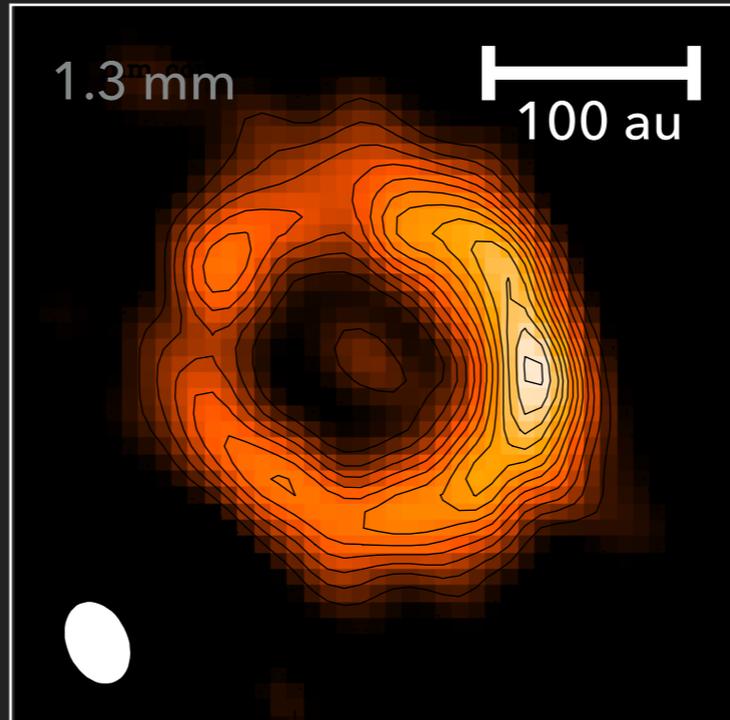


SMA, $\theta=1''$, $\sigma=2.8$ mJy

Lin+2006



PdBI, $\theta=0.5''$, $\sigma=0.2$ mJy

Tang+2012

=> ALMA?

YA-WEN TANG (ASIAA)

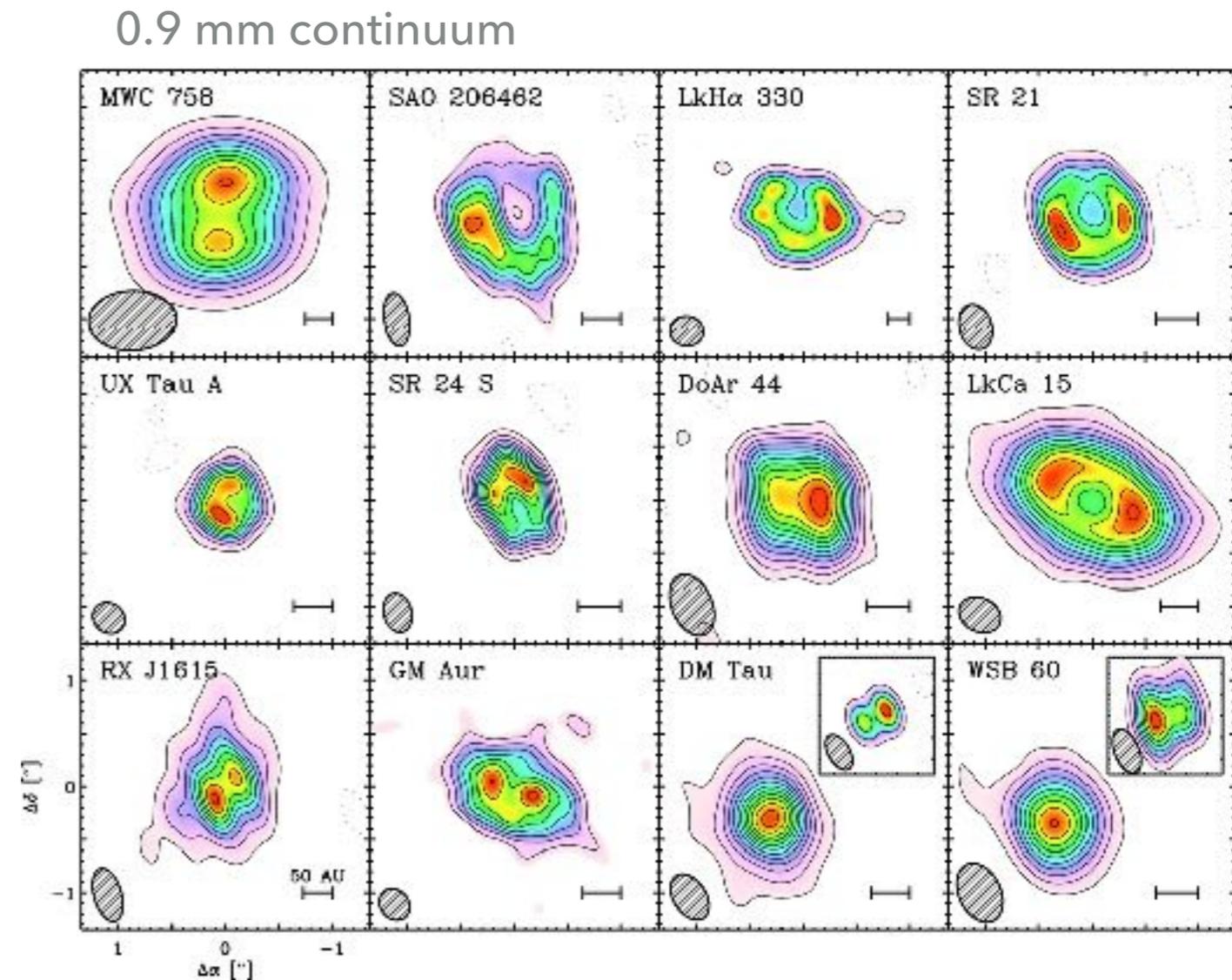
**CIRCUMSTELLAR DISKS WITH
THE WSMA**

OUTLINE

- ▶ highlights of recent disk studies
 - ▶ transitional disk: sub-structures resolved at mm continuum, distribution of gas and dust
 - ▶ disk structures around binary systems
- ▶ science cases for the wSMA?

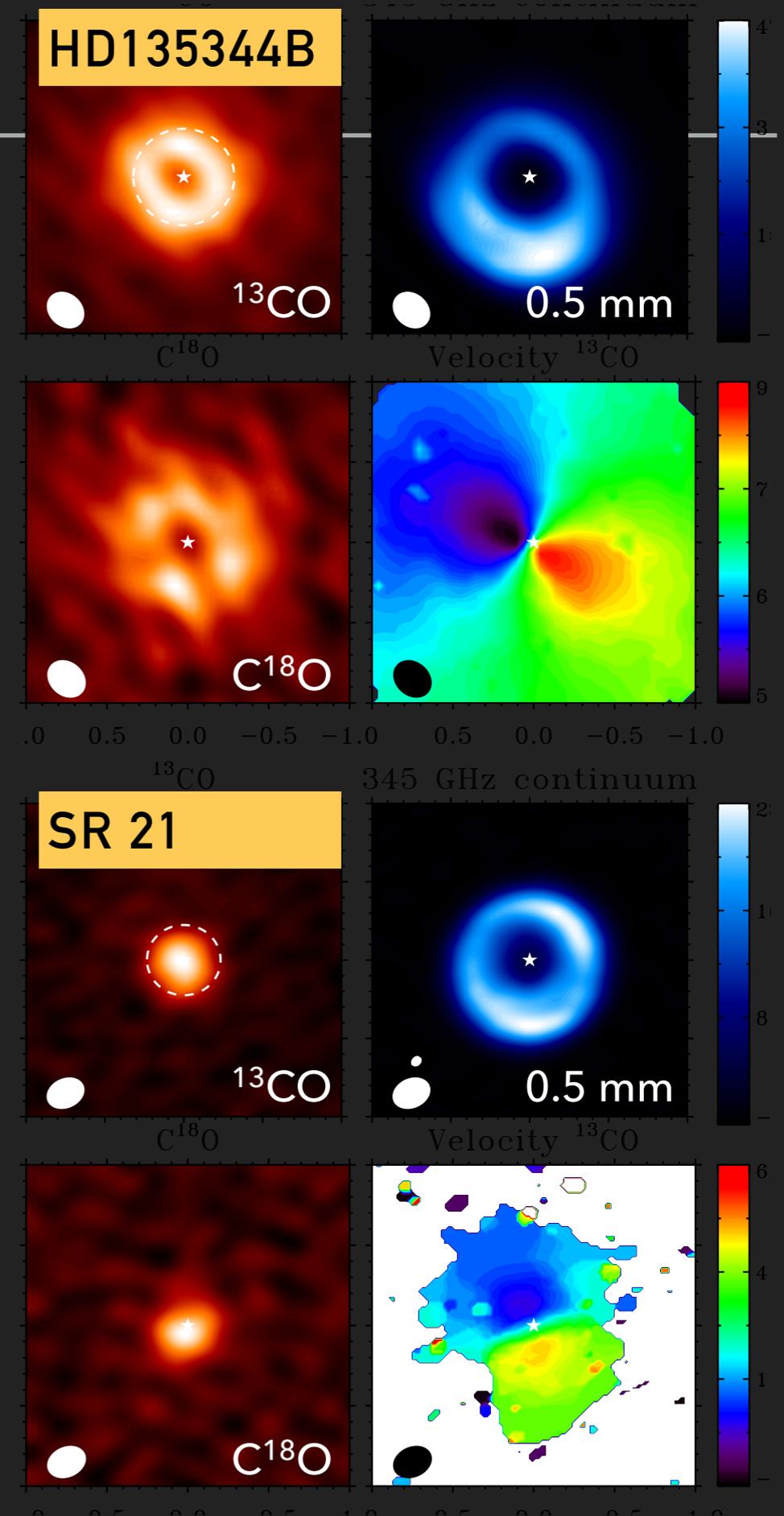
TRANSITIONAL DISKS AT 0.3''

- ▶ SMA observation: 12 bright transitional disks with 0.3'' angular resolution, 1-4 mJy/beam sensitivity
- ▶ 20% of the disks in the upper half of the L_{mm} have cavities
- ▶ more likely formed via tidal interactions with low-mass companions

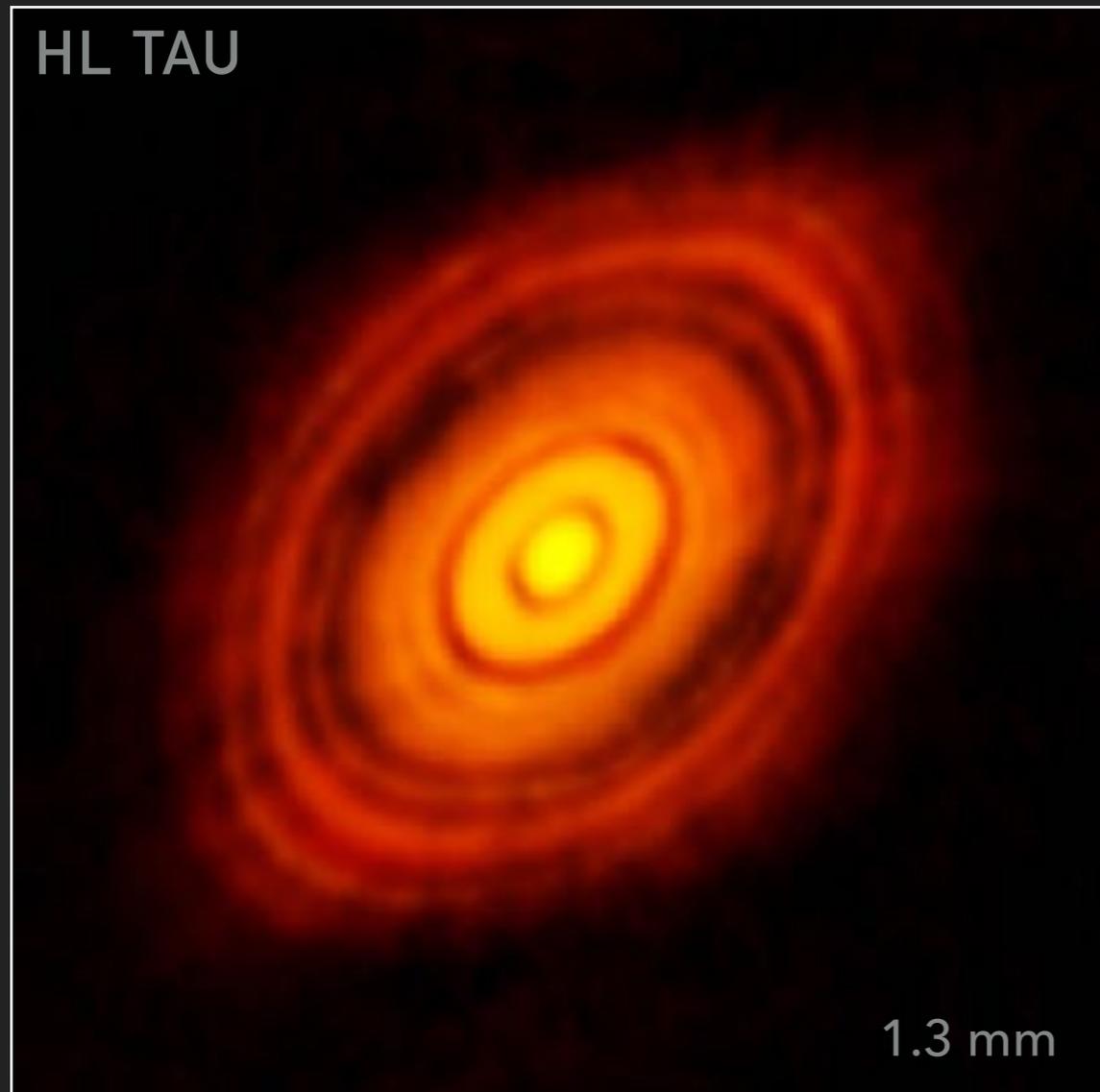


GAS AND DUST DISTRIBUTION

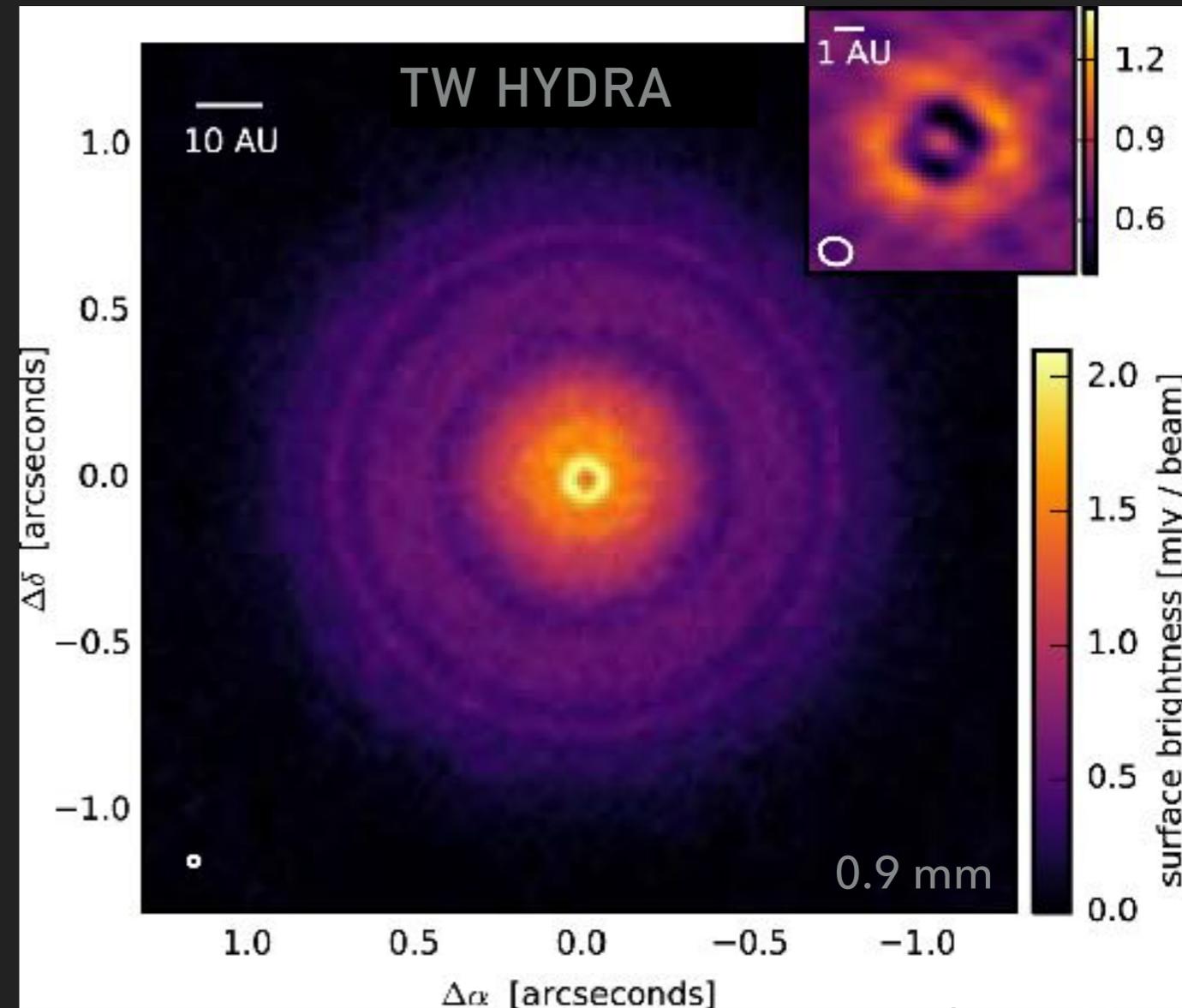
- ▶ 0.3'' resolution, $\sigma_{\text{cont}}=0.3$ mJy/beam, $\sigma_{\text{C}^{18}\text{O}}=15$ mJy/beam
- ▶ use ^{13}CO 6-5 and C^{18}O 6-5 to derive the gas density profile toward 4 bright disks
- ▶ gas cavity is 2 times smaller than dust cavity
- ▶ gas density in the cavity drops by 1000 times as compared to the profile of the outer disk



FINE STRUCTURES WITHIN DISKS



ALMA Partnership+2015

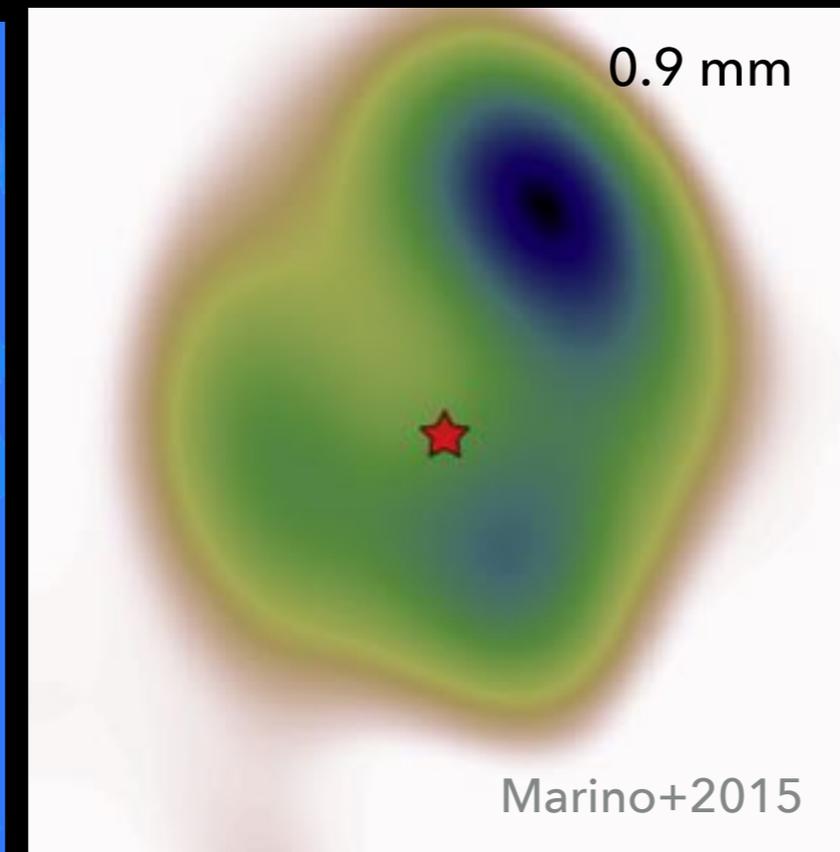
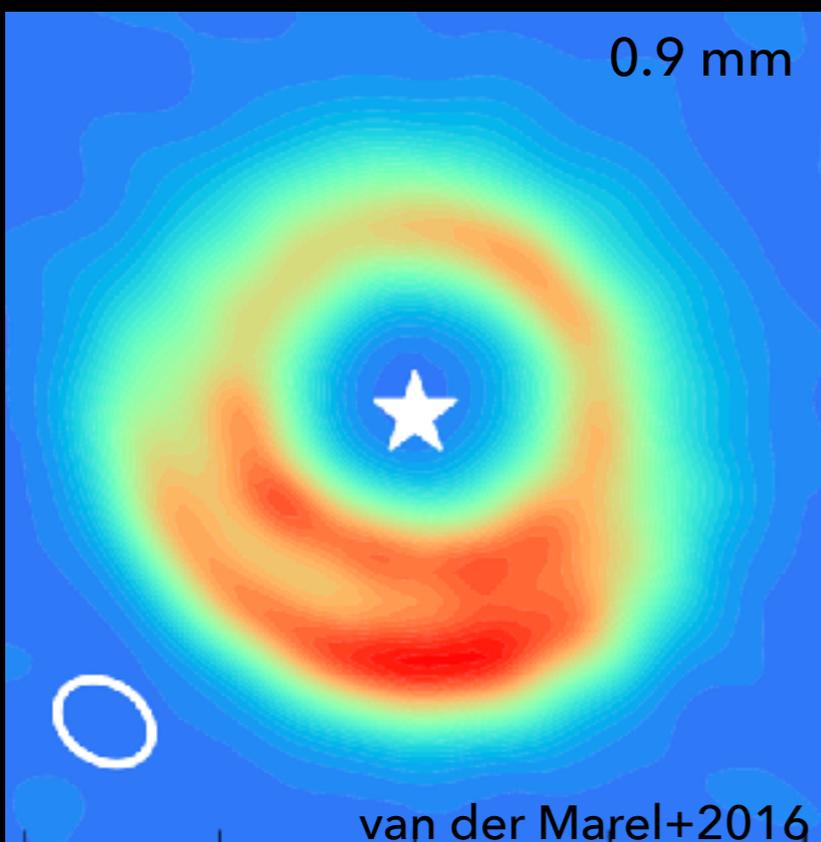
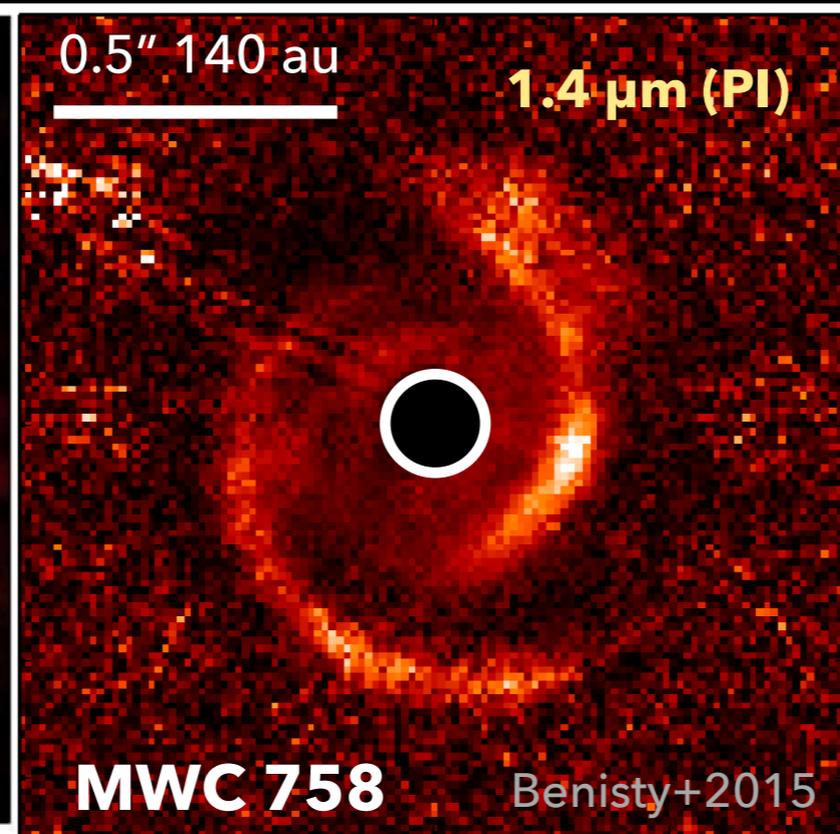
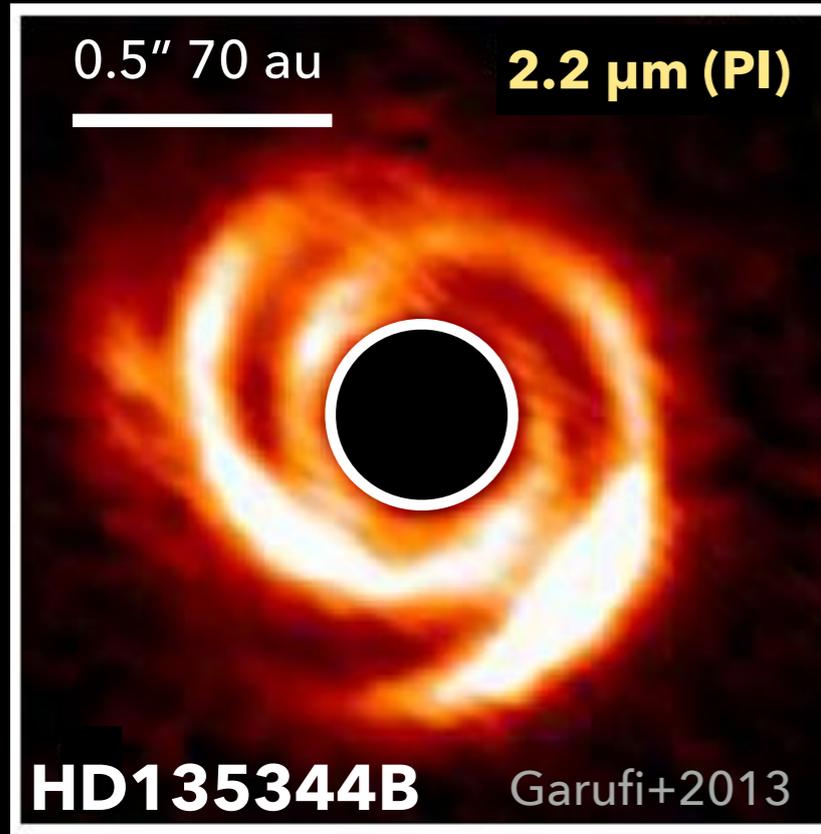


Andrews+2016

0.09", 0.009 mJy/beam

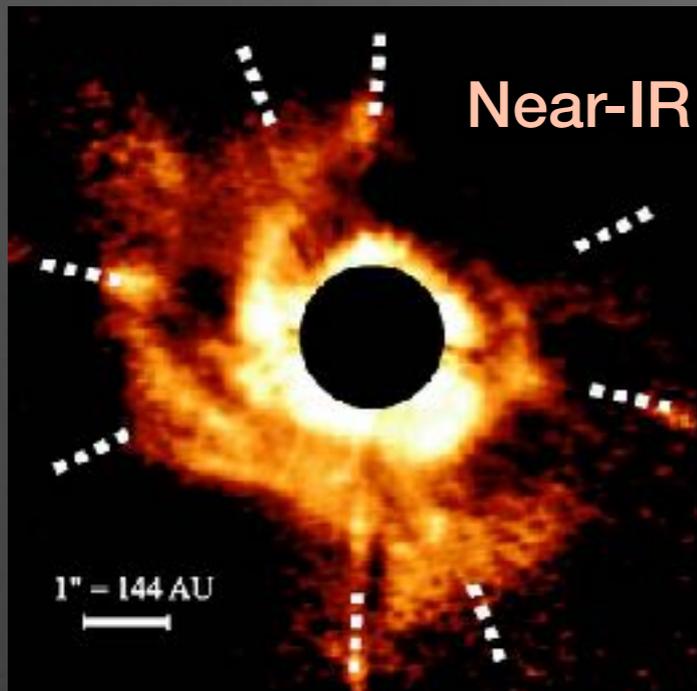
~ > 3 times better angular resolution,
40 times more sensitive than the
wSMA

SYNERGY BETWEEN NIR AND MM EMISSION

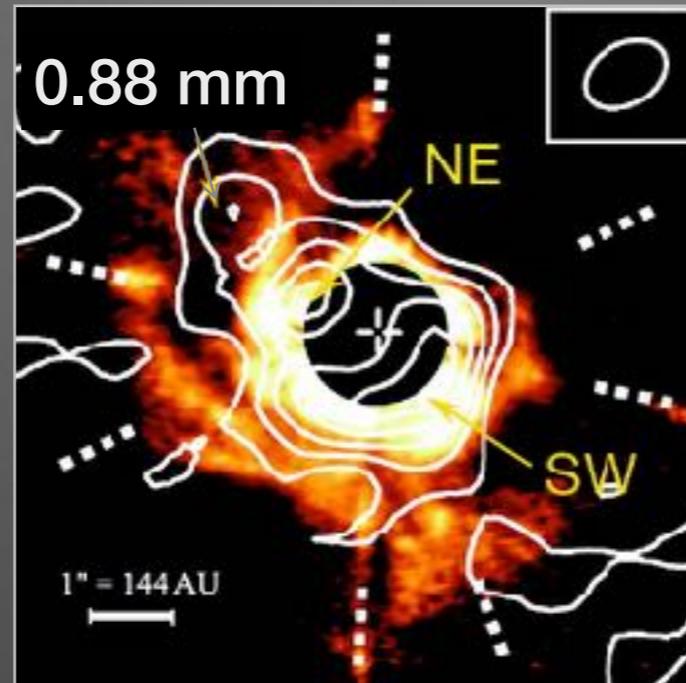


- two spirals and some sub-structures are clearly detected in the polarized intensity images
 - part of the spirals can be induced by planets
- asymmetric rings in the submm continuum emission
 - a hole at the center => dust filtering? larger dusts (mm) trapped at certain radii; smaller dusts (μm) flow inward
 - analysis of these rings suggests possible spirals

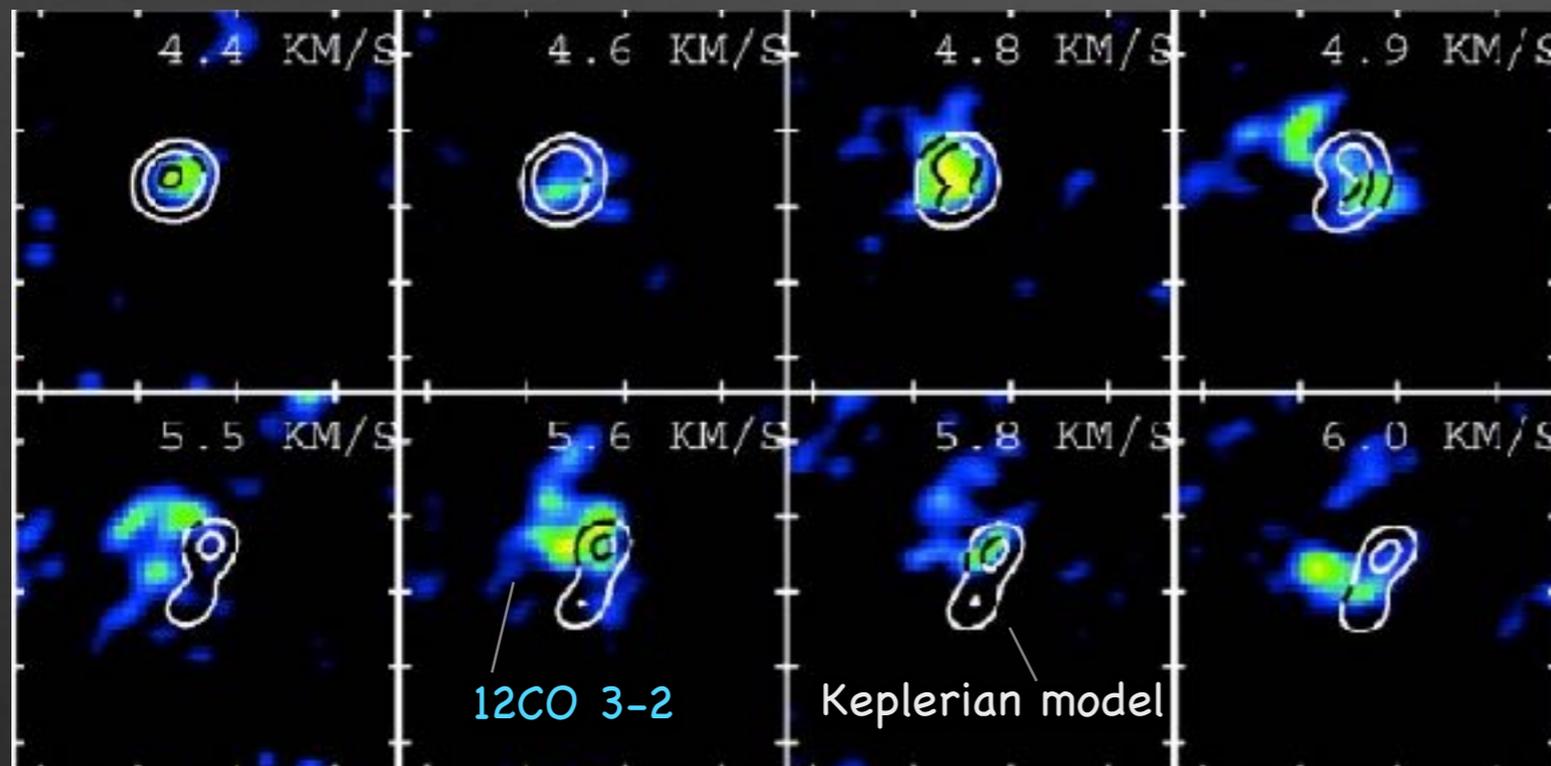
AB Aur disk



Fugakawa+ 2004



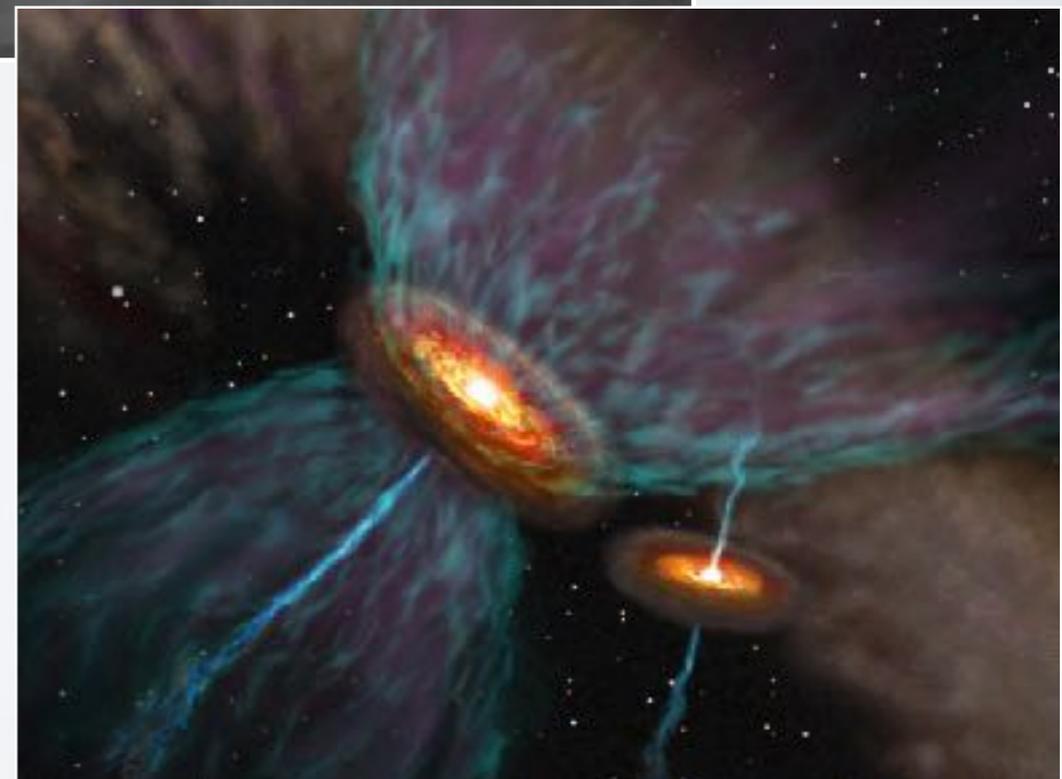
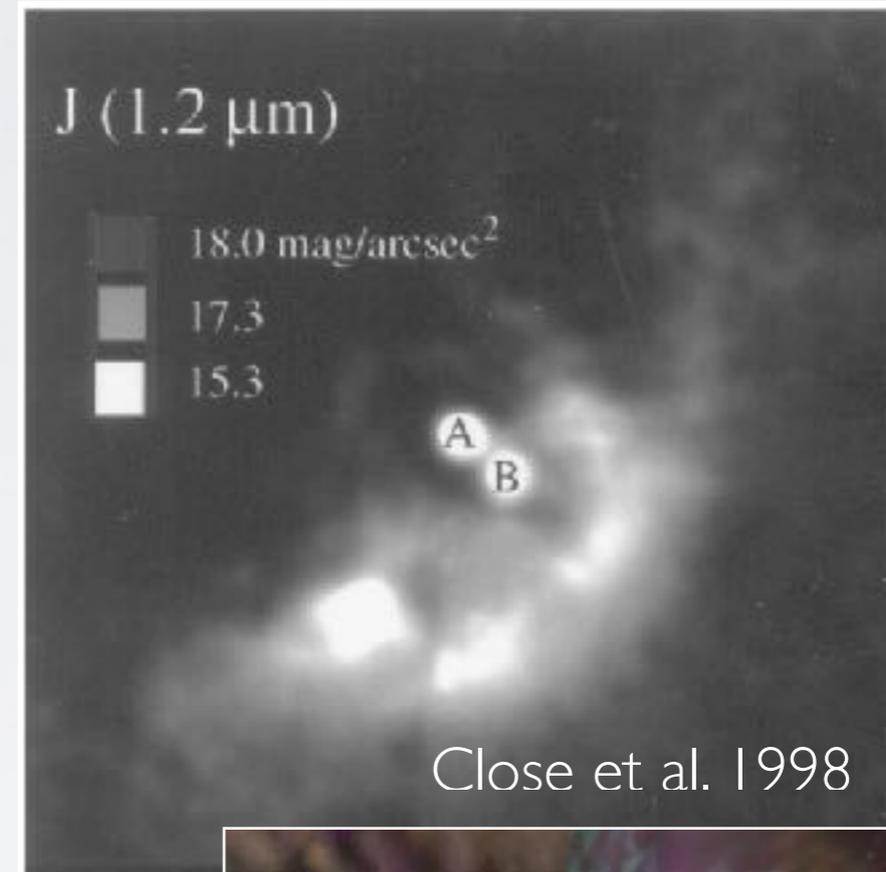
- central star: A0 type ($2.4 M_{\odot}$)
- distance: ~ 140 pc
- spiral: beside optical/NIR spirals, a spiral was identified using ^{12}CO 3-2
- gas kinematics: observed with angular resolution $\sim 1''$, sub-Keplerian (Pietu+ 2005)



Lin+ 2006

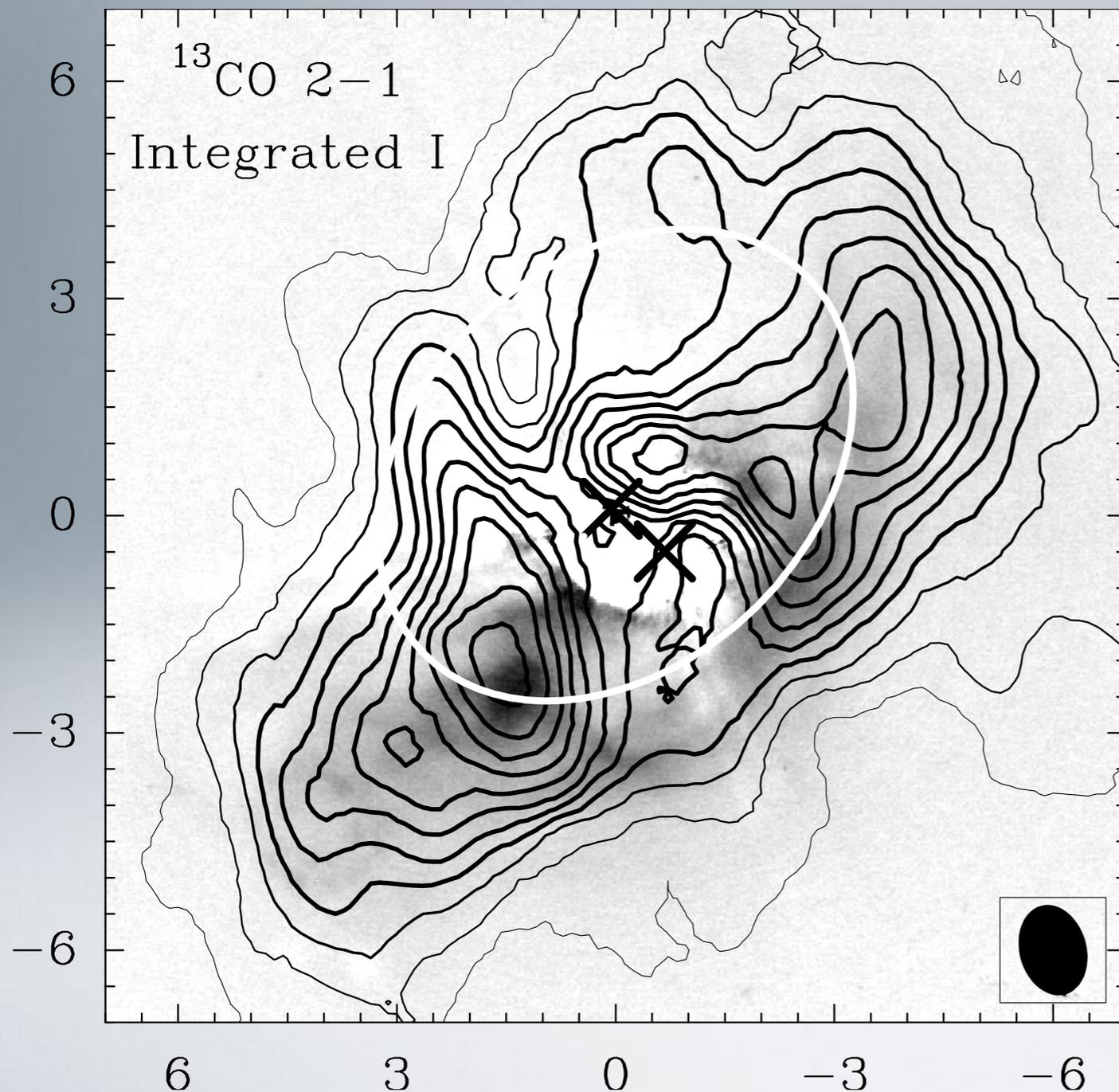
T Tauri binary UY Aur

- T-Tauri binary system with a separation 0.88" (120 AU)
- the primary:
 - K7 (0.95) or M0 (0.6) M_{\odot}
 - brightness is relatively stable
 - accretion rate: $\sim 2 \times 10^{-8} M_{\odot}/\text{yr}$
 - pristine ISM-like dust
- the secondary:
 - M0 (0.6) or M2.5 (0.25) M_{\odot}
 - brightness varies by 5 mag. in the R band over 50 yrs
 - accretion rate: $\sim 6 \times 10^{-8} M_{\odot}/\text{yr}$
 - silicate dust



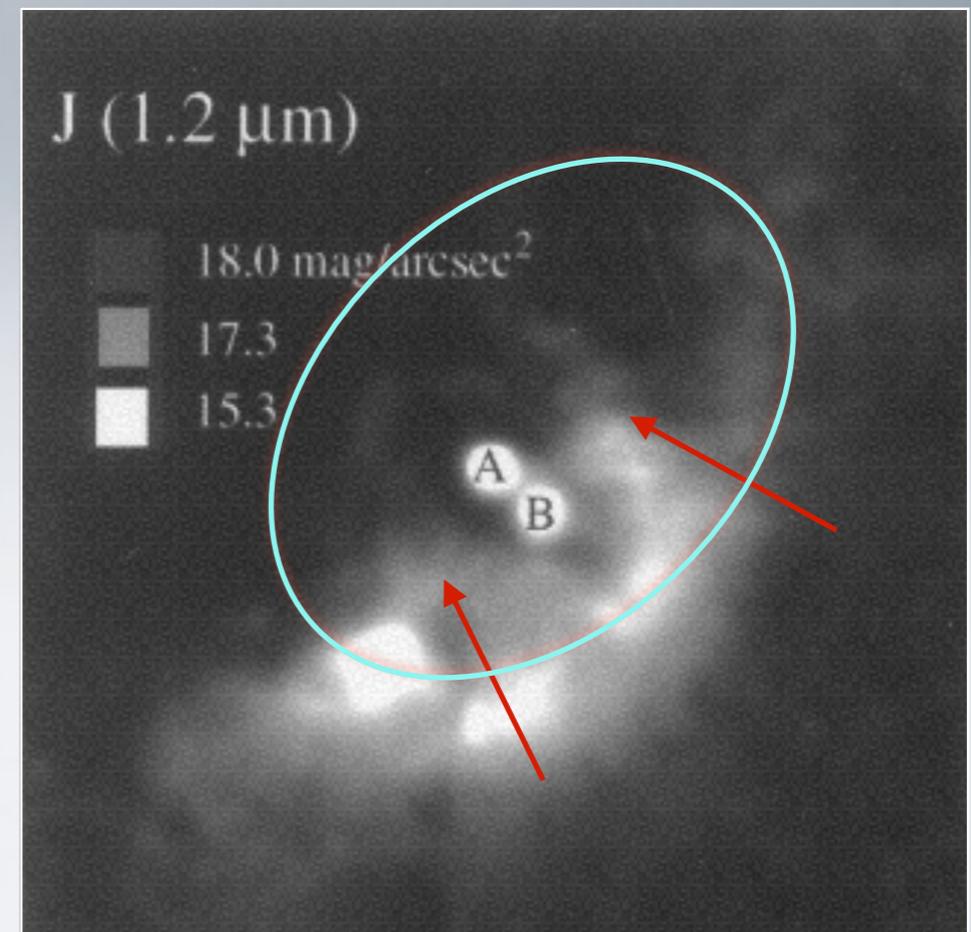
Circumbinary material:

PdBI ^{13}CO 2-1 observations

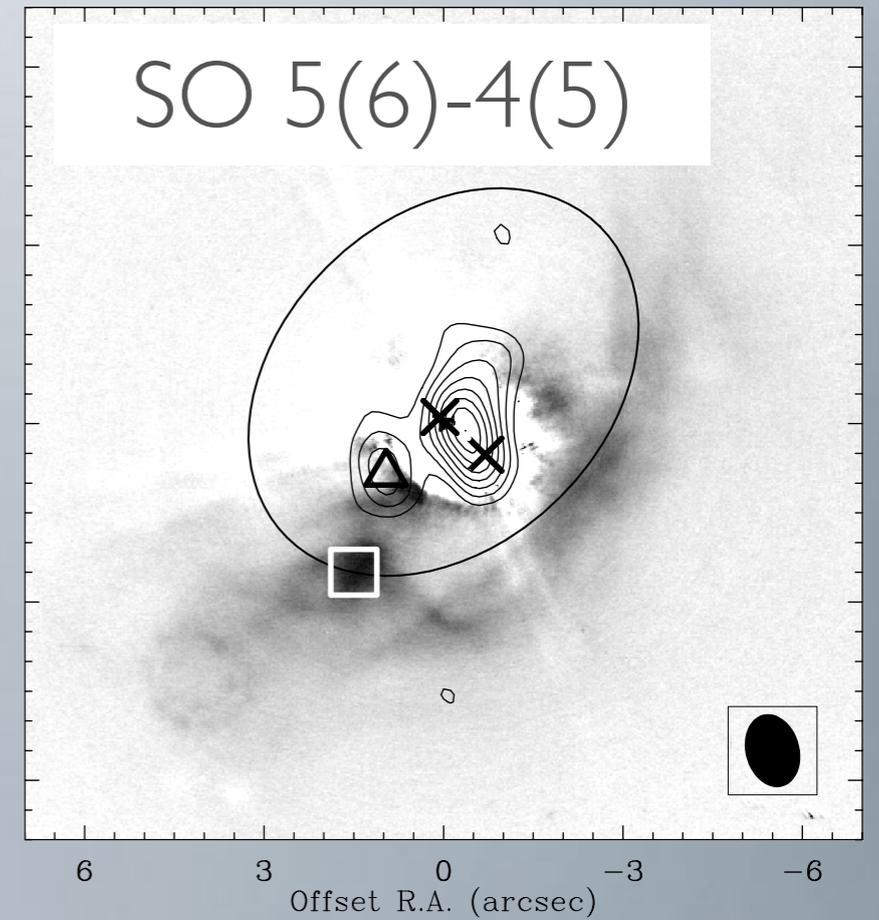
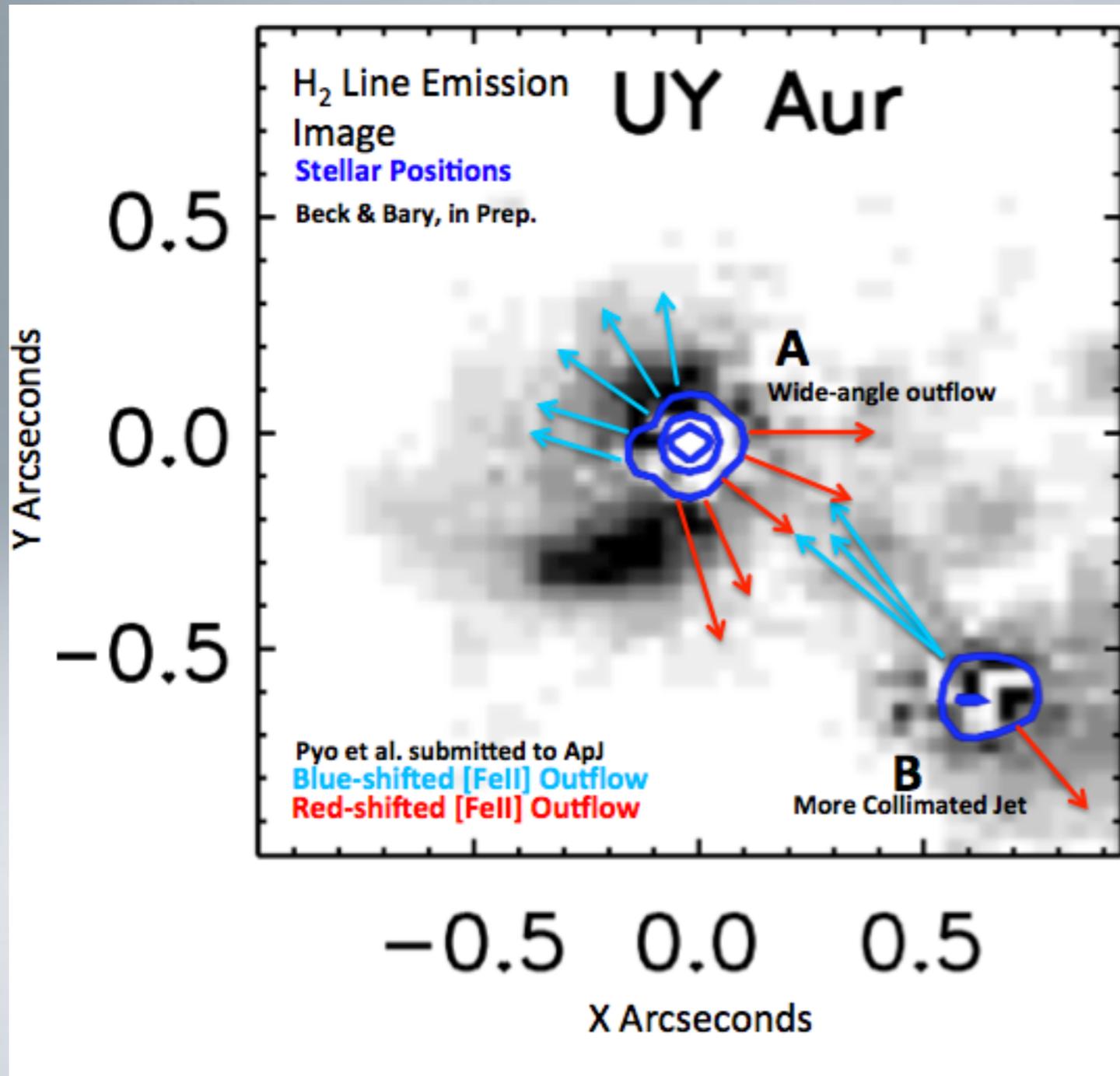


Tang+2014

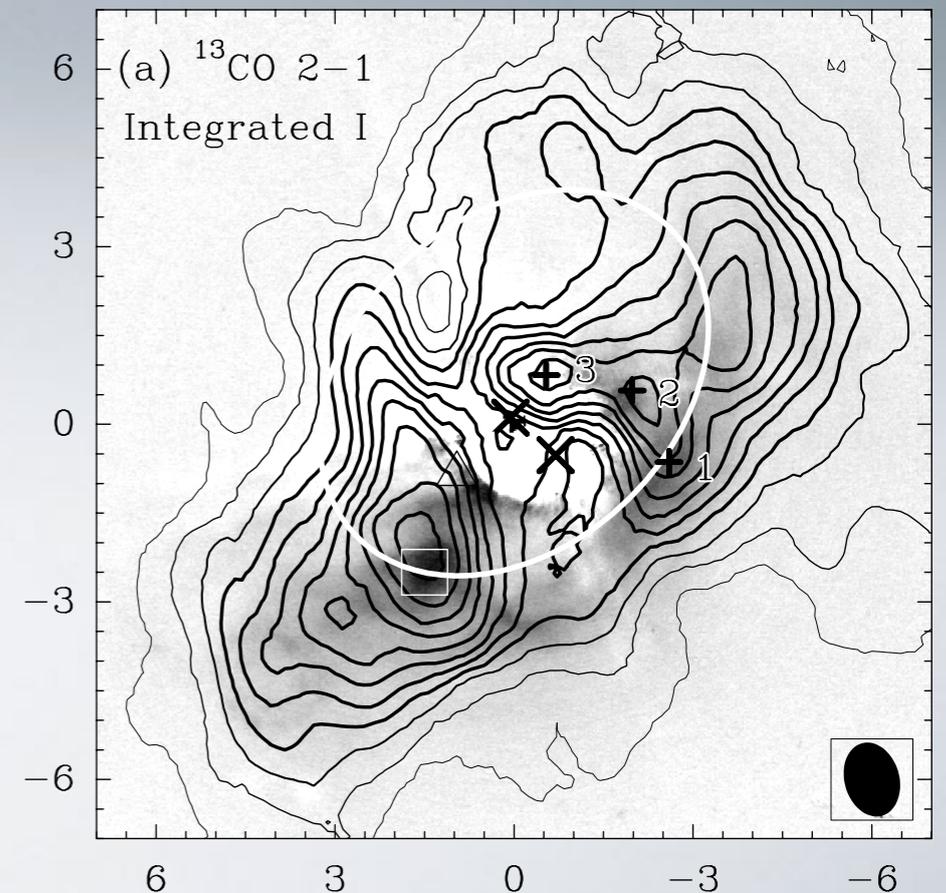
- circumbinary disk/ring
- spiral-like streamers (accreting spirals)
- extended arm-like structure



Circumbinary material: ...and, there is SO



Tang+2014

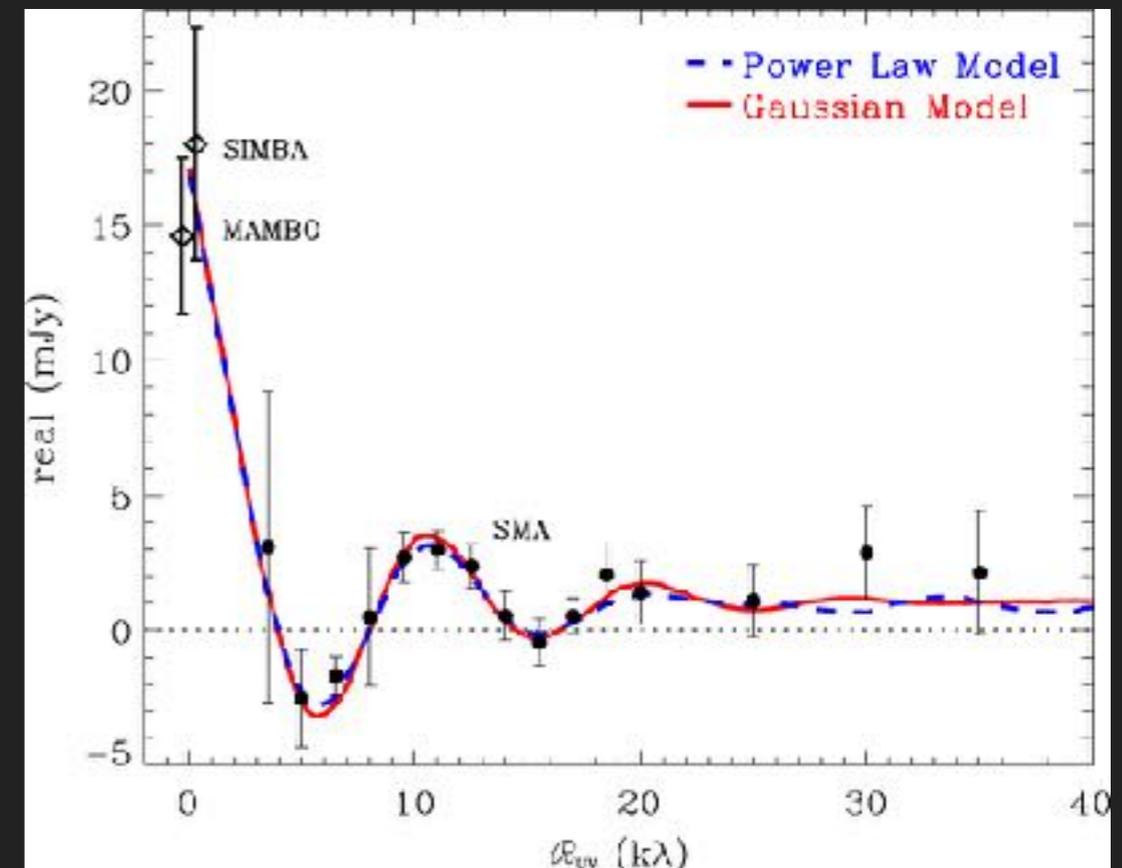
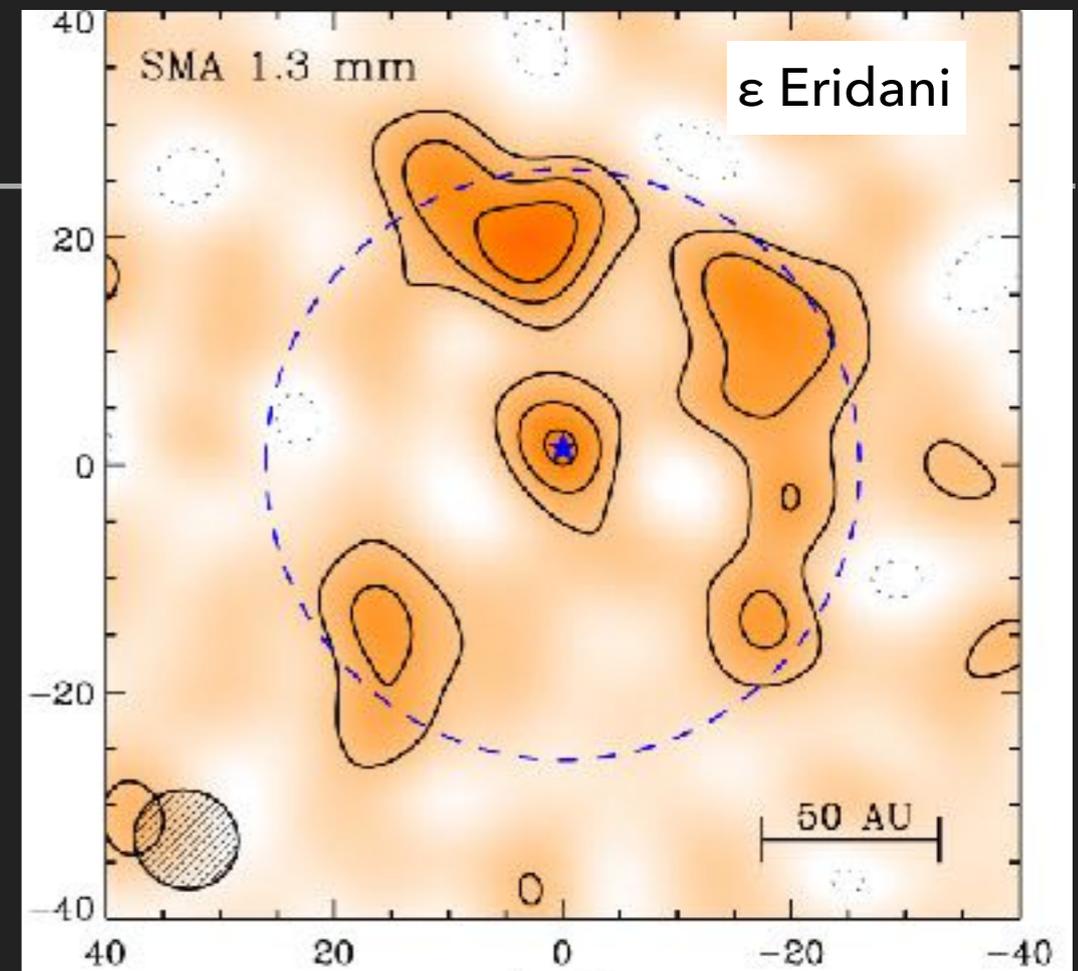


ALMA RESULTS

- ▶ moderate resolution, comparison of gas and dust distribution
- ▶ high angular resolution and high sensitivity: disk structures
- ▶ ==> possible direction for the wSMA?

DEBRIS DISK

- ▶ SMA observation: 1.3 mm continuum, $9''$, $\sigma=0.2$ mJy
- ▶ an annulus with width of 20 au at $r=64$ au and a central continuum is detected



SCIENCES WITH THE WSMA

- ▶ monitor the flux variation of circumstellar disks
- ▶ binary system: how mass transport between the stars with respect to the orbital phase
 - ▶ wide separation binaries,
 - ▶ > 10 yrs to get enough information
- ▶ single system: related to accretion => young systems
- ▶ survey
 - ▶ wSMA will be sensitive in continuum
 - ▶ spectral line survey to look for interesting objects
 - ▶ stacking to search for lines