DSHARP

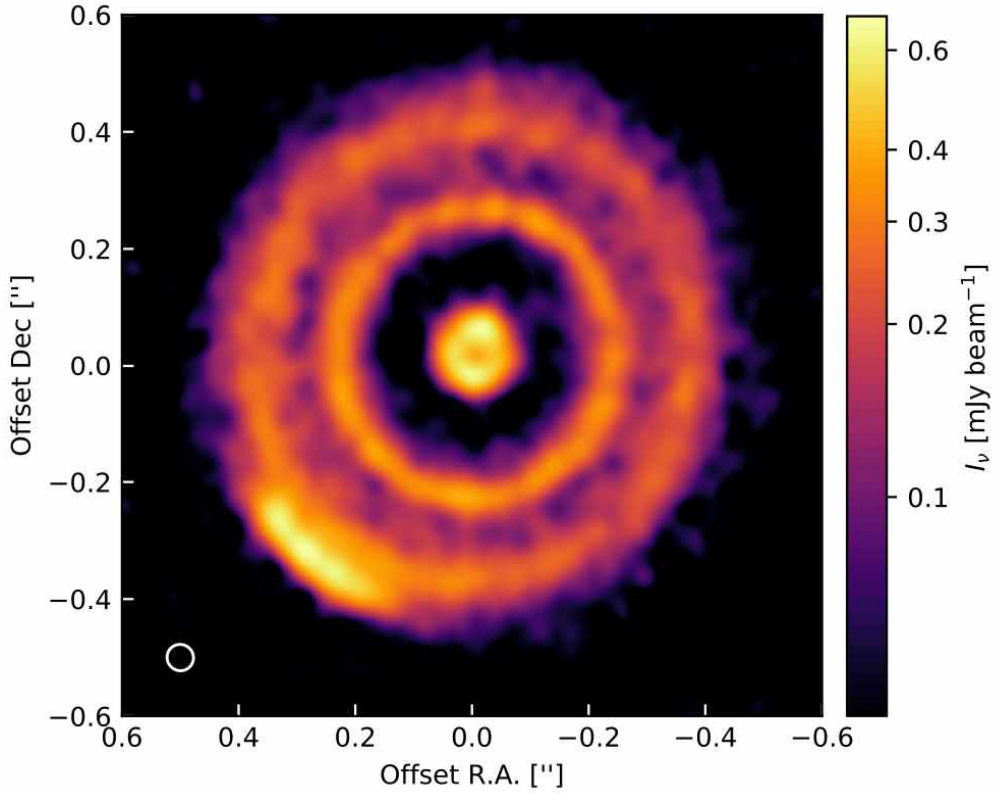
The **D**isk **S**ubstructures at **H**igh **A**ngular **R**esolution **P**roject

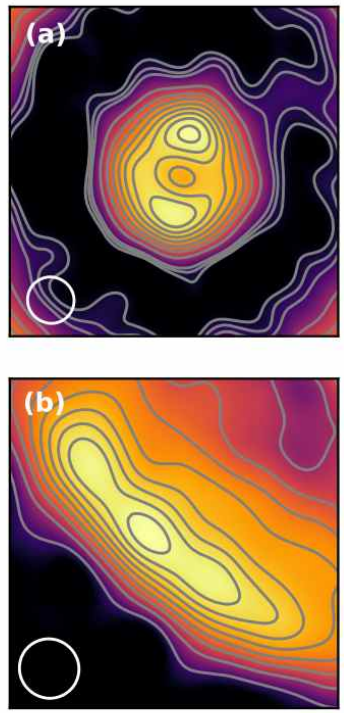
KSHARP

Kwon and **S**tudents **H**d143006 **A**lma **R**adio **P**roject

이영민
신수현
박혜진

HD143006

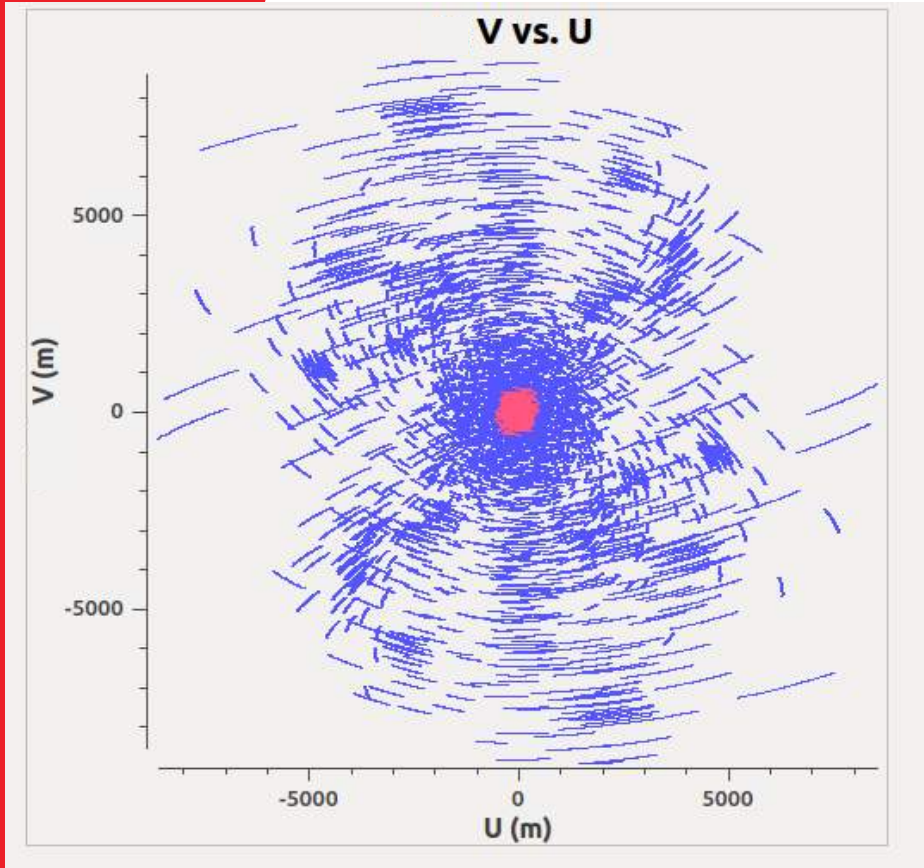




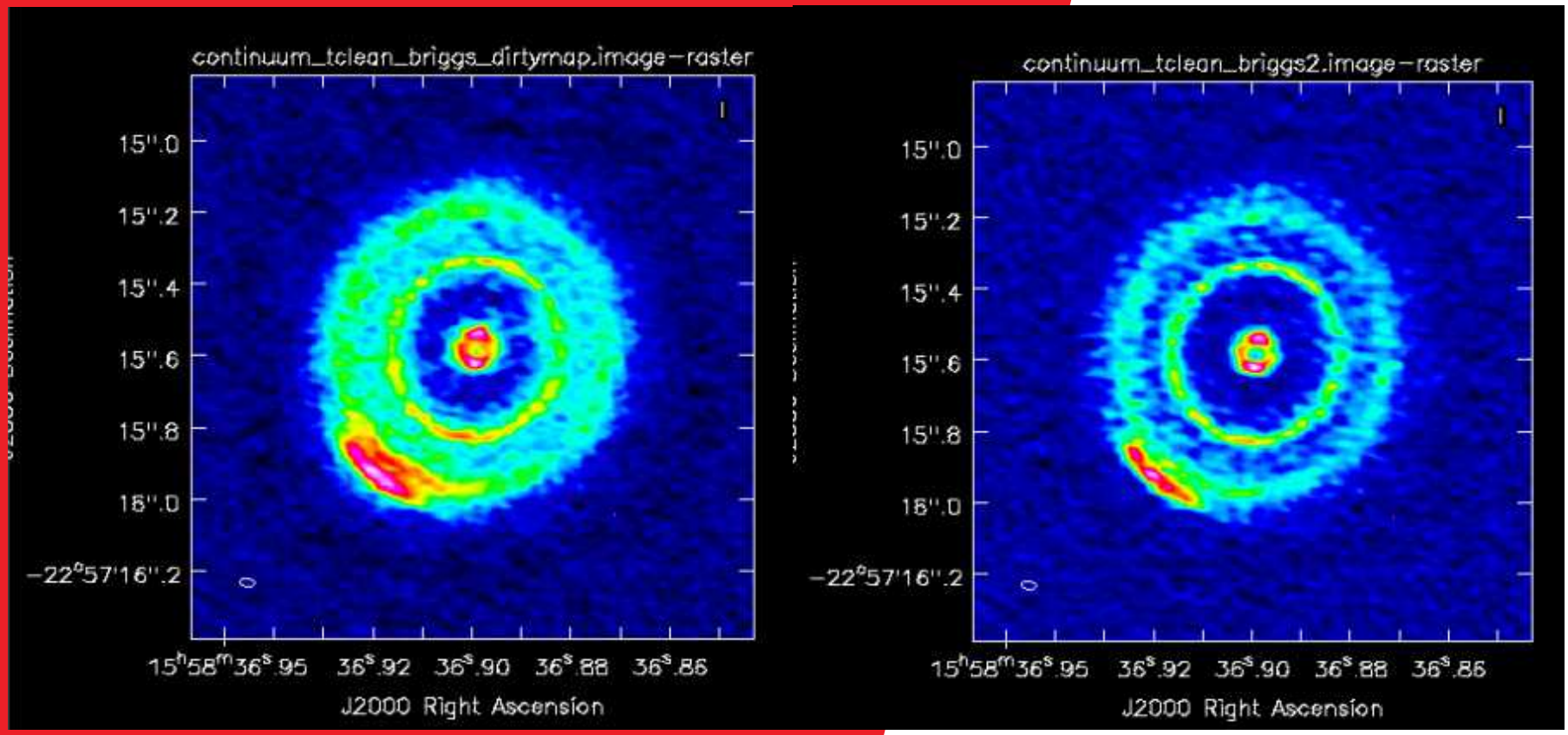
G type
T - Tauri star
D ~ 165 pc

Observation

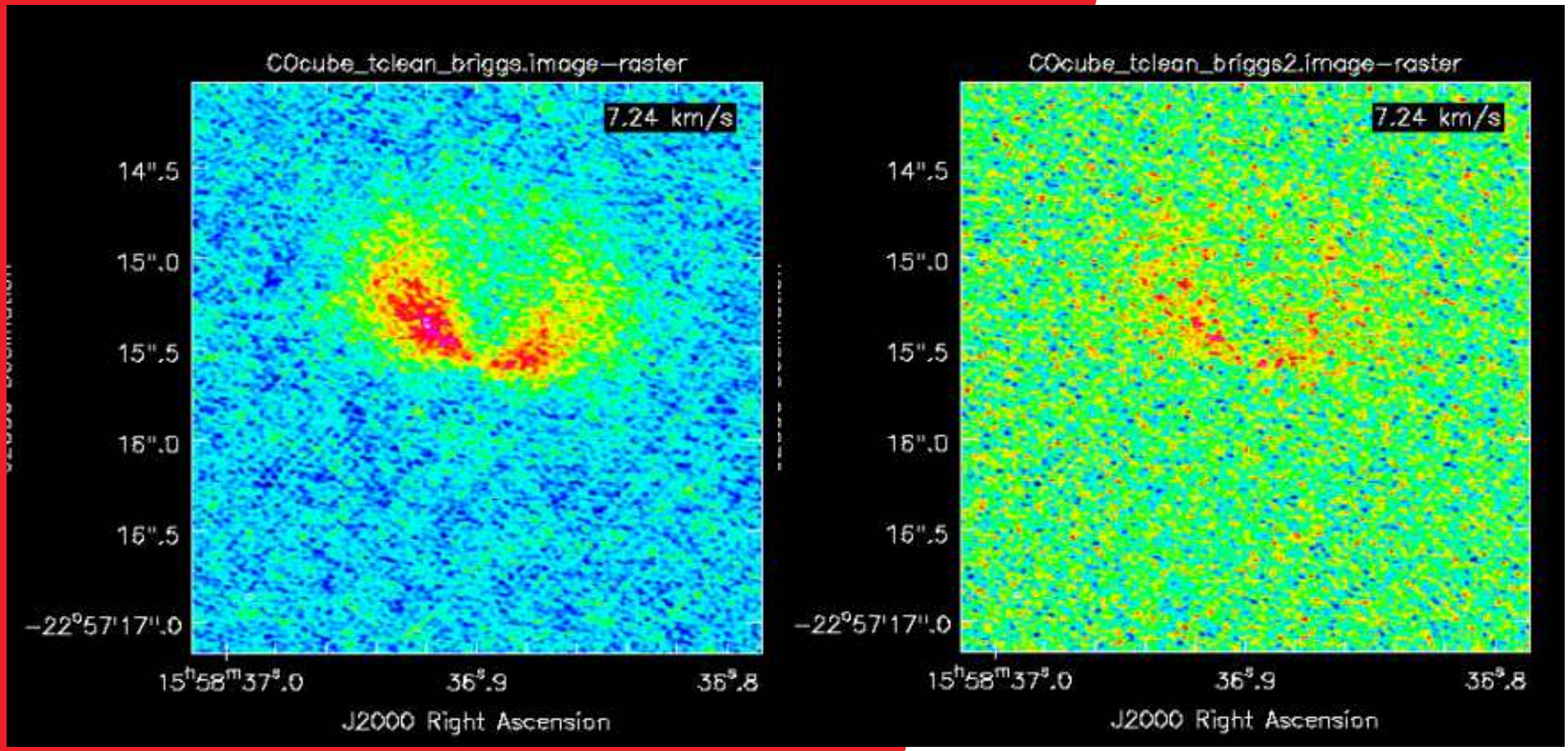
- 12m only
- 5 Observations
  - 14Jun2016 ~ 26Nov2017
- Compact (15min) + Extended (1hr)
- Angular resolution
  - Continuum ~ 0.02 x 0.03
  - COcube ~ 0.05 x 0.07



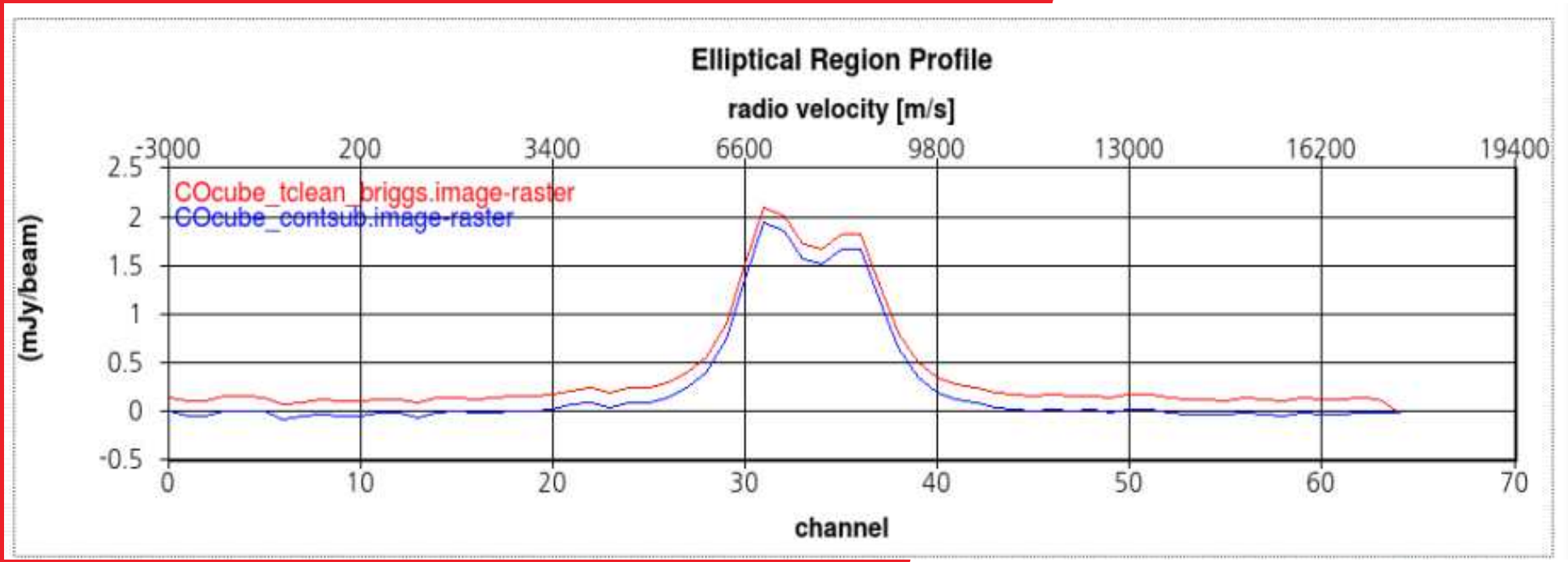
robust =0 Weighting – Continuum



robust =0 Weighting – CO line



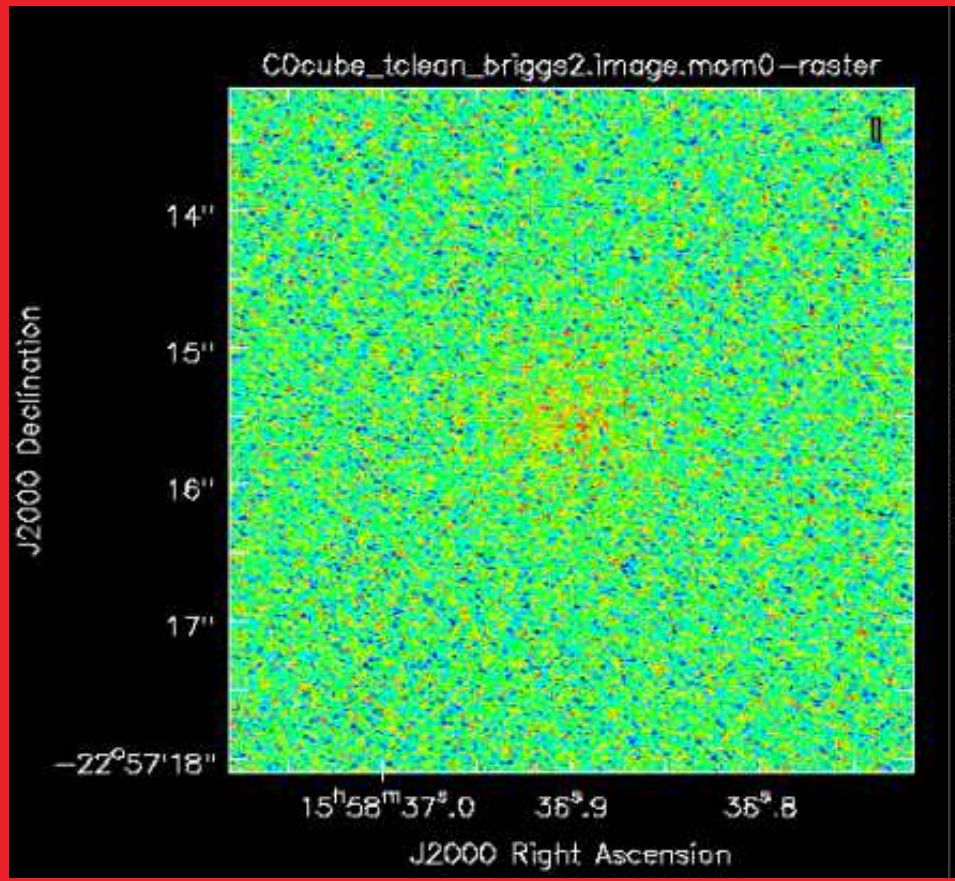
robust =0 Weighting – CO line

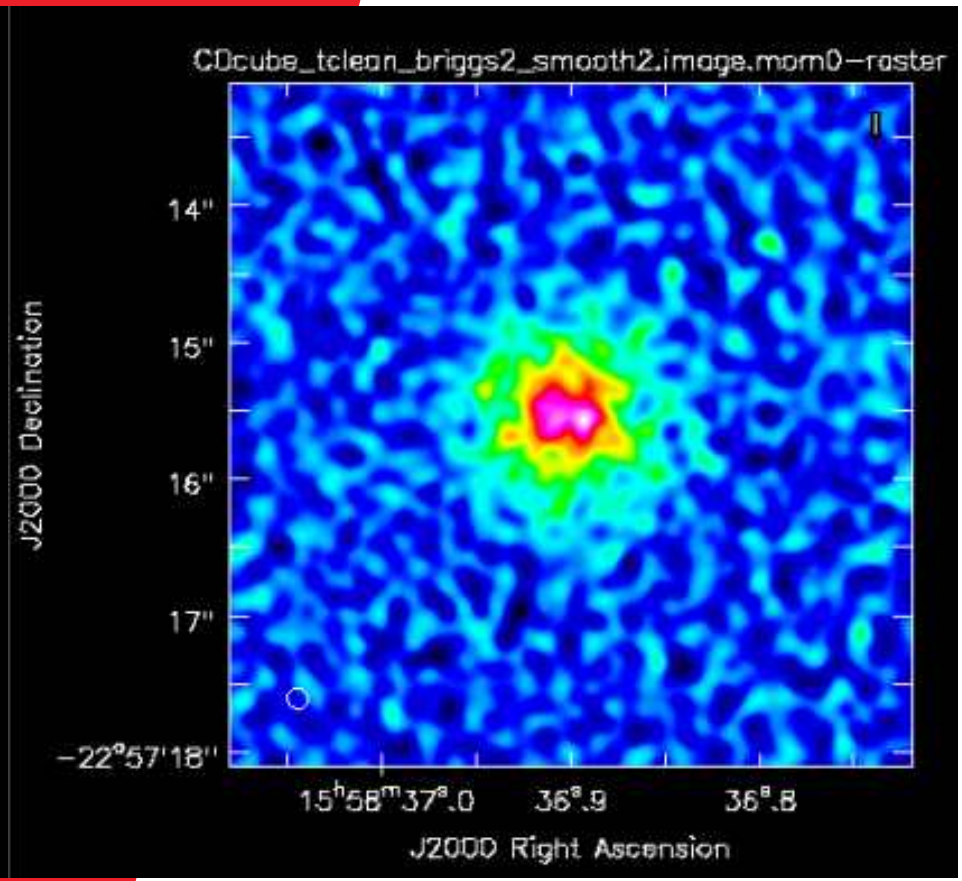


robust =0 Weighting – moment

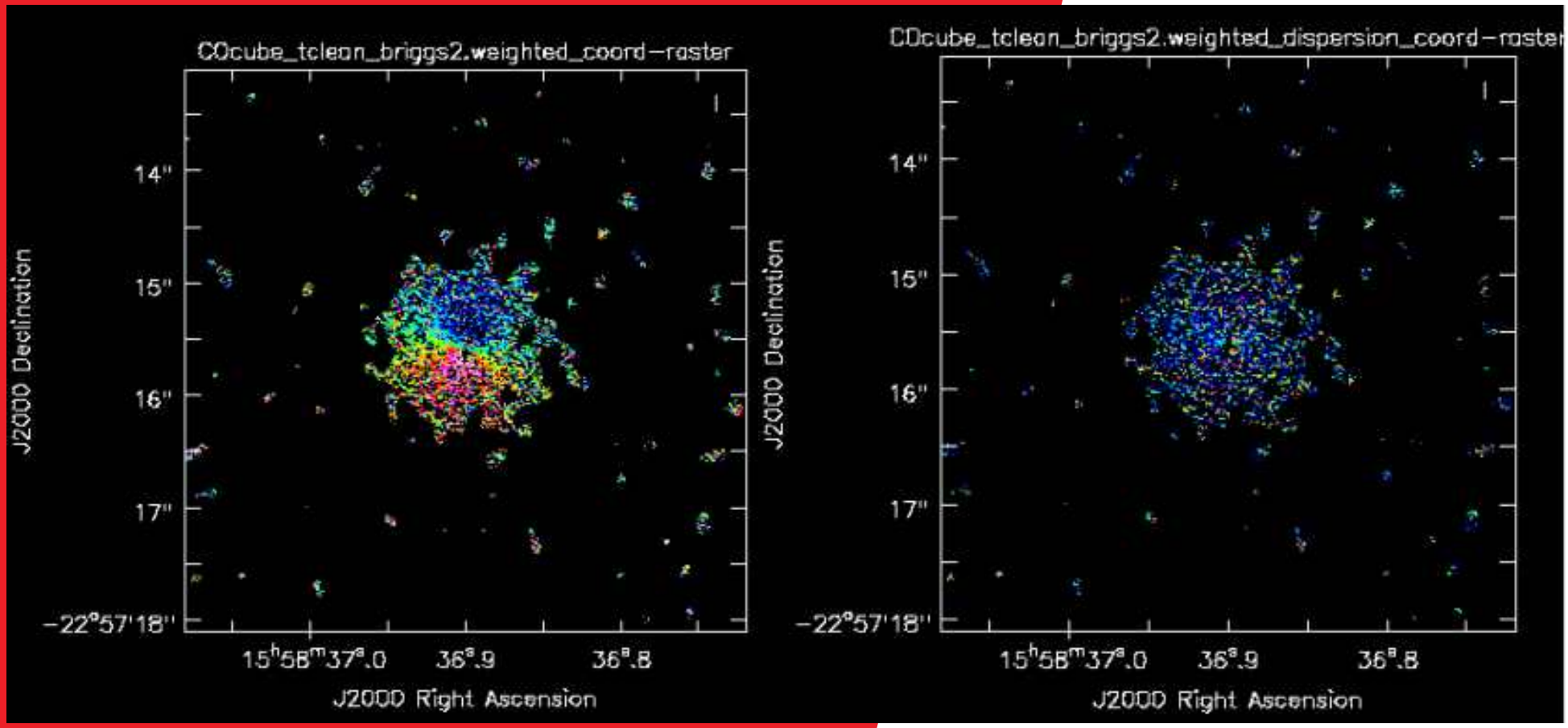
Moment 0 map

1. Smooth X
2. Smooth O (beam: minor, major=0.15arcsec)

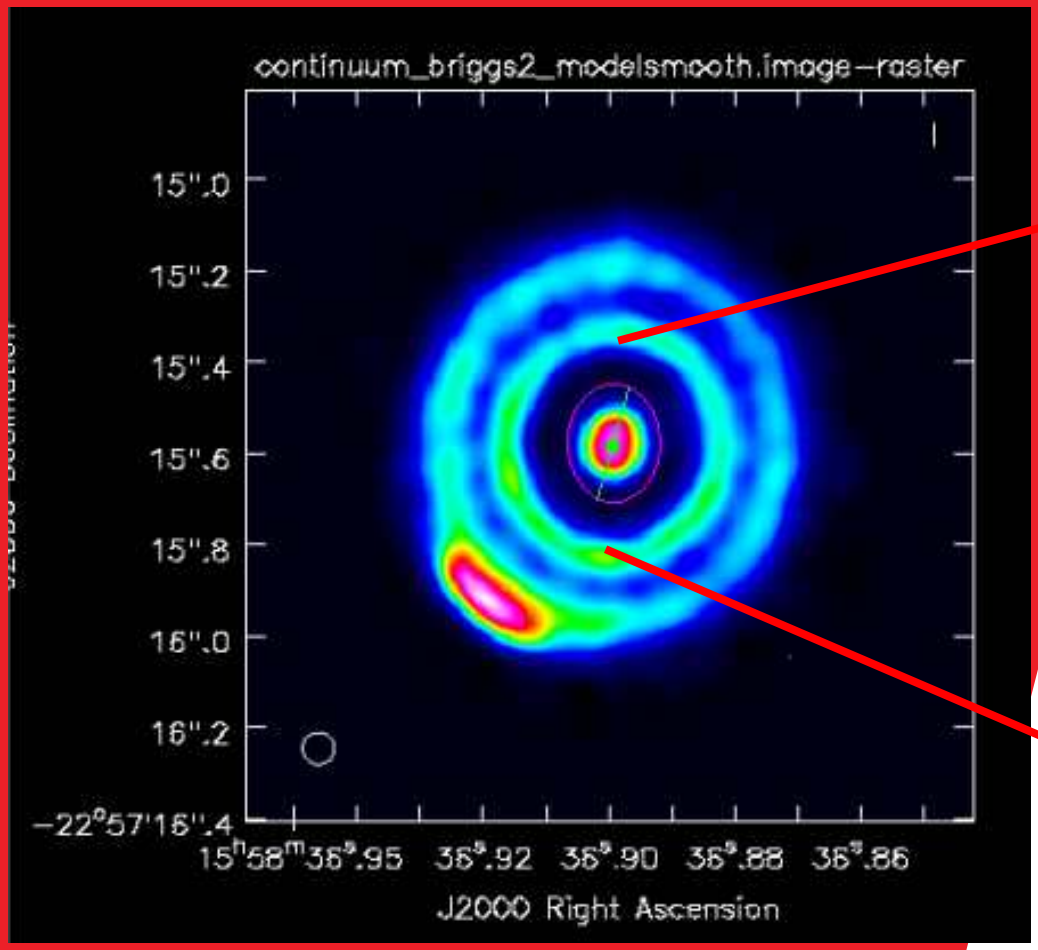




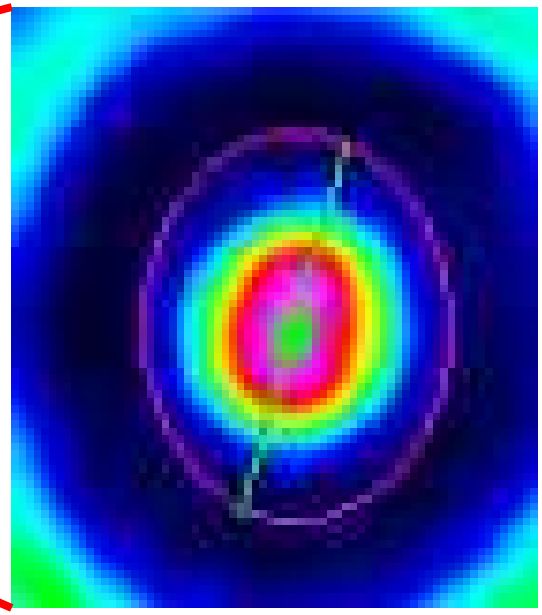
robust =0 Weighting – moment



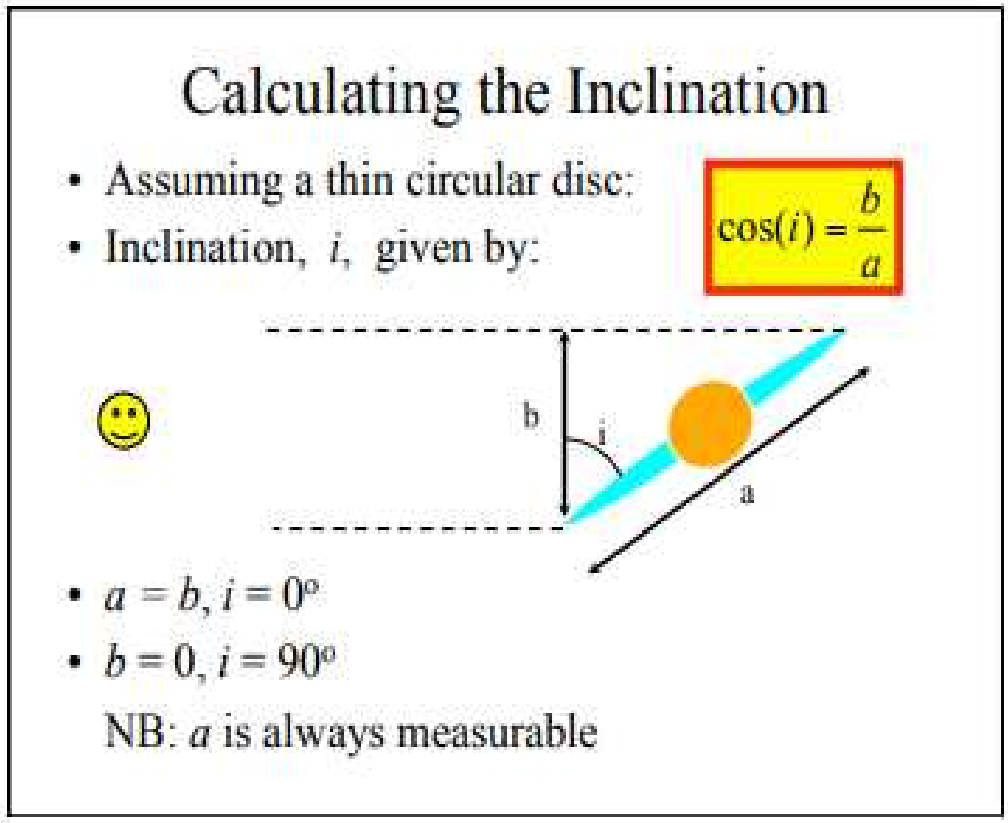
Inclination



major axis: 0.14125arcsec
minor axis: 0.124112arcsec



Inclination



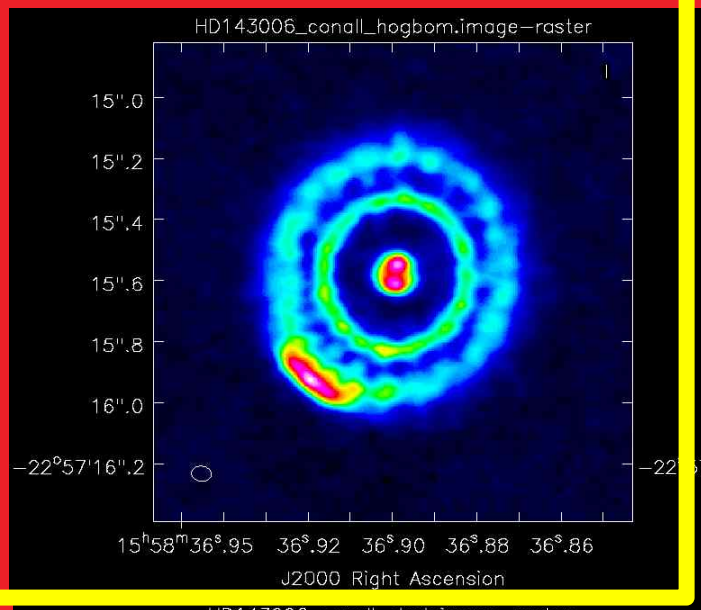
http://www-star.st-and.ac.uk/~kdh1/eg/eg06c.pdf

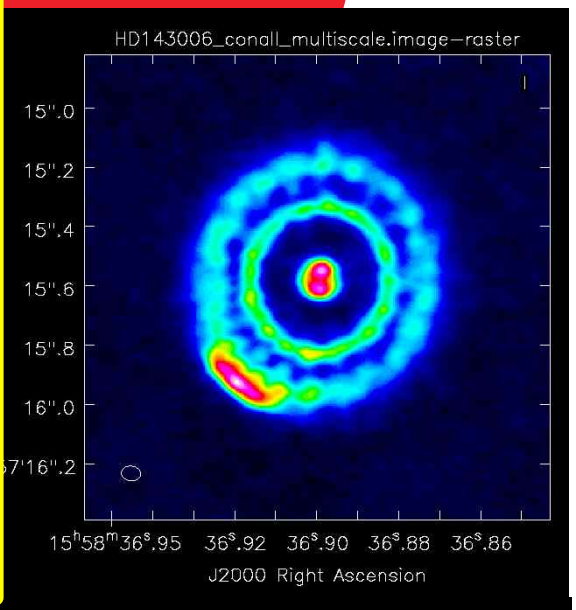
$$\cos(i) = \frac{minor\ \ axis}{major\ \ axis}$$

i = 28.517 degree

Natural Weighting – dust continuum

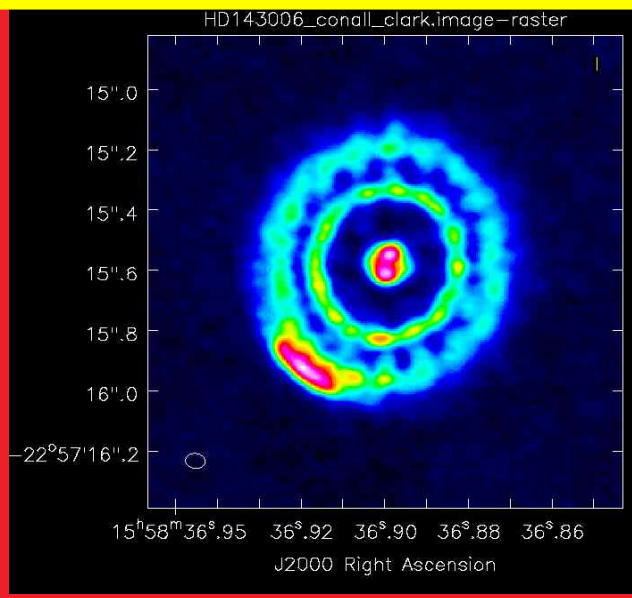
Hogbom

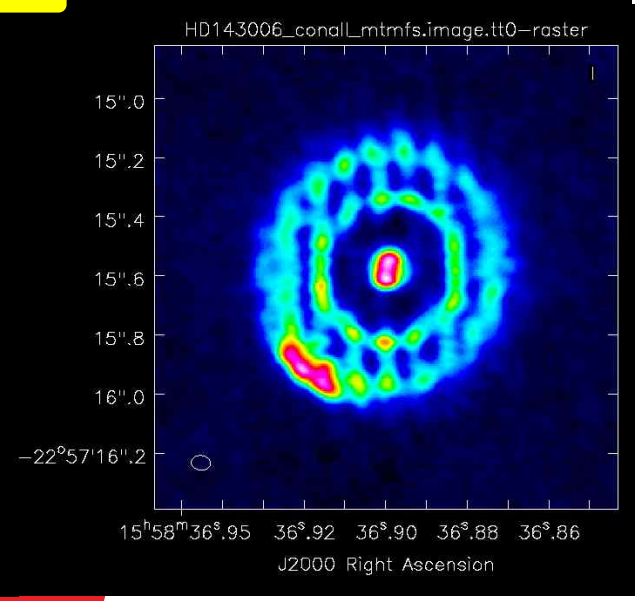




multiscale

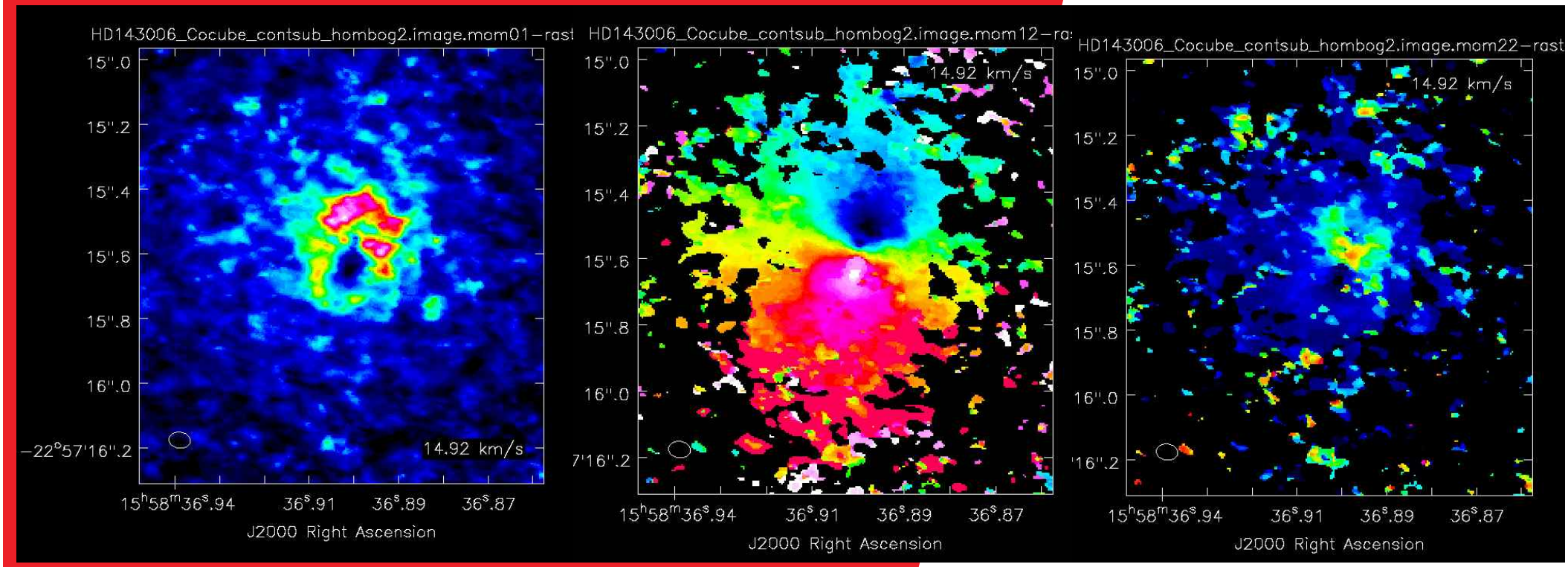
Clark



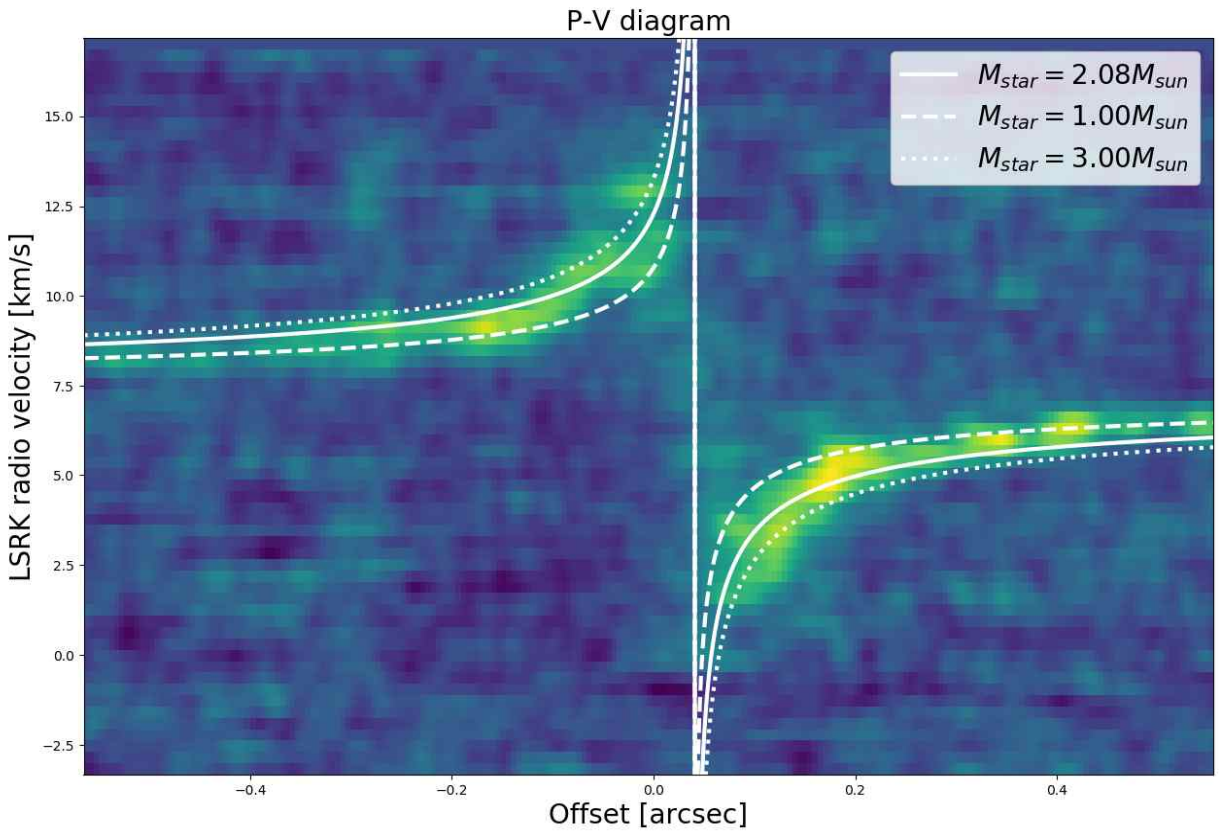


mtmfs

Natural Weighting – CO line (2 → 1)

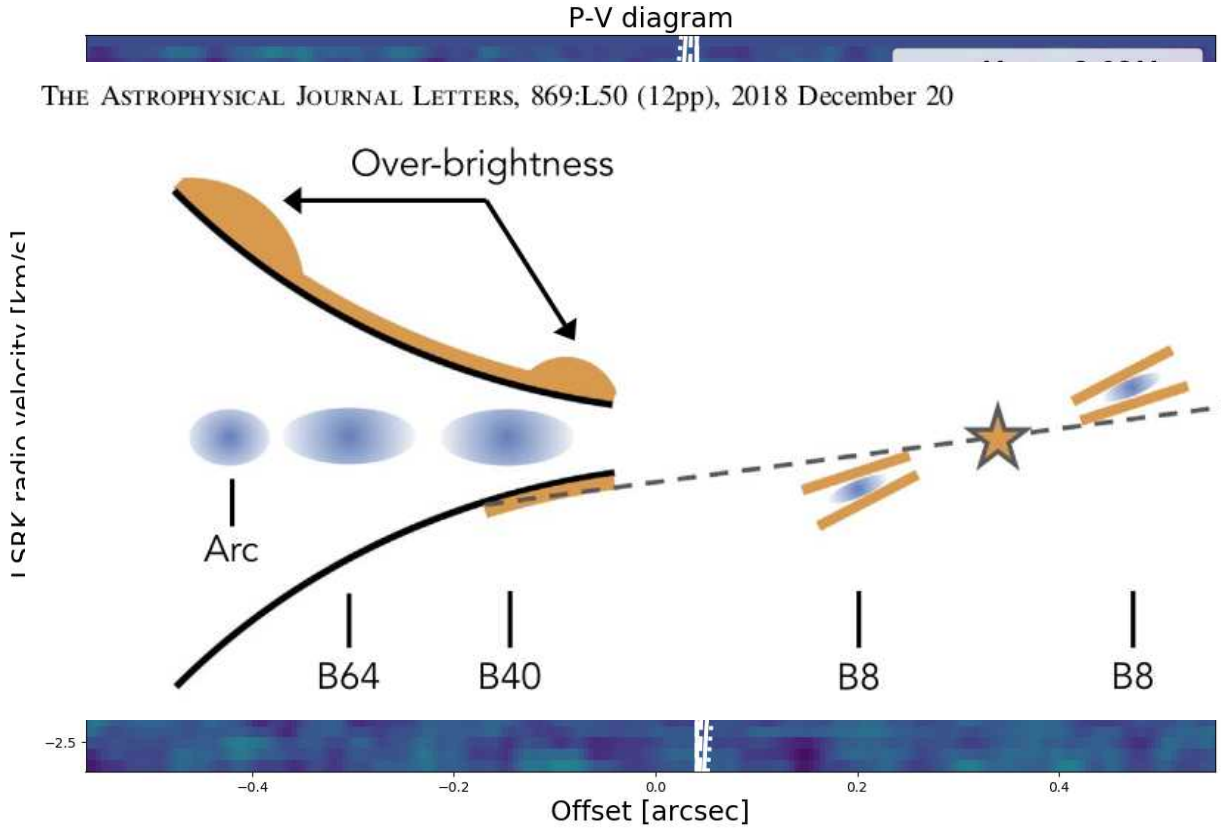


P-V Diagram



- Keplerian motion
- $M_* = R \times v^2/G$
- M_*= $2M_{sun}$ ~ $1.8M_{sun}$

P-V Diagram



Over-brightness

Arc

B64 B40 B8 B8 B40 B64

V_{sun}

LSRK radio velocity [km/s]

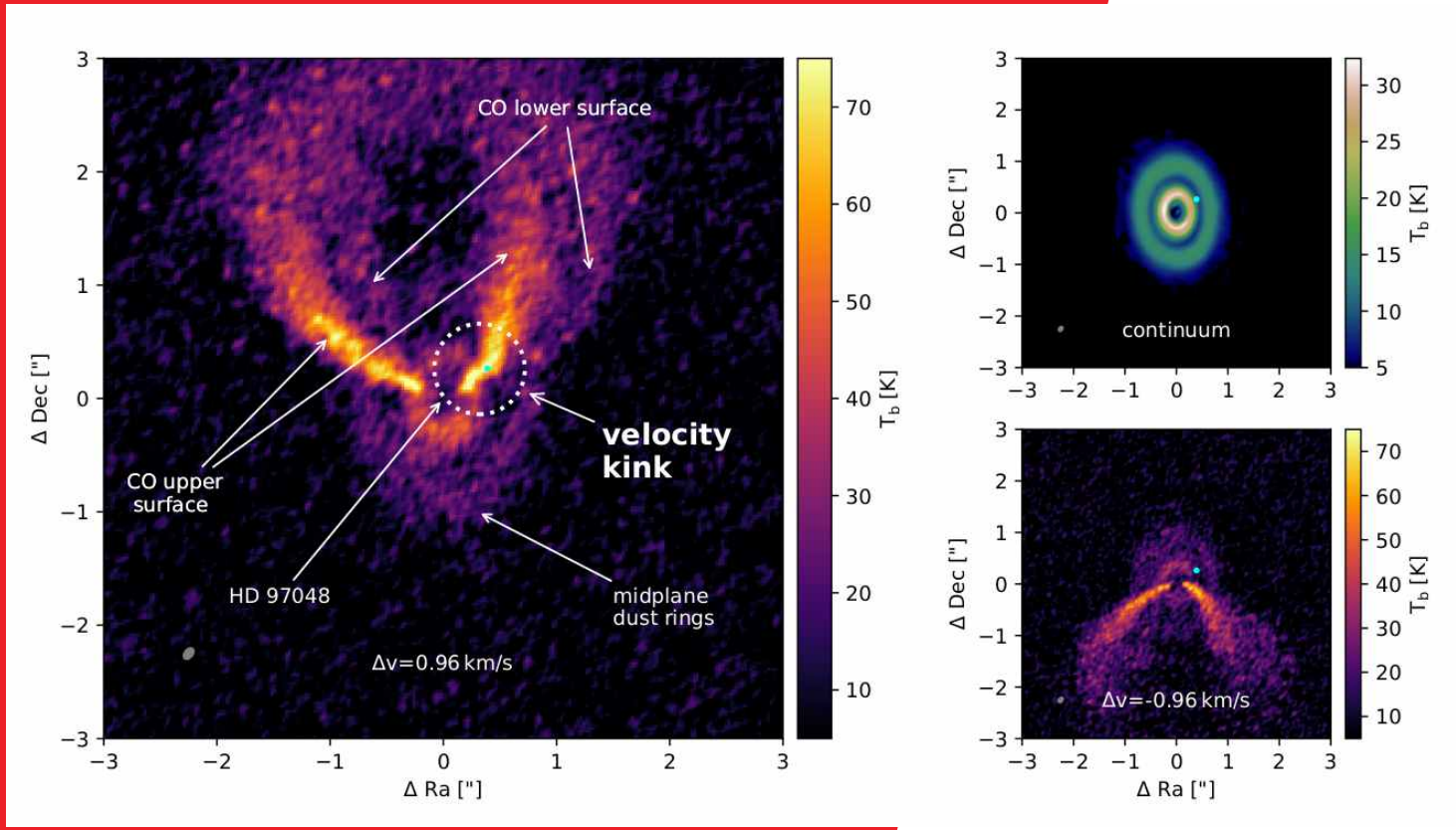
−2.5

−0.4 −0.2 0.0 0.2 0.4

Offset [arcsec]

P-V Diagram

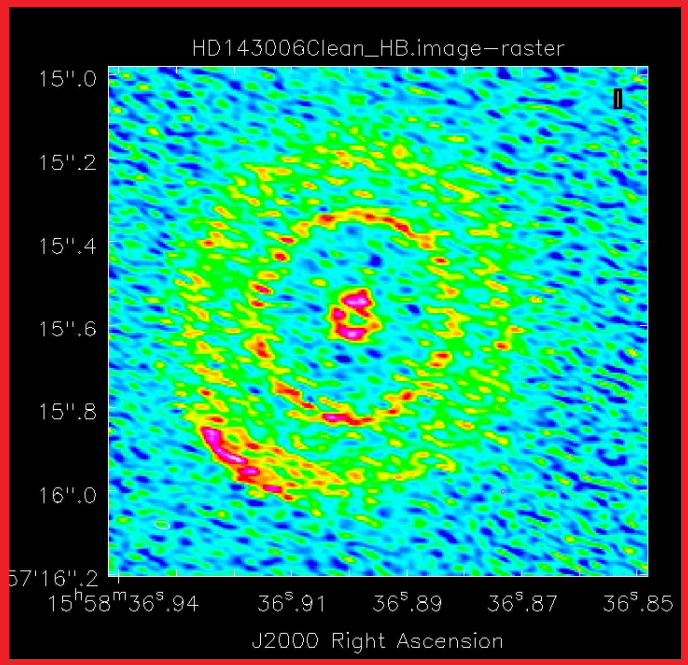
- Kinematic detection of a planet!!



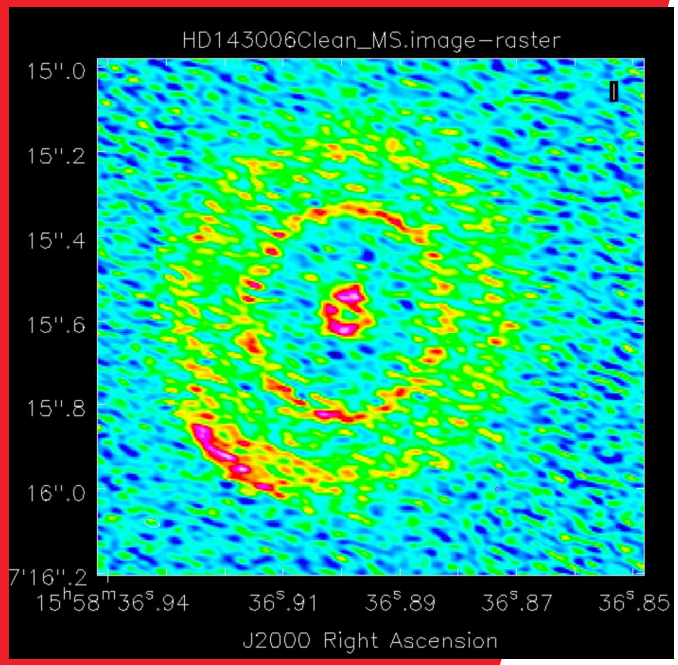
Pinte+19

Uniform Weighting - Dust continuum

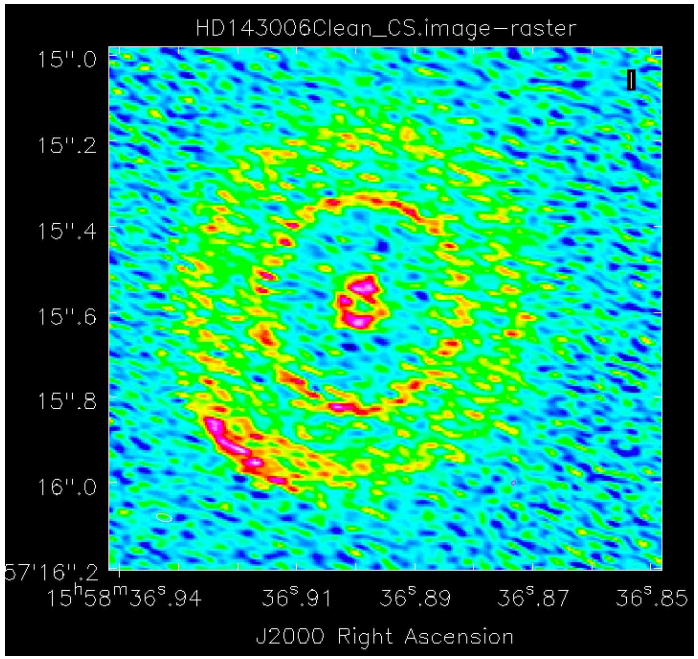
Hogbom



Multiscale

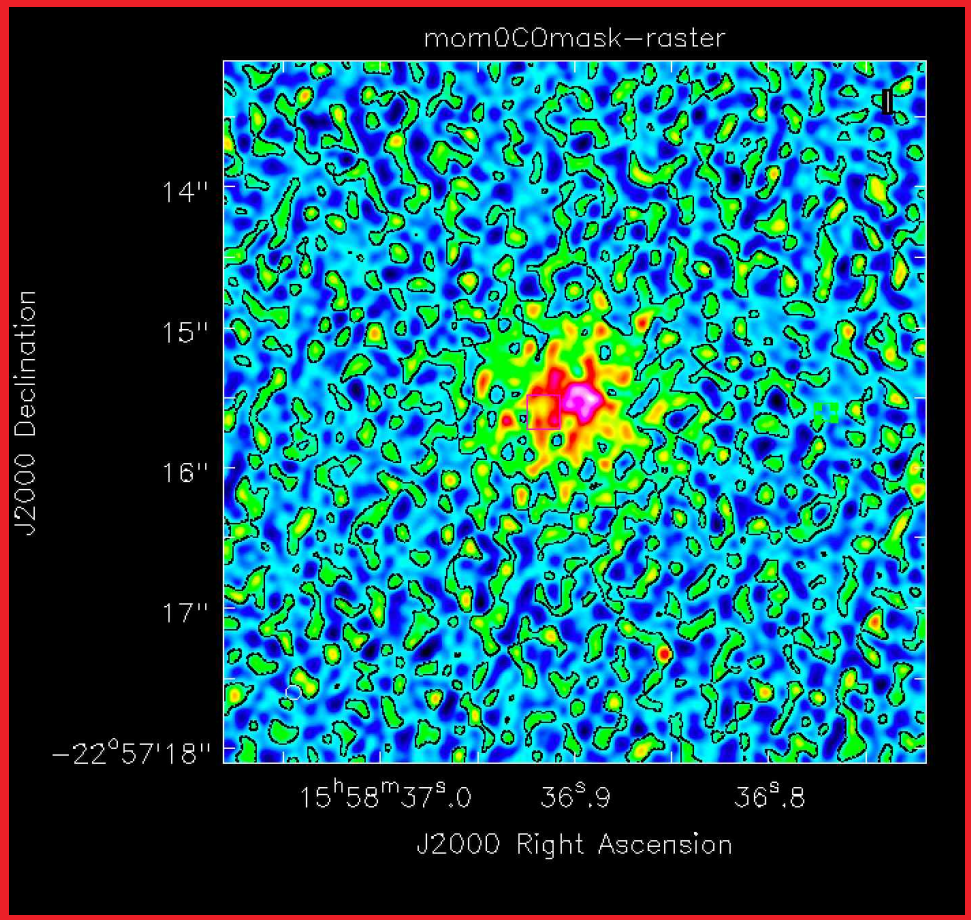


ClarkStokes

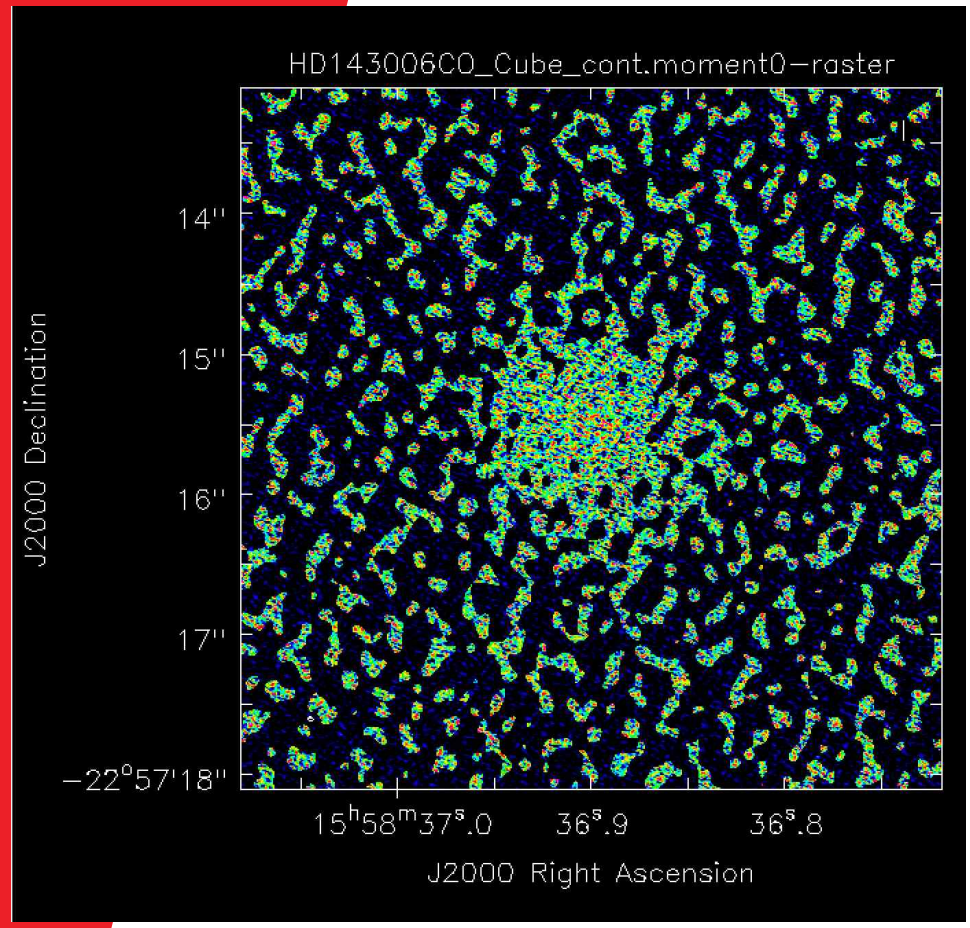


Uniform Weighting – Moment Map

Mask image

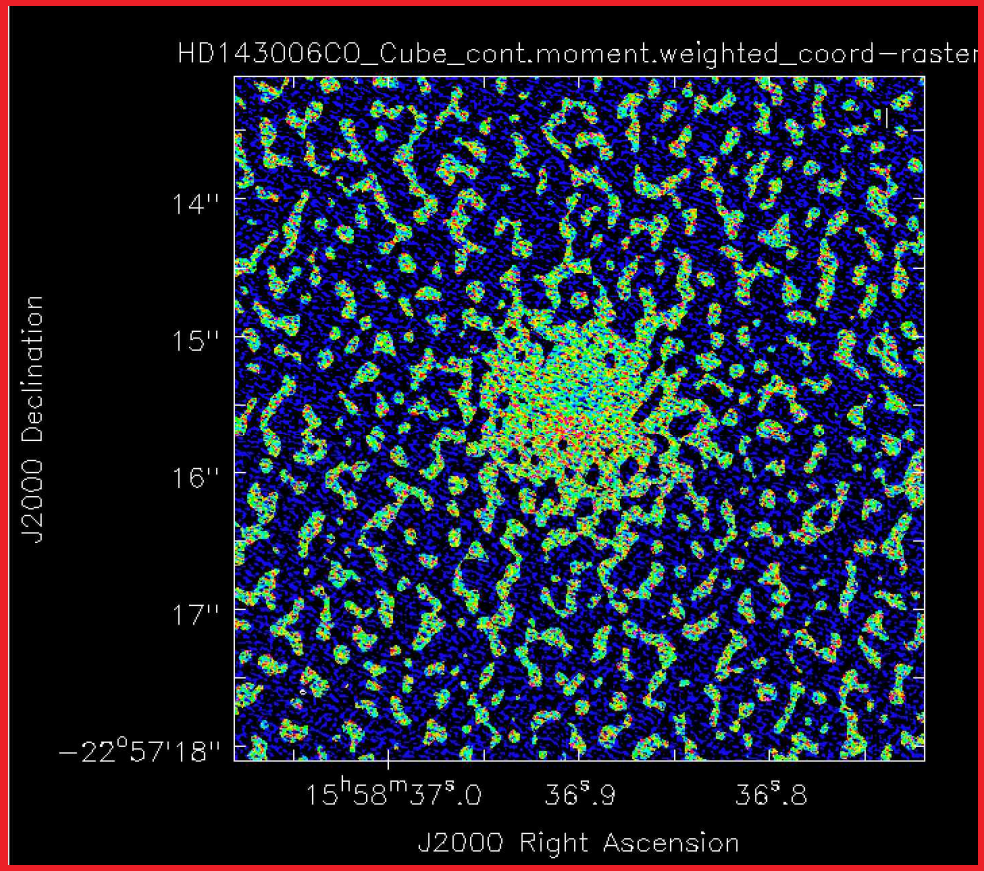


Moment0

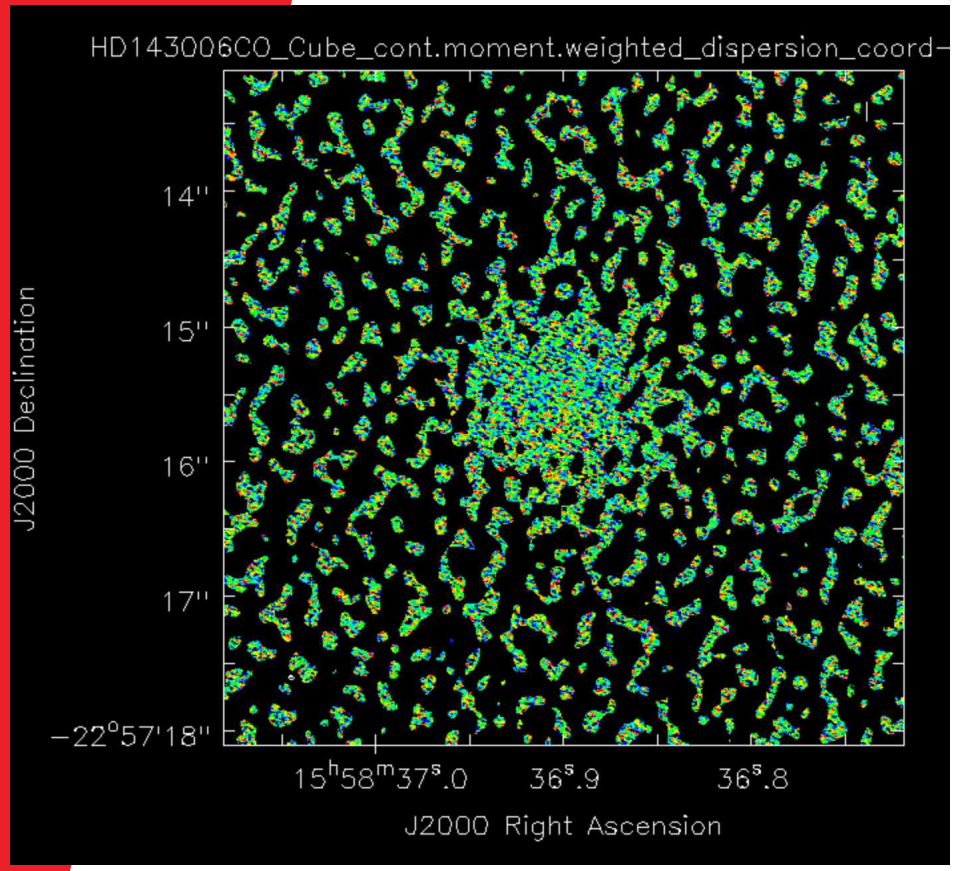


Uniform Weighting – Moment Map

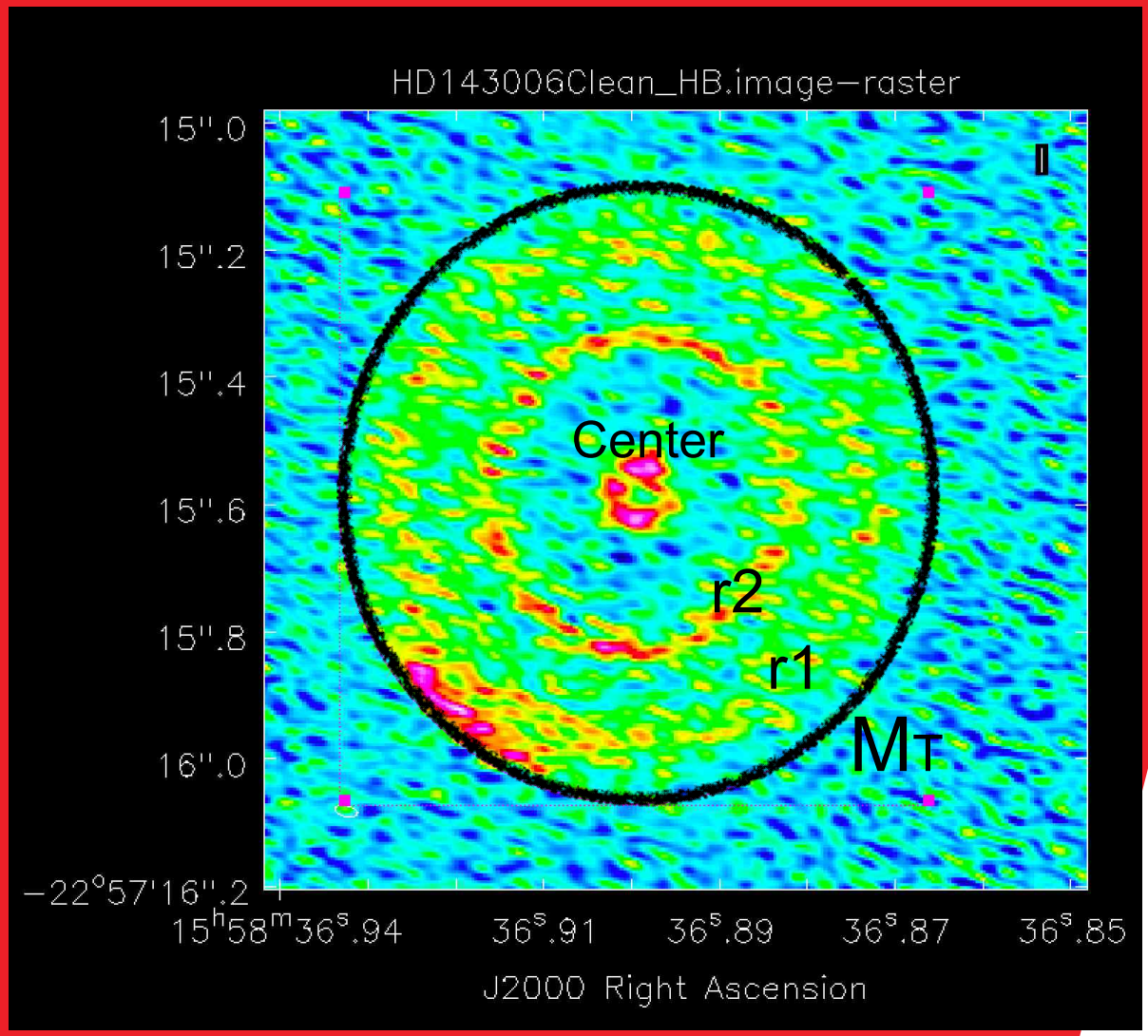
Moment1



Moment2



Masses of Rings



$$F_\nu \sim \kappa_\nu B_\nu(T_d)\frac{M_T}{D^2}$$

Kwon et al. 2009

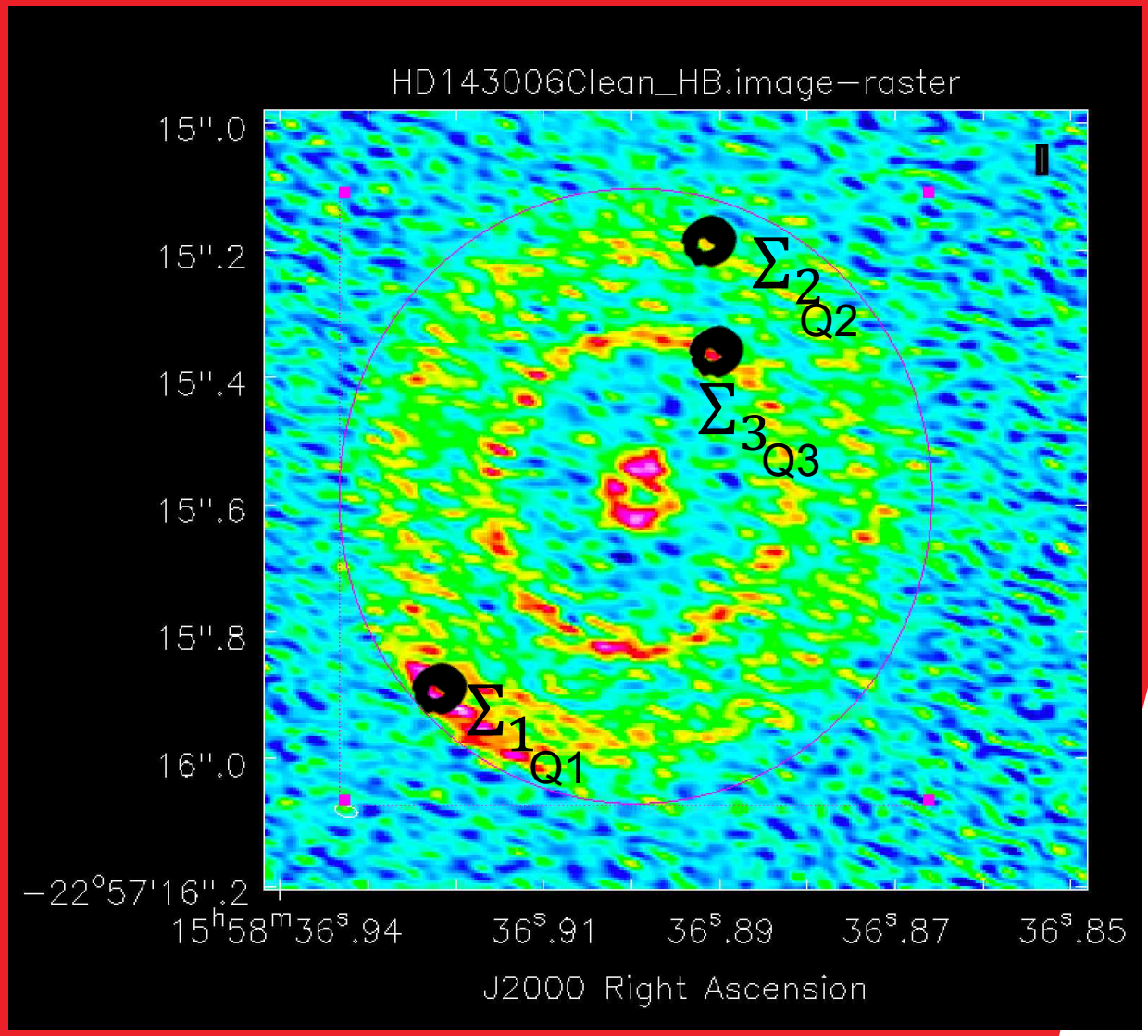
$$D = 165 \pm 5\text{pc}$$

Gaia Collaboration et al. (2018)

$$M_T \sim 1.75 \times 10^{-2}\text{M}_\odot$$
$$M_{r1} \sim 1.2 \times 10^{-2}\text{M}_\odot$$
$$M_{r2} \sim 3.64 \times 10^{-3}\text{M}_\odot$$
$$M_{center} \sim 10^{-3}\text{M}_\odot$$

Toomre Criterion for Protoplanetary disk

(Kwon et al. 2011)



Mass of protostar

$$M_* \sim 2\mathrm{M}_\odot$$

$$\Omega = \sqrt{\frac{GM_*}{R^3}}$$

$$Q = \frac{c_s \Omega}{\pi G ?}$$

Q < 1.5 :
Gravitationally unstable.

Result

$$Q_1 = 0.448$$
$$Q_2 = 0.921$$
$$Q_3 = 1.721$$

… with fixed gas to dust ratio
& Uniform TD

Toomre Criterion for Protoplanetary disk