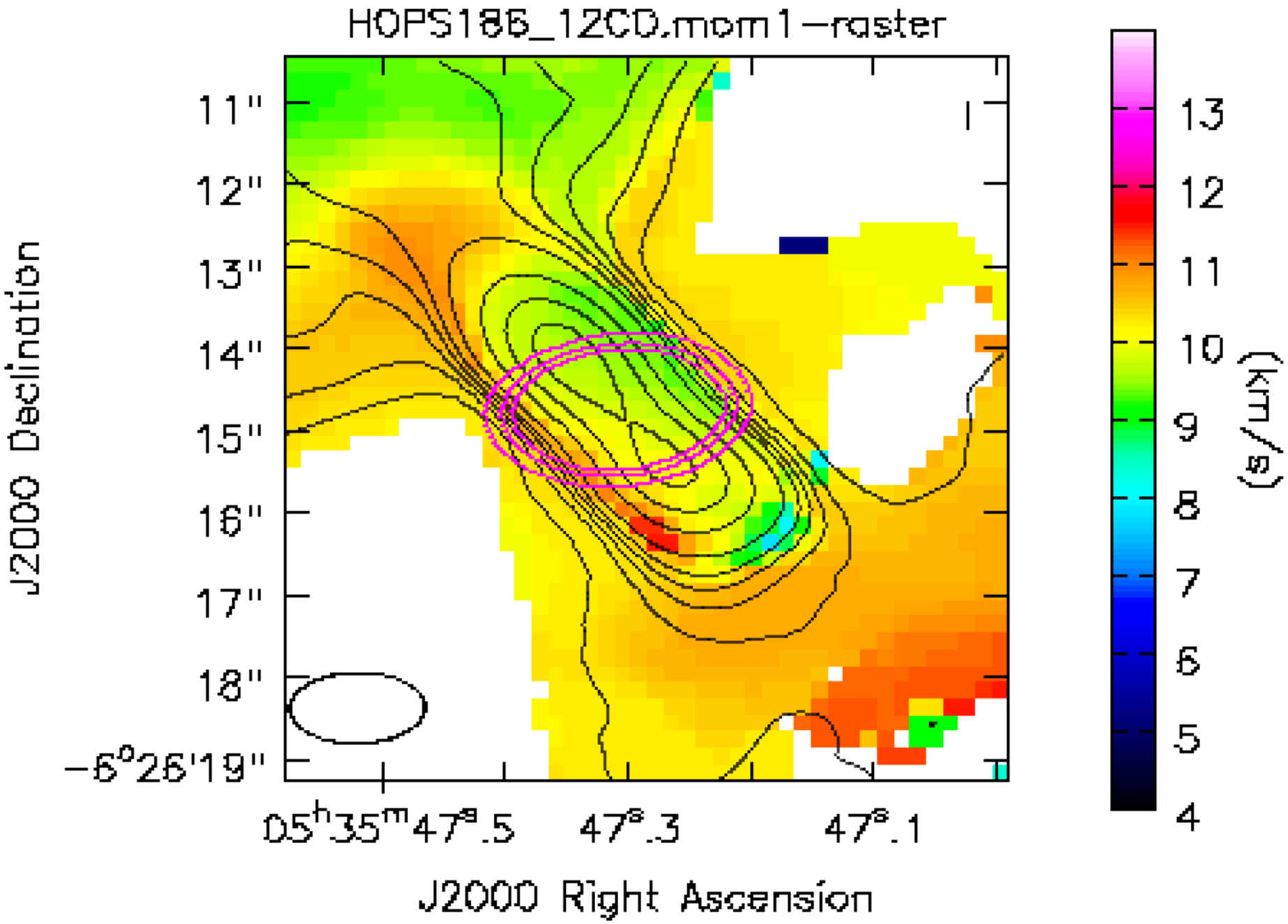

HOPS186_13CO_cube1.pbcor.pvline.002—raster
LSRK radio velocity (km/s)
Offset (arcsec)
20
18
16
14
12
10
8
6
4
2
0
−2
−10
−6
−4
−2
0
2
4
6
8
10

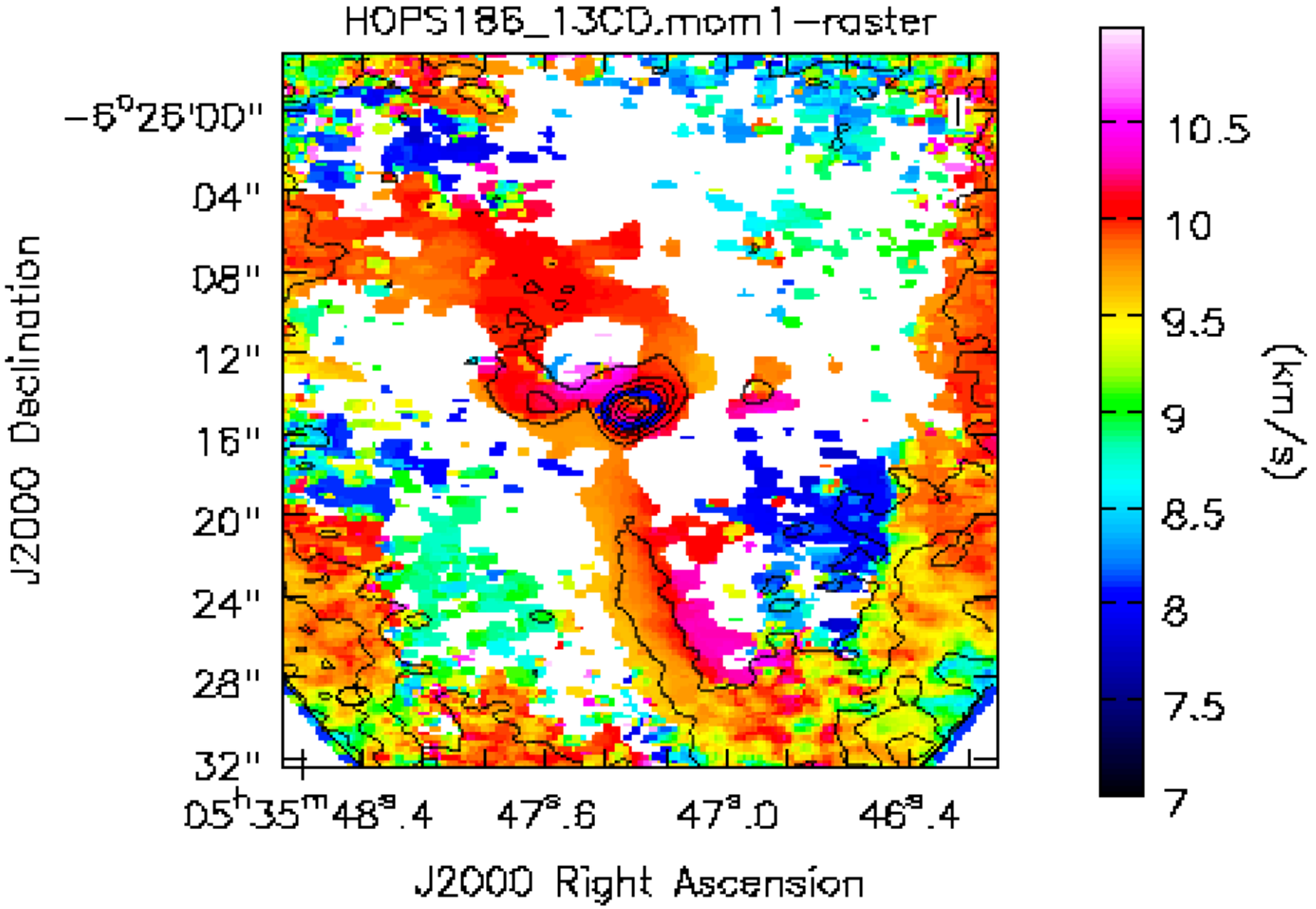

HOPS186_C18O_cube1.pbcor.pvline.001—raster
LSRK radio velocity (km/s)
Offset (arcsec)
20
18
16
14
12
10
8
6
4
2
0
−2
−15
−10
−5
0
5
10
15

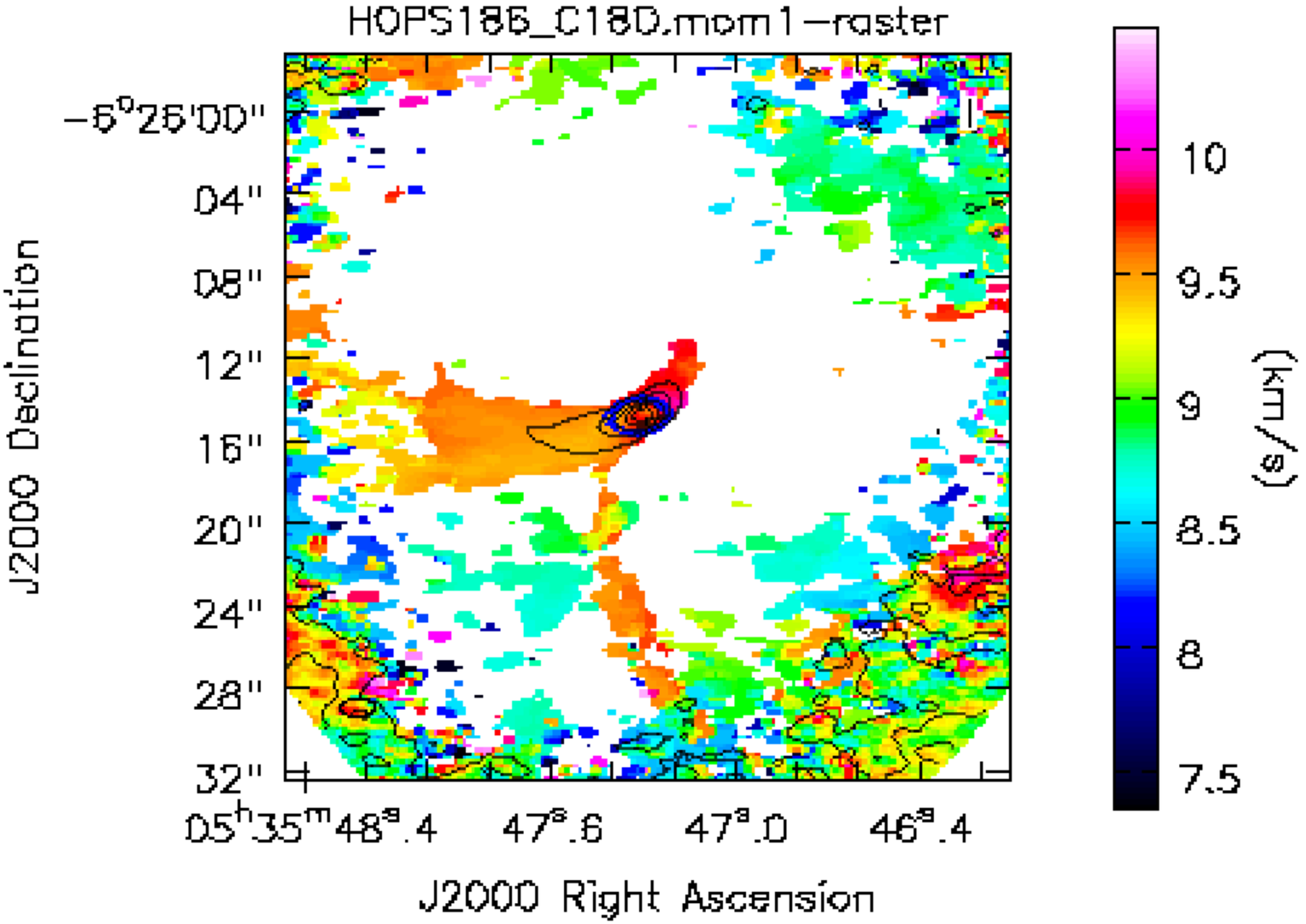

HOPS186_C18O_cube1.pbcor.pvline.002—raster
LSRK radio velocity (km/s)
Offset (arcsec)
20
18
16
14
12
10
8
6
4
2
0
−2
−8
−6
−4
−2
0
2
4
6
8


HOPS186_cont.image-raster
−6°26'00"
04"
08"
12"
16"
20"
24"
28"
32"
J2000 Declination
05h35m48s.4
47s.8
47s.4
47s.0
46s.6
46s.2
J2000 Right Ascension


HOPS186_12CO.mom1—raster
−5°25'00"
04"
08"
12"
16"
20"
24"
28"
32"
J2000 Declination
05h35m48s.4
47s.6
47s.0
46s.4
J2000 Right Ascension
13
12
11
10
9
8
7
6
5
4
(km/s)


HOPS186_12CO.mom1—raster
11"
12"
13"
14"
15"
16"
17"
18"
−6°26'19"
05h35m47s.5
47s.3
47s.1
J2000 Declination
J2000 Right Ascension
13
12
11
10
9
8
7
6
5
4
(s/km)


HOPS186_13CO.mom1-raster
−5°25'00"
04"
08"
12"
16"
20"
24"
28"
32"
J2000 Declination
05h35m48s.4
47s.6
47s.0
46s.4
J2000 Right Ascension
10.5
10
9.5
9
8.5
8
7.5
7
(km/s)


HOPS186_C18O.mom1—raster
−5°25'00"
04"
08"
12"
16"
20"
24"
28"
32"
J2000 Declination
05h35m48s.4
47s.6
47s.0
46s.4
J2000 Right Ascension
10
9.5
9
8.5
8
7.5
(km/s)

- HOPS 168 data reduction with CASA
- Wide outflow lobe and narrow jet component
- 12CO, 13CO shows embedded central structure
- C18O traces central part
- Helical motion ?

REFERRENCE

Nurnberger et al. 1997 A&A 324 1036
Hirota et al. 2007 PASJ 59 897
Megeath et al. 2012 AJ 144 197
Fisher et al. 2013 NA 334 1
Isella et al. 2006 A&A 451 951
https://almascience.nao.ac.jp/alma-data/archive
http://www.cv.nrao.edu/php/splat/
https://jvo.nao.ac.jp/portal/top-page.do
Physicsoftheuniverse.com

THANK YOU !

Q & A