On the kinematics of photoevaporating disks. The case of MWC349

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Outline

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Disks around massive stars

Are disks a key ingredient in massive star formation?

- Yes, in regions with few 10^4 Lo (outflows, ...)
- What about star formation in regions with > 10^5 -10^7 Lo?
- The formation process influences their evolution

  Time scale for the dispersal of the surrounding material

- Massive stars will ionize the surrounding gas → UCHII regions
- VLA surveys of UCHII regions: Life time paradox
- 30 % Broad Recombination Line Objects (Jaffe & Martin-Pintado et al. 1999)

  Broad radio recombination lines (V > 60 km s^{-1})

  Rising radio spectra ($S \sim \upsilon^{\alpha}$) with $\alpha > 0.4$

Photoevaporation of protostellar disks around massive stars

Disks in superclusters

Galactic superclusters>10^7 Lo
Sgr B2N, Sgr B2M, W49A

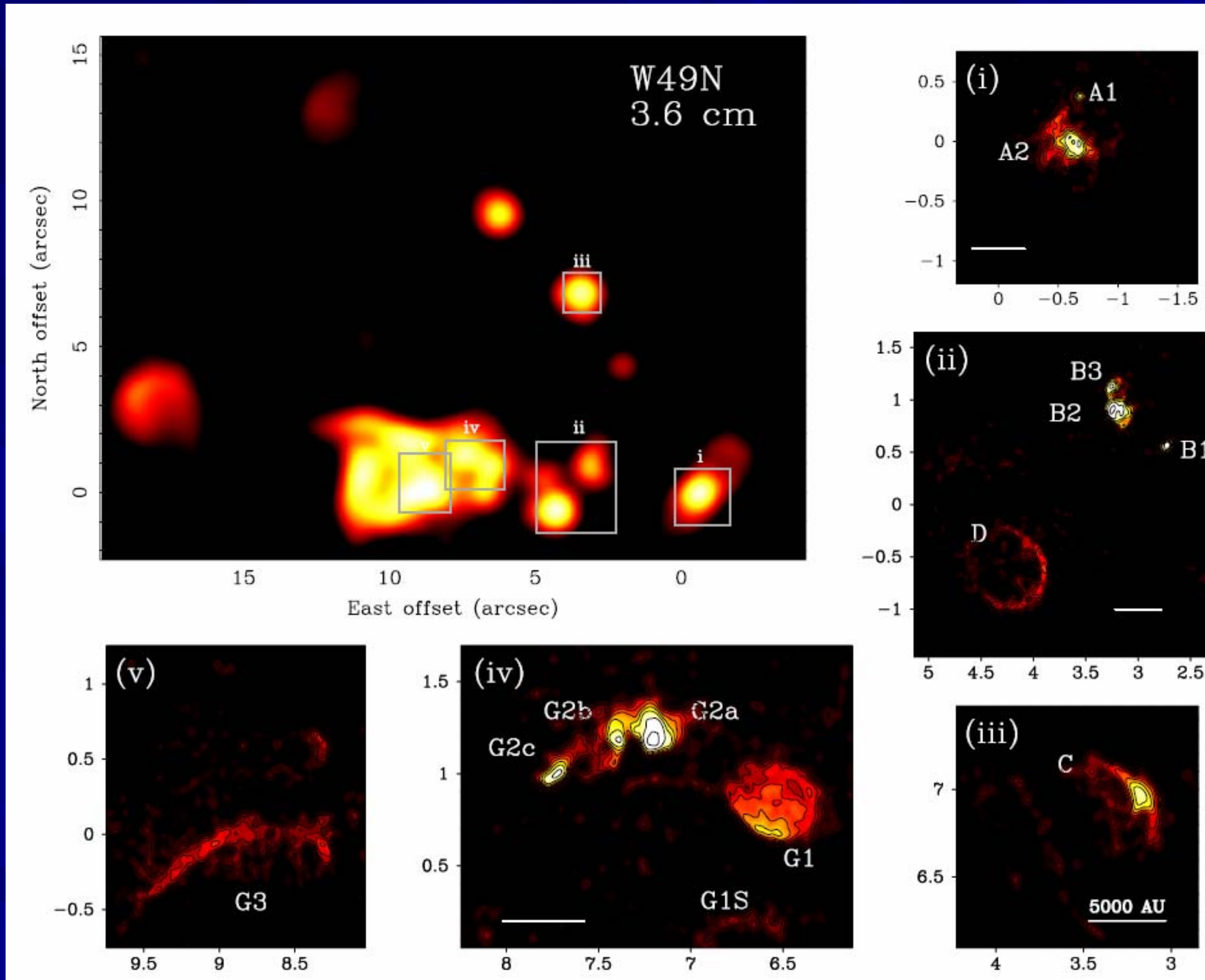
W49A: 30%-50% BRLOs

Radio continuum
+
Recombination Lines

↓

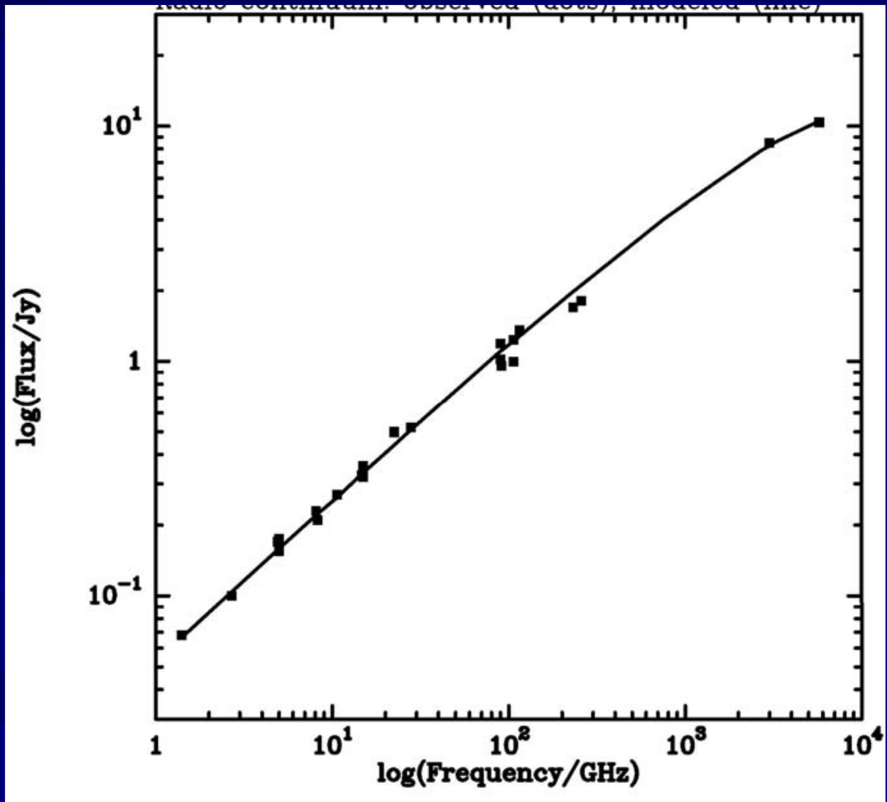
Study the protostellar disks in nearby objects: MW349

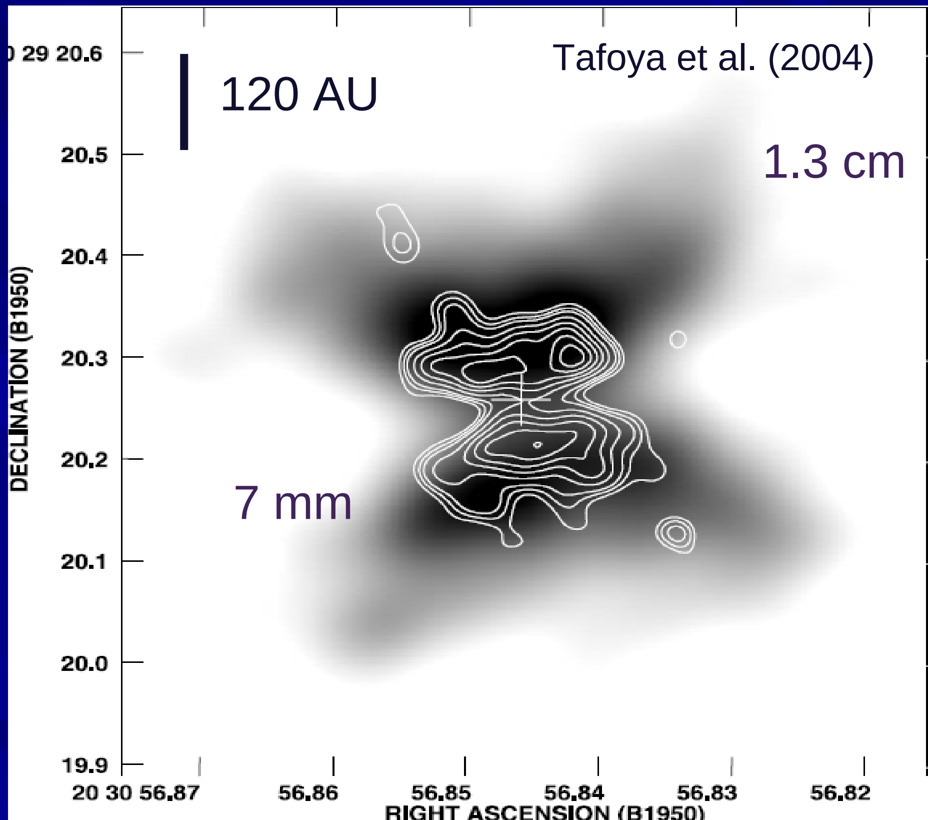
Depree et al. (2006) **VLA** 0.″055 x 0.″044 (~500 AU) 7 mm



The case of MWC349

- MWC 349 A: Be star, 3 10^4 Lo, 20 Mo, in a binary system
- Free-free emission is "biconical" ➔ neutral disk
- Spectral index 0.67 ➔ density profile r^{-2} also in the disk

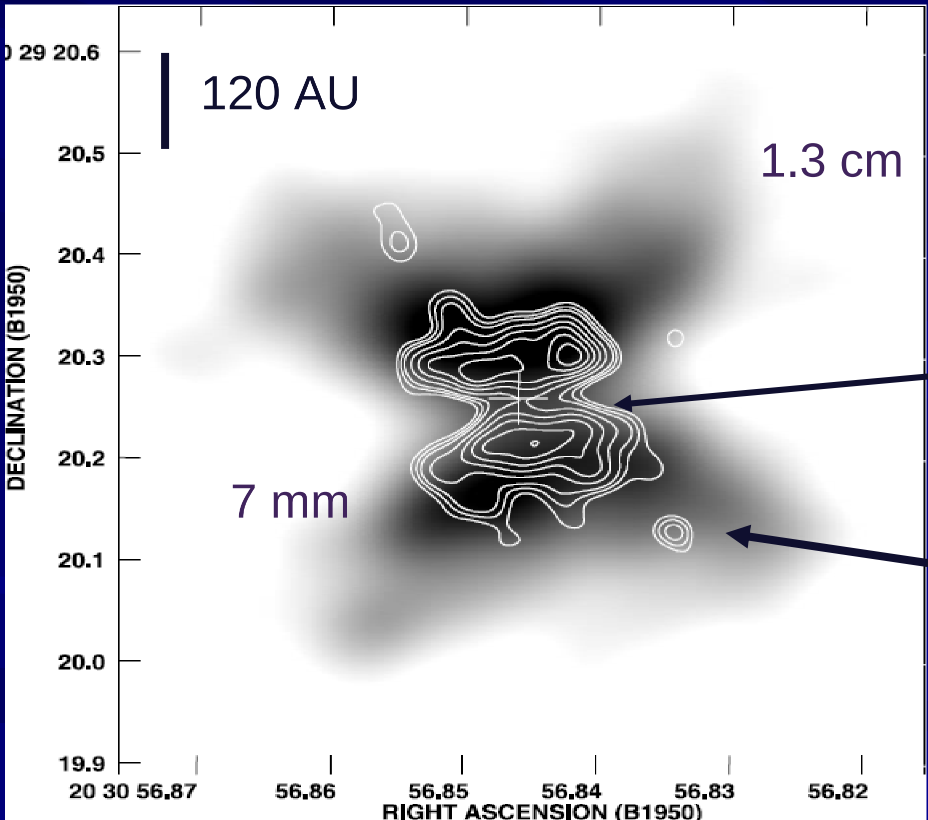




The case of MWC349

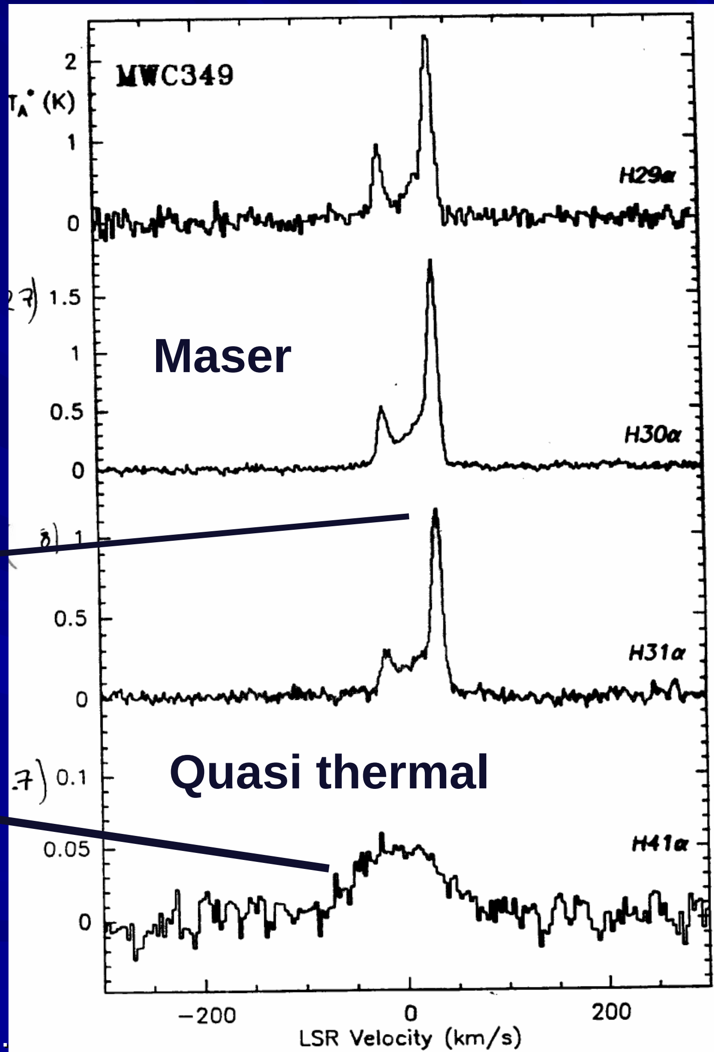
- Kinematics : ionized wind 60-90 Km/s and a rotating disk
- OVRO: peak separation➔ Keplerian for 20 Mo
- Mass loss ~ few 10^{-6} Mo/year
- Is the wind rotating?

Martin-Pintado et a. (1989)



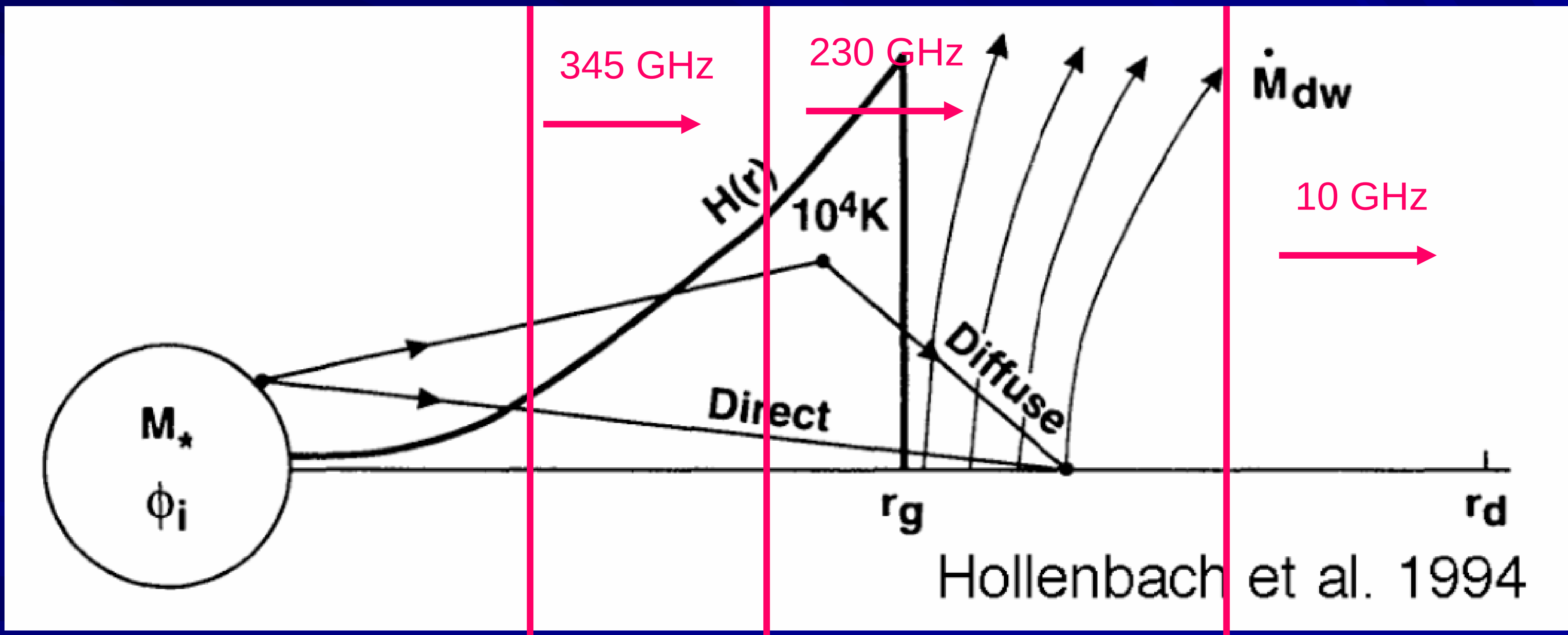
Disk

Wind



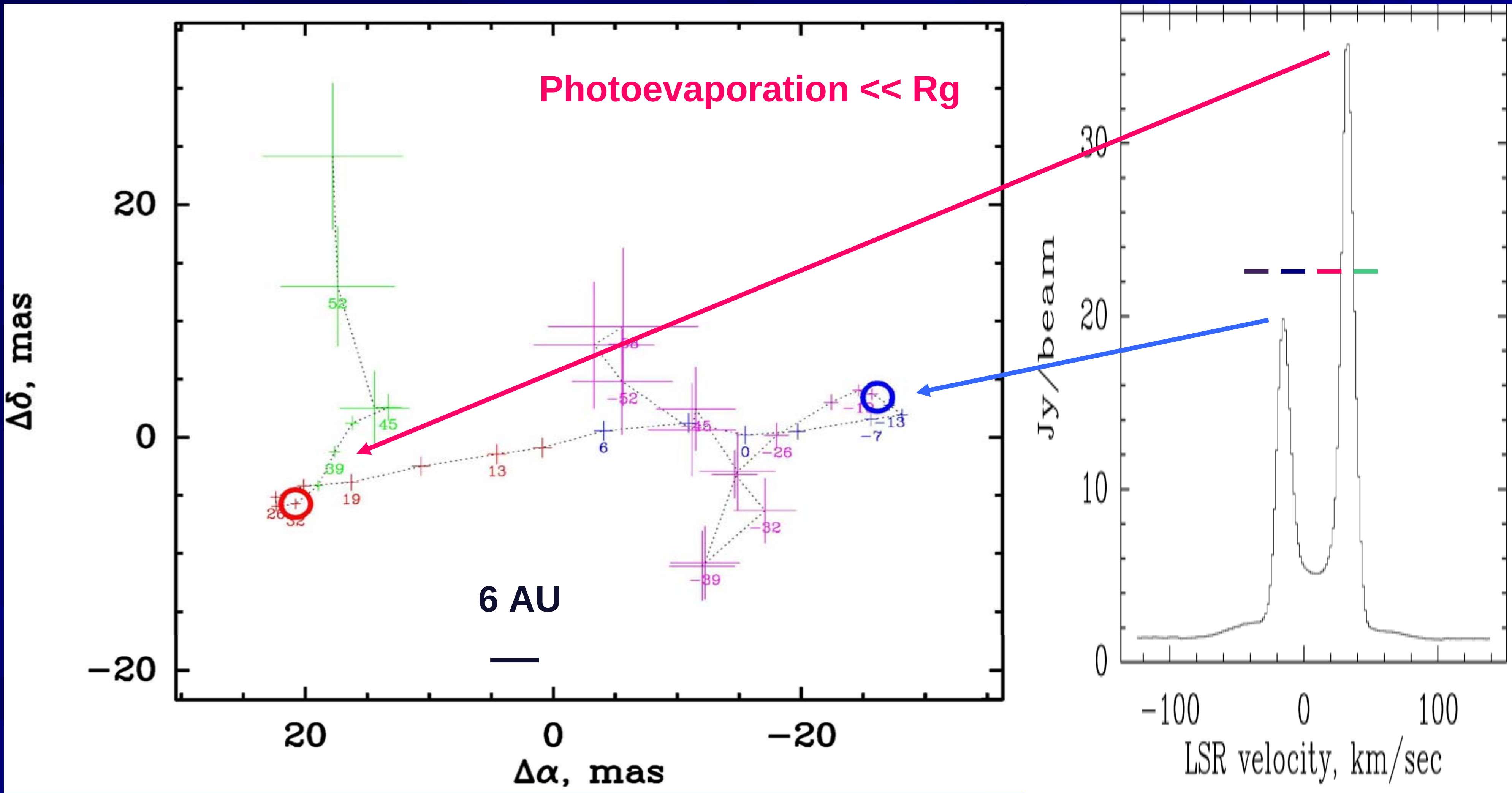
Photoevaporating disk

Gravitational radius, rg, 180 AU for 20 Mo



Kinematics of photoevaporating disks

PdBI : Relative position between different velocities: Error of 0.001" for peaks



MWC 349 Kinematical model

Kinematical model to explain the relative position of the emission at different velocities

Includes non-LTE excitation

Old parameters

$$\mathbf{Ne} = \mathbf{A}\, r^{-\gamma}\, e^{-(\theta/\theta_0)} :$$

$$A = 5.4 \times 10^{9}\,\mathrm{cm}^{-3}$$

$$\text{para } r = 10^{14}\,\mathrm{cm}$$

$$\gamma = 2.11$$

$$\theta = 10^{\circ}$$

$$\mathbf{Te = 6.000\ K}$$

Keplerian disk:

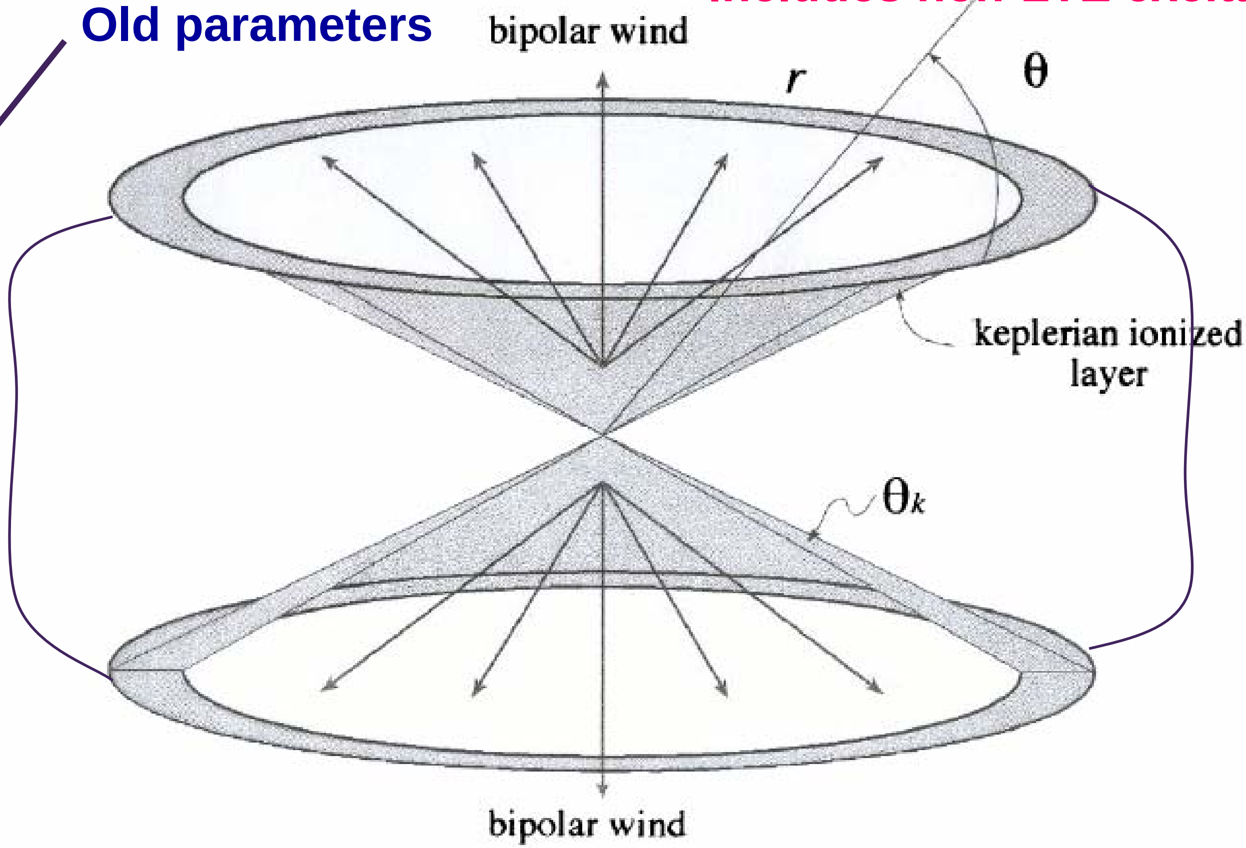
$$M_{*} = 30\ \mathrm{Mo}$$

$$\theta_k = 3.5^{\circ}$$

Bipolar wind:

$$V_{exp} = 58\ \mathrm{km\ s^{-1}}$$

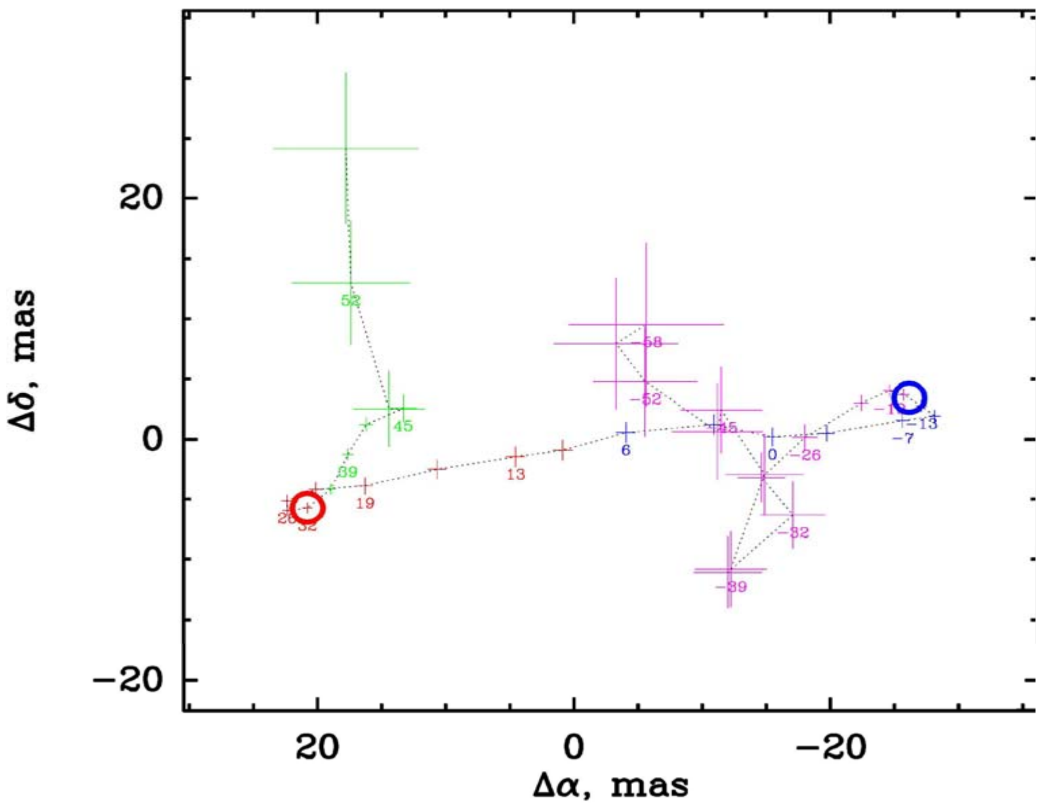
Inclination angle



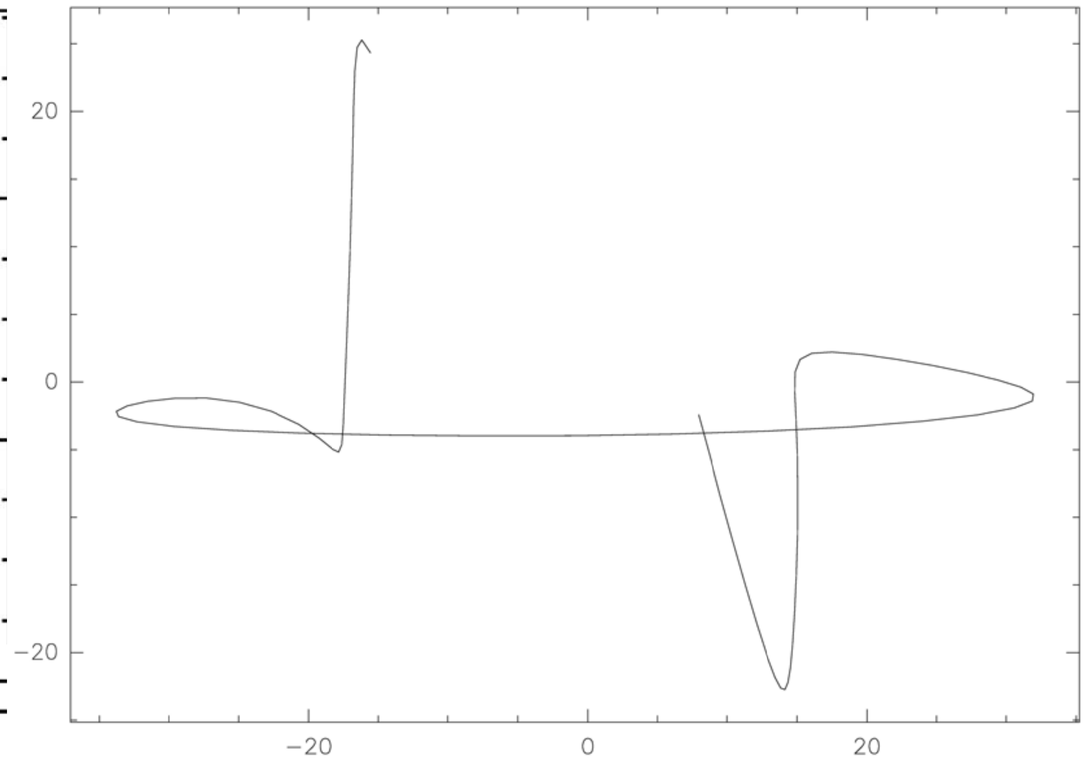
Model results

The model fits: spectral index, morphology , line profiles of quasithermal emission

Results: **Rev<<Rg,   Inclination= 8º, Keplerian with 60 Mo !!.   Wind is rotating.**
Scale height: hydrostatic equilibrium , ~ distance



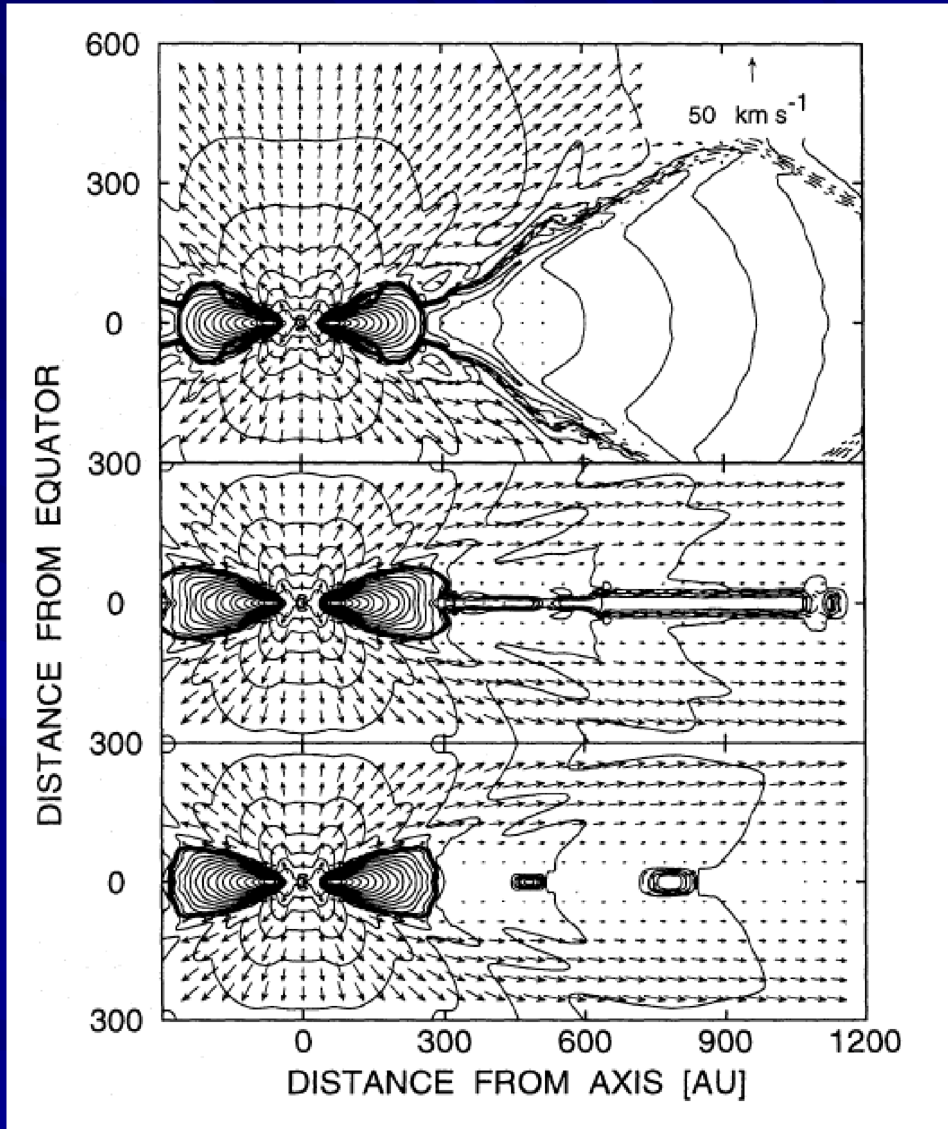
Scale height: ~ distance



Other models

Yorke et al. (1996, 1997)

Interaction of the circumstellar material with an isotropic stellar wind



The ALMA Era. Nearby

We need the E-VLA (broad lines) and ALMA + IR

MWC349 : **Mapping in lines and continuum + relative positions. Masers > 150 GHz**

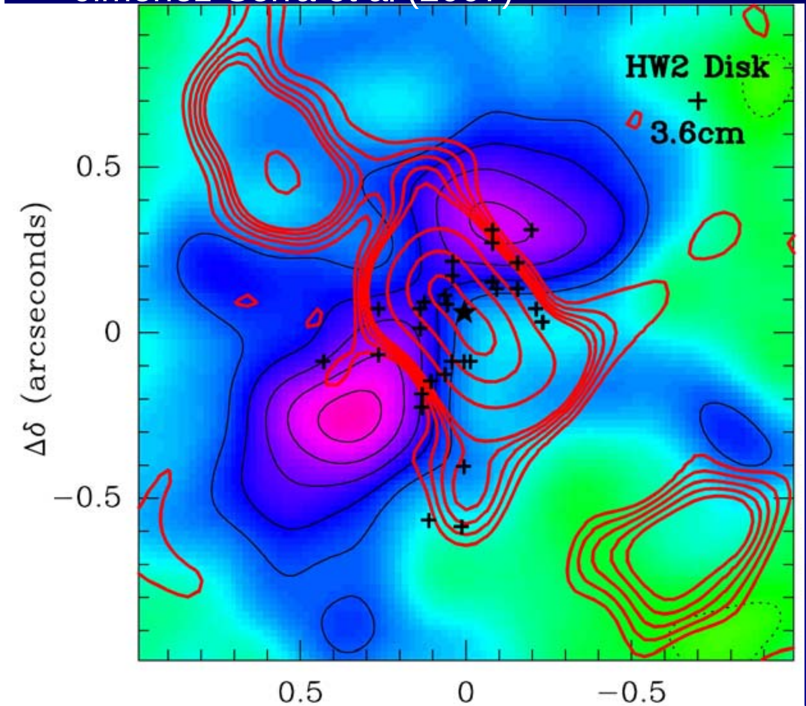
➔Provide a very good representation of the structure and kinematics

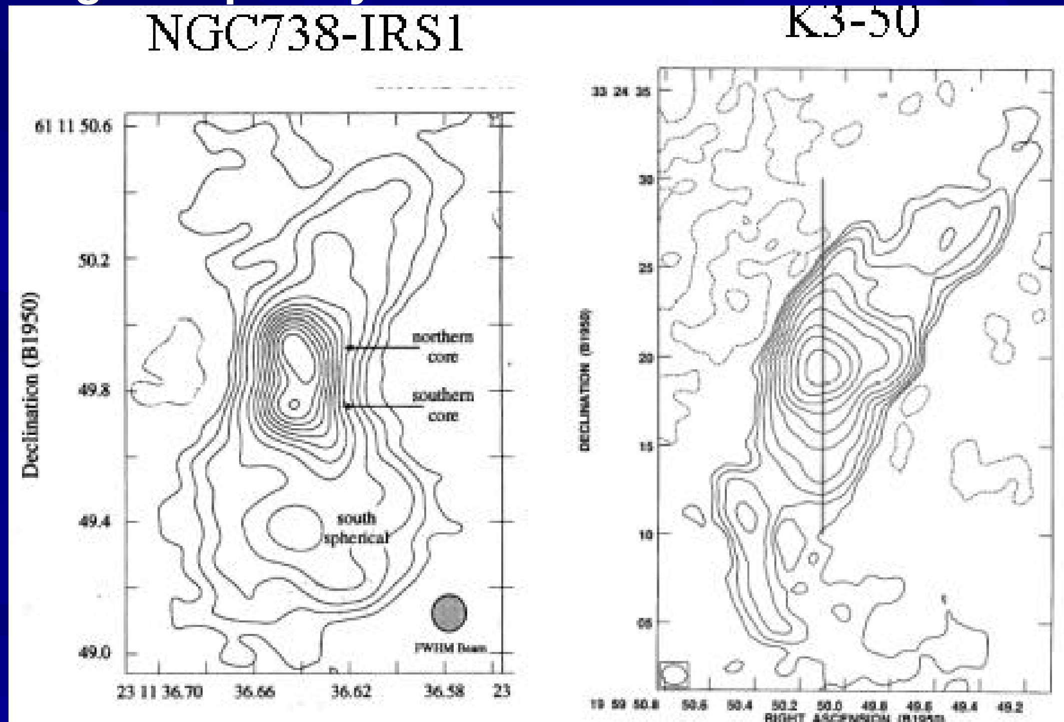
Monitoring in lines and continuum (Rodriguez et al. 2007)

Other sources: **Mapping in lines and continuum 100GHz ..) + relative positions.**

Search for masers at high frequency >345 GHz

Jimenez-Serra et al (2007)





The ALMA Era. Superclusters

W49N: **At λmm-submm recom lines: Tl >150 mJy. Need high angular resolution**
Mapping in lines and continuum + relative positions. Masers > 150 GHz

➔Provide information on the kinematics (presence of a keplerian disk?)

High accuracy in bandpass calibration