Accretion process in young and evolved objects

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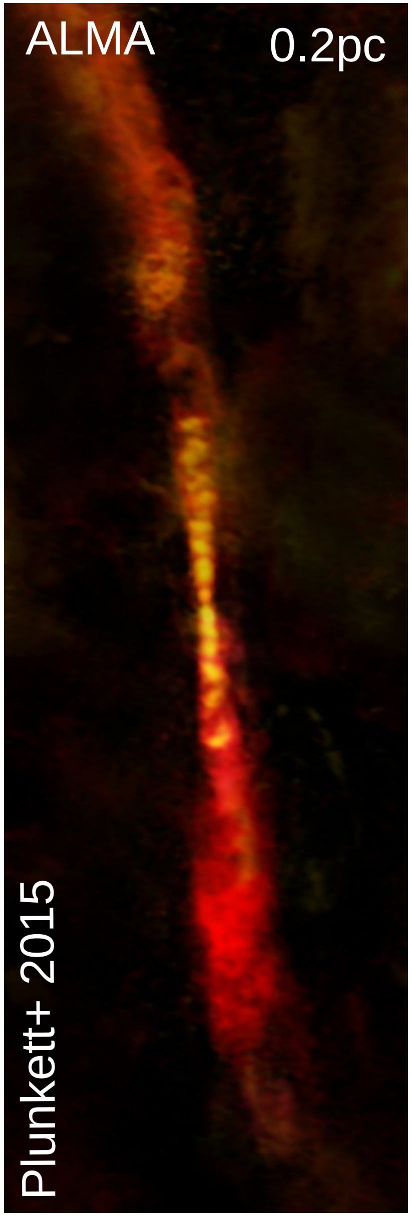
ESO

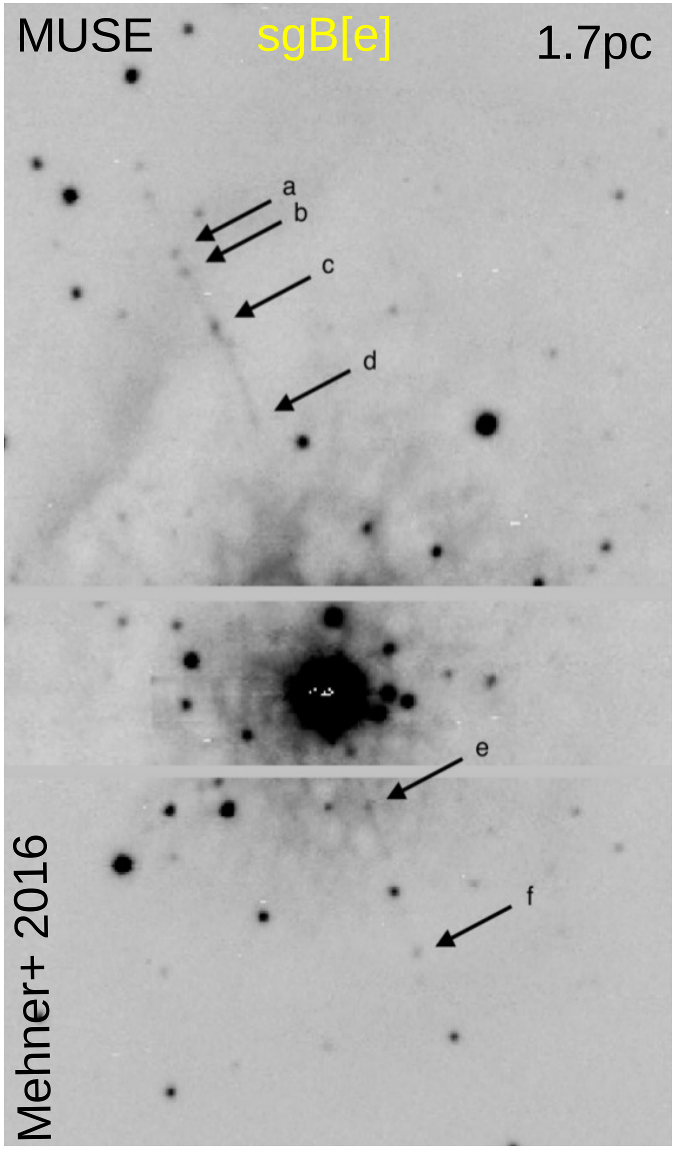
Alessio Caratti o Garatti (Dublin), Stefan Kraus (Exeter)

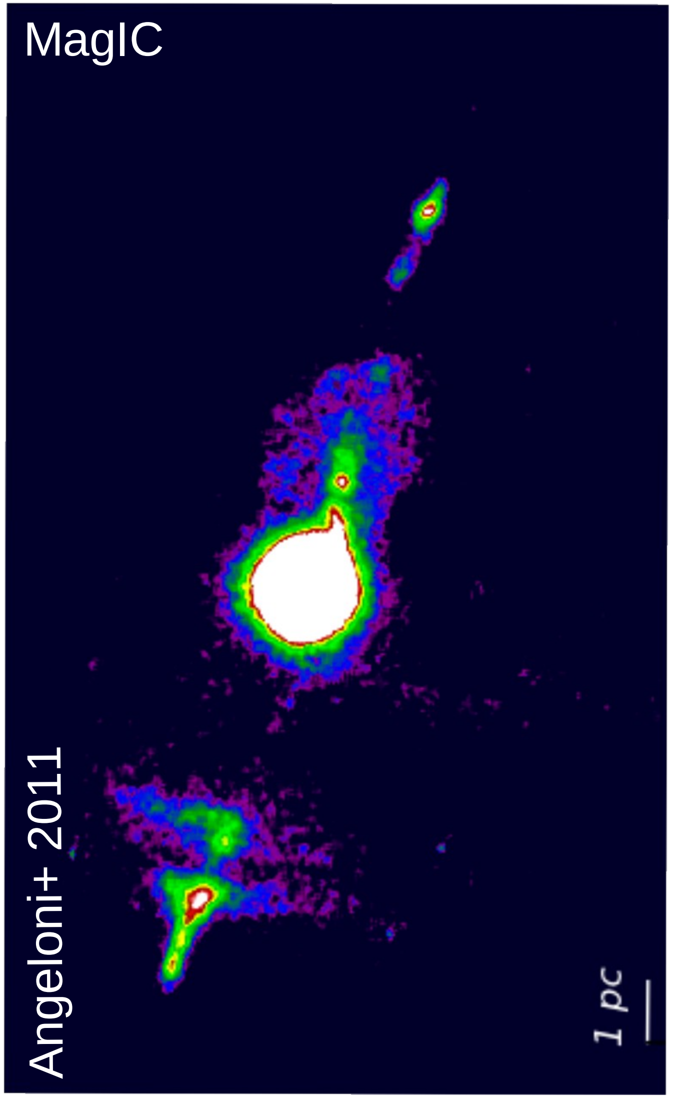
…. a comparison

?

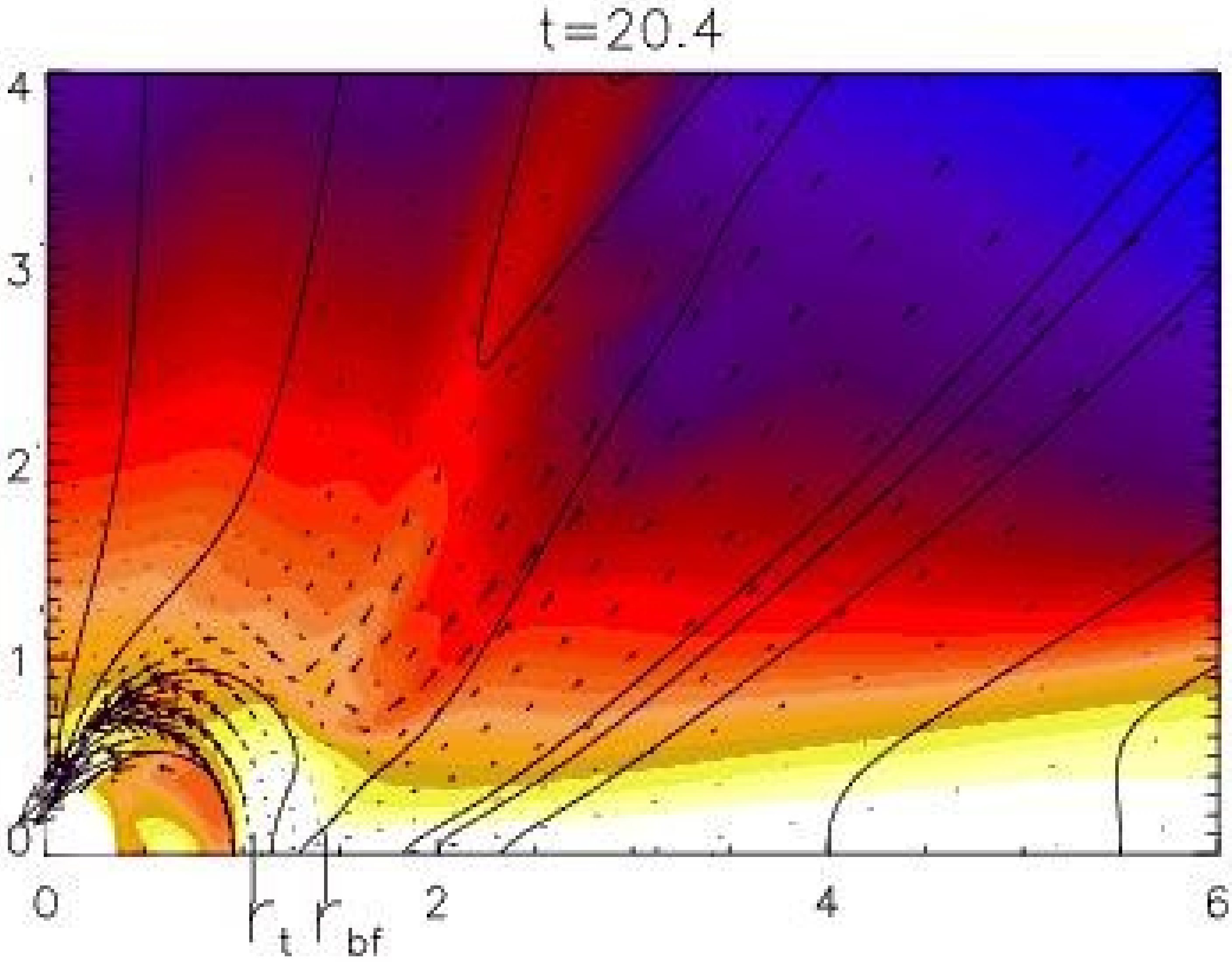
Accretion traced by jets





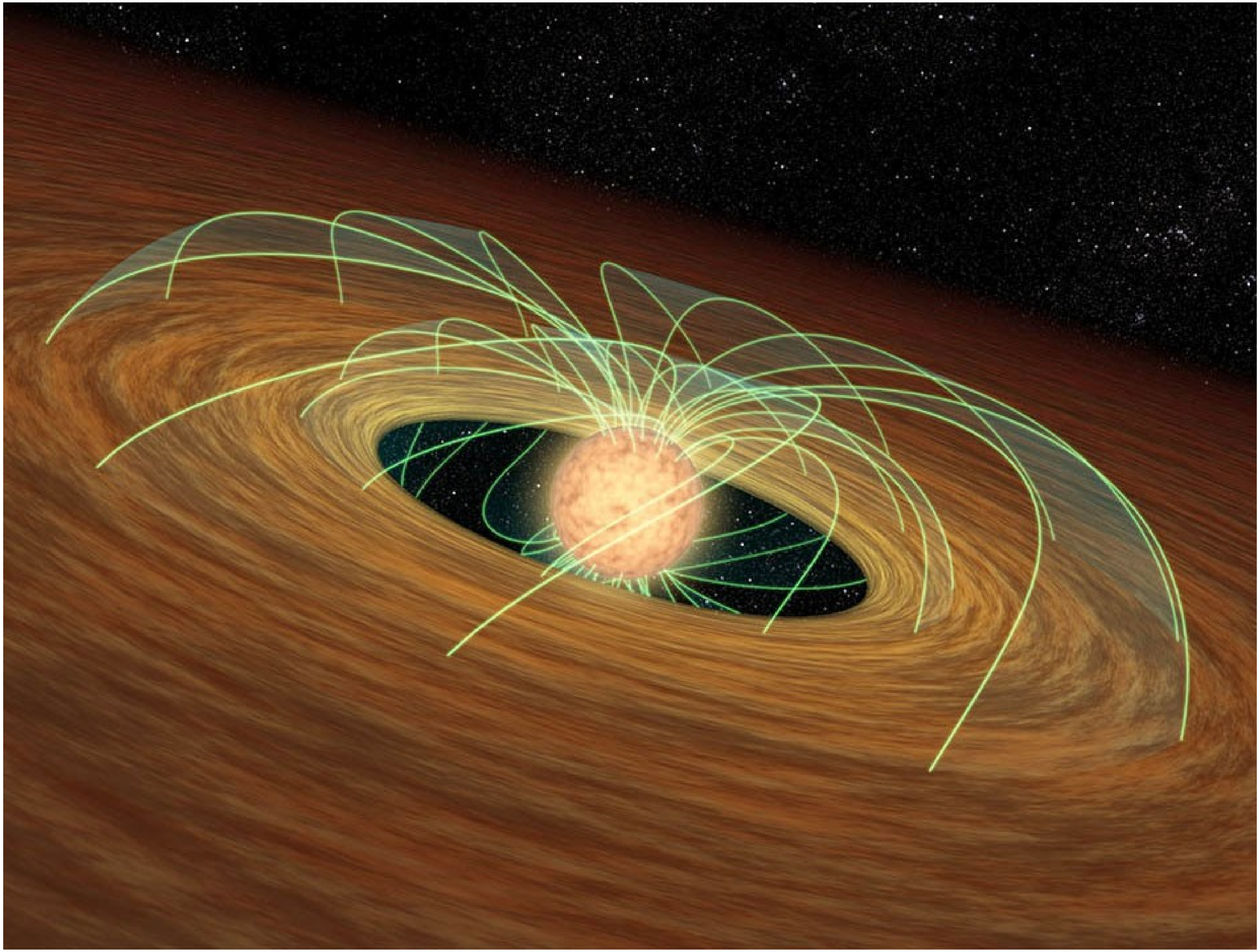


B-field funnels and accretion

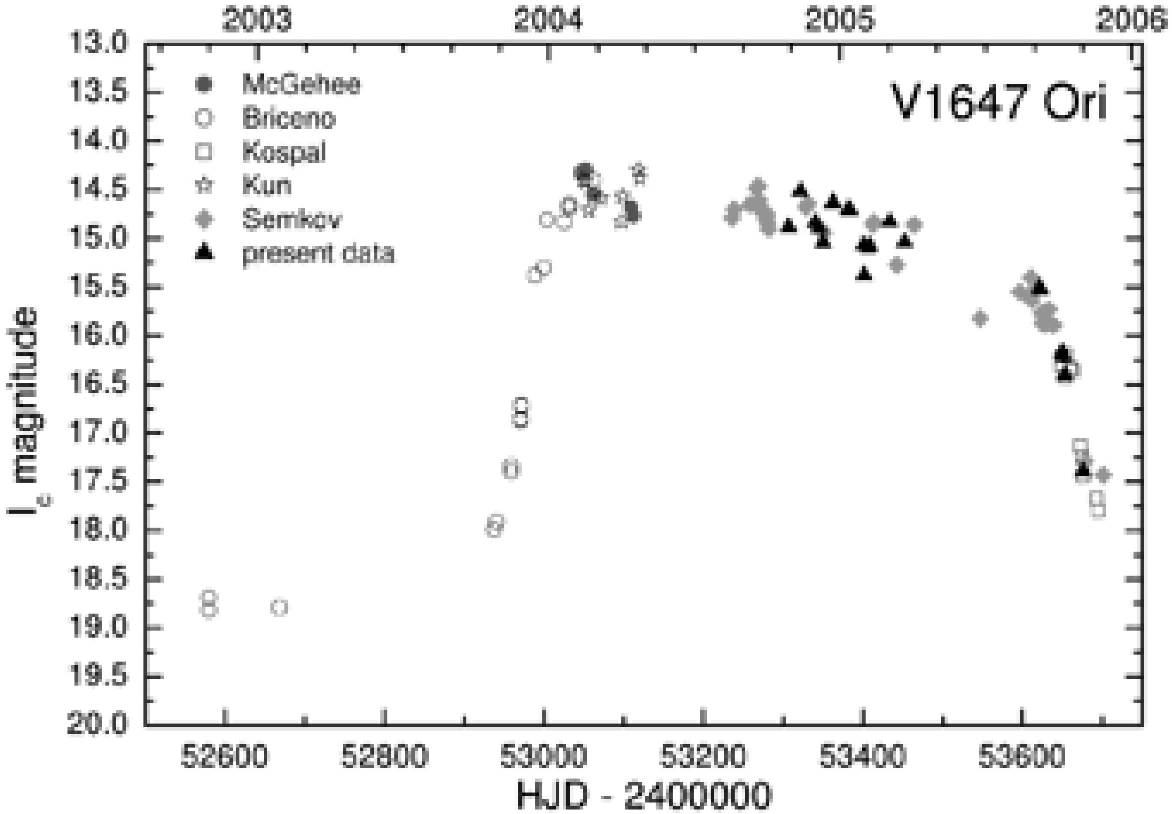


Bessolaz+ (2008)

B-field funnels and accretion



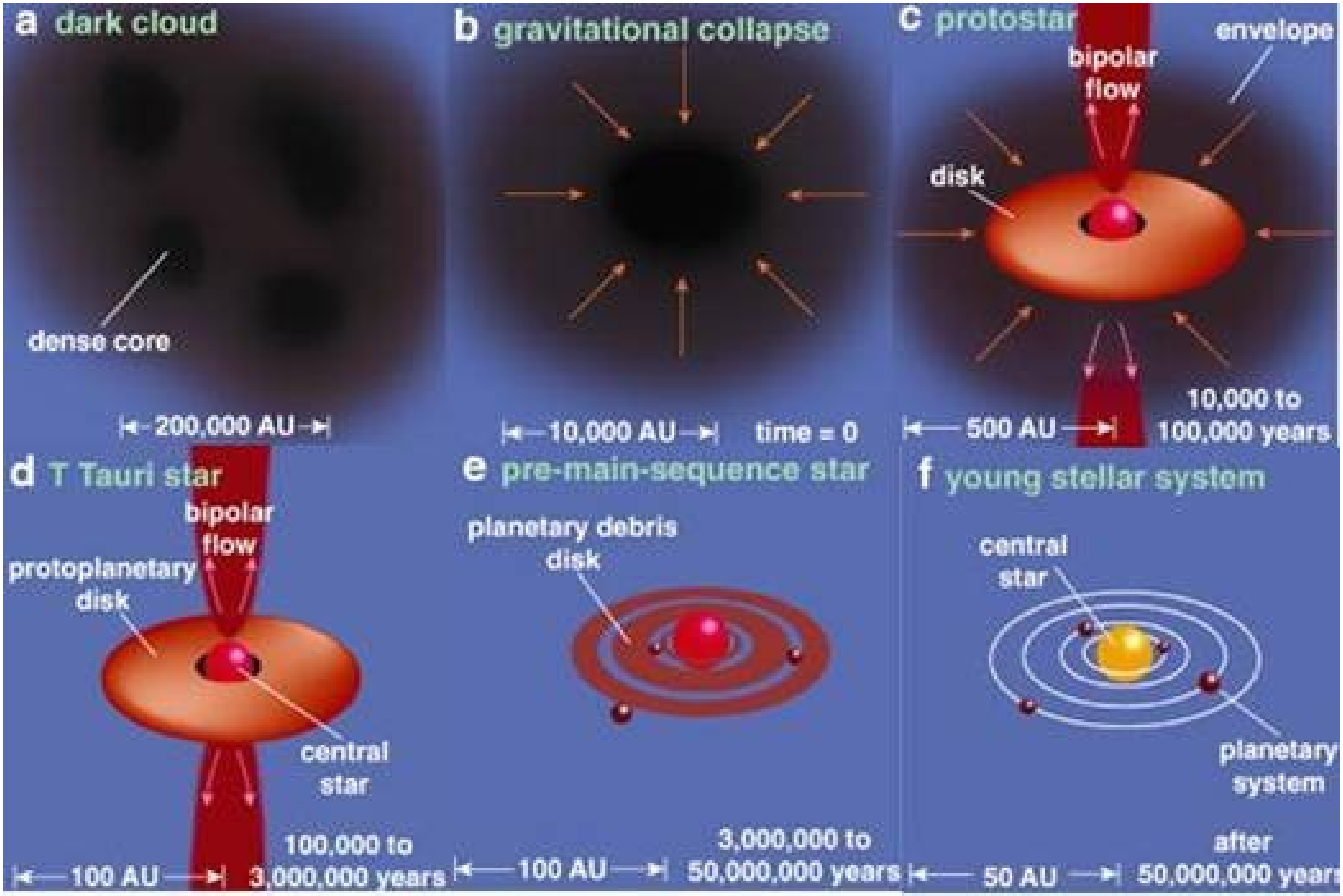
Time variability and accretion



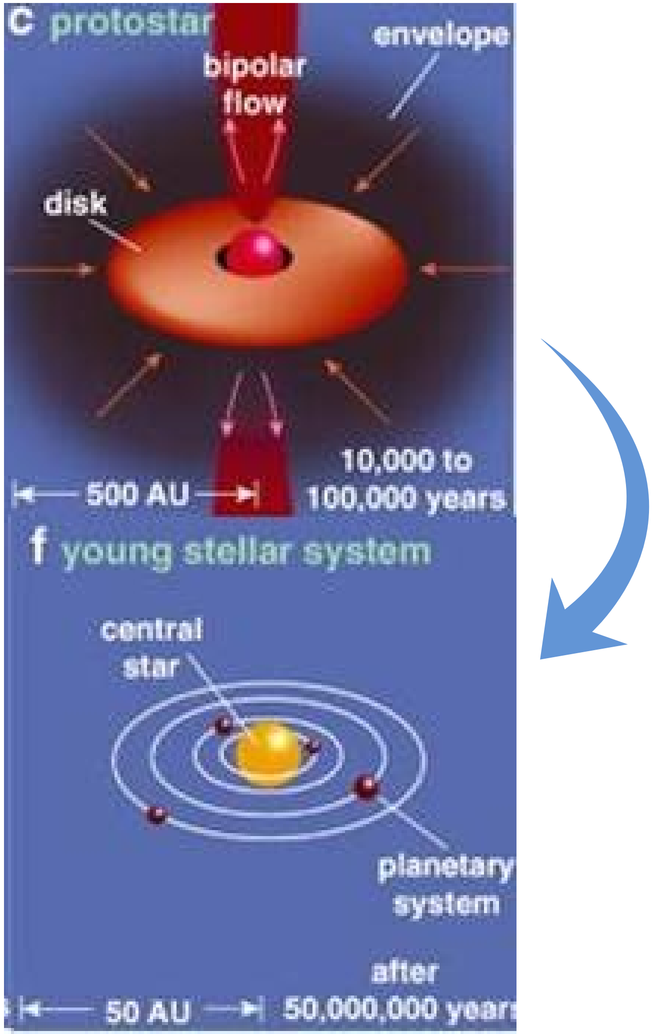
FU Orionis outbursts last for years and are > 4 mags,

while **EXor** outburst are less extreme with $M_{acc} \sim 10^{-6}\ M_o$/yr.

Low-mass SF

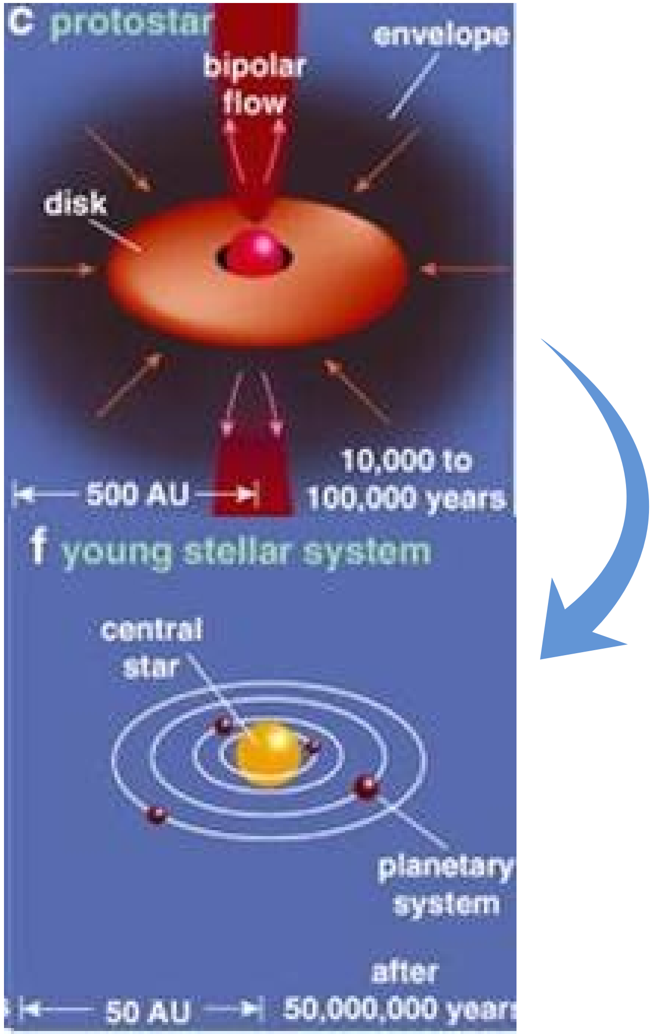

a dark cloud
dense core
200,000 AU
b gravitational collapse
10,000 AU
time = 0
c protostar
bipolar flow
envelope
disk
500 AU
10,000 to 100,000 years
d T Tauri star
bipolar flow
protoplanetary disk
central star
100 AU
100,000 to 3,000,000 years
e pre-main-sequence star
planetary debris disk
100 AU
3,000,000 to 50,000,000 years
f young stellar system
central star
planetary system
50 AU
after 50,000,000 years

High-mass SF

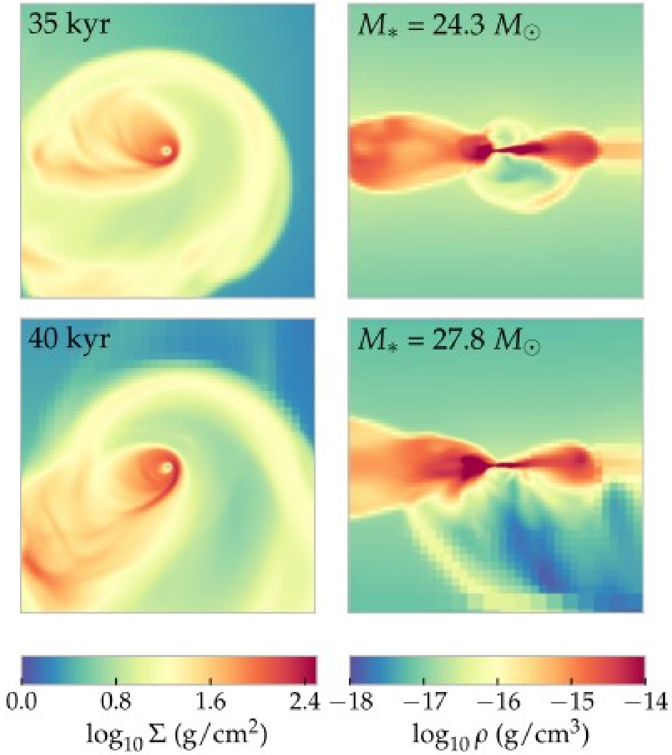

c protostar
bipolar flow
envelope
disk
500 AU
10,000 to 100,000 years
f young stellar system
central star
planetary system
50 AU
after 50,000,000 years

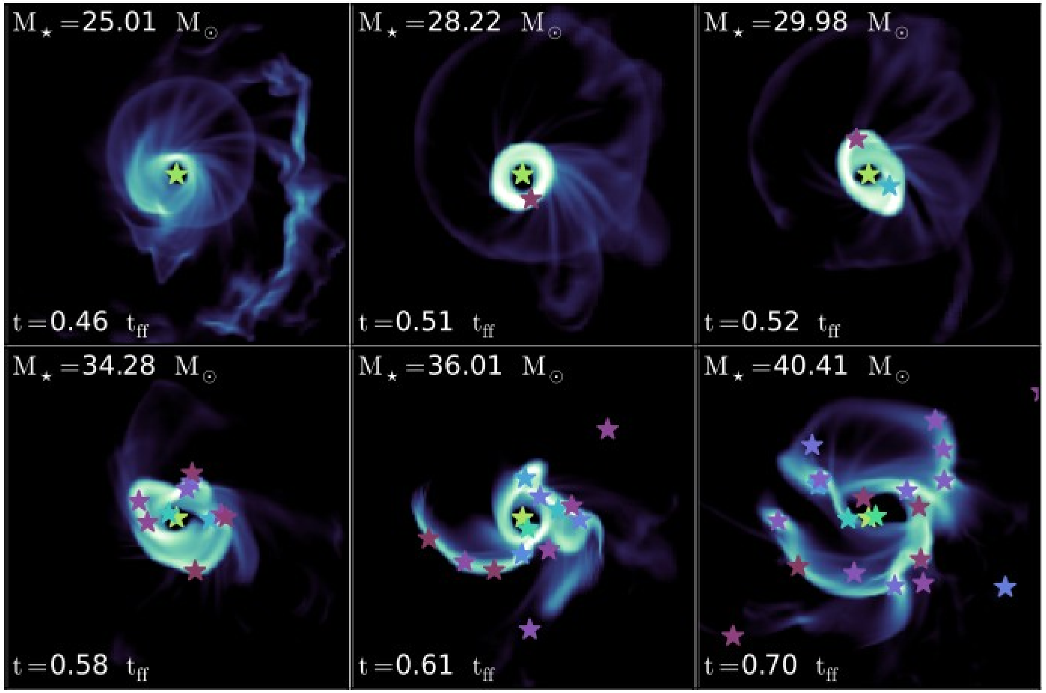
High-mass SF

- M > 8 Msol
- M < 25 Msol
- Binarity and mulitplicity
- .. the old problem
- Coalescence or disk accretion ?



Conflicting models

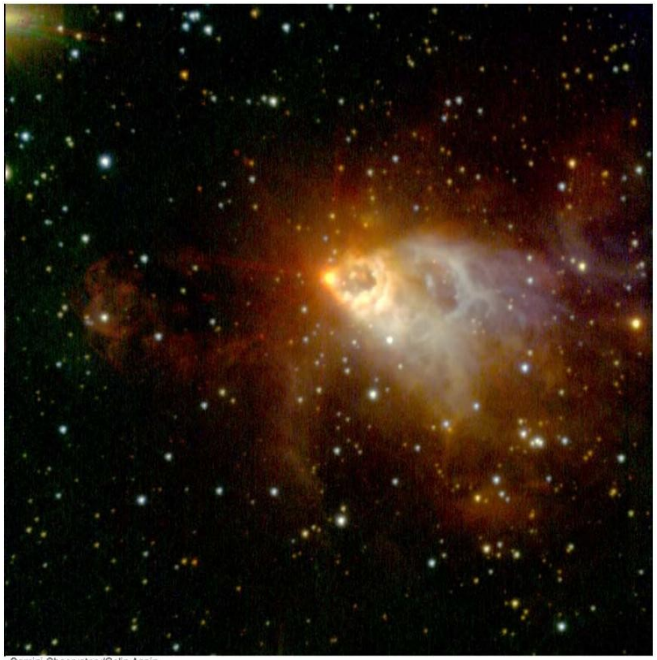




Monolithic collapse leads to a single massive star (Klassen et al. 2016)

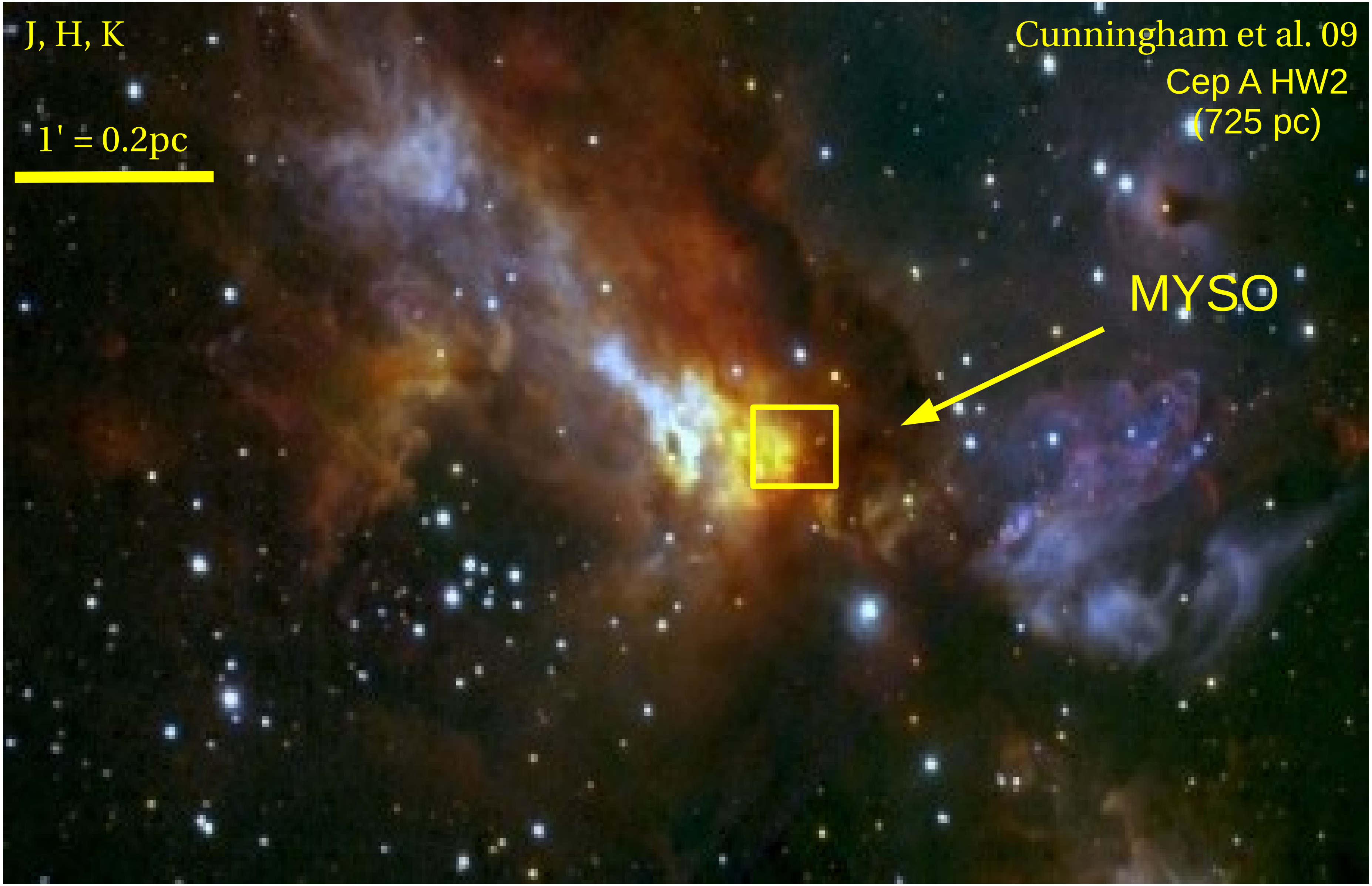
Monolithic collapse leads to multiple stars (Rosen et al. 2016)

Massive YSO

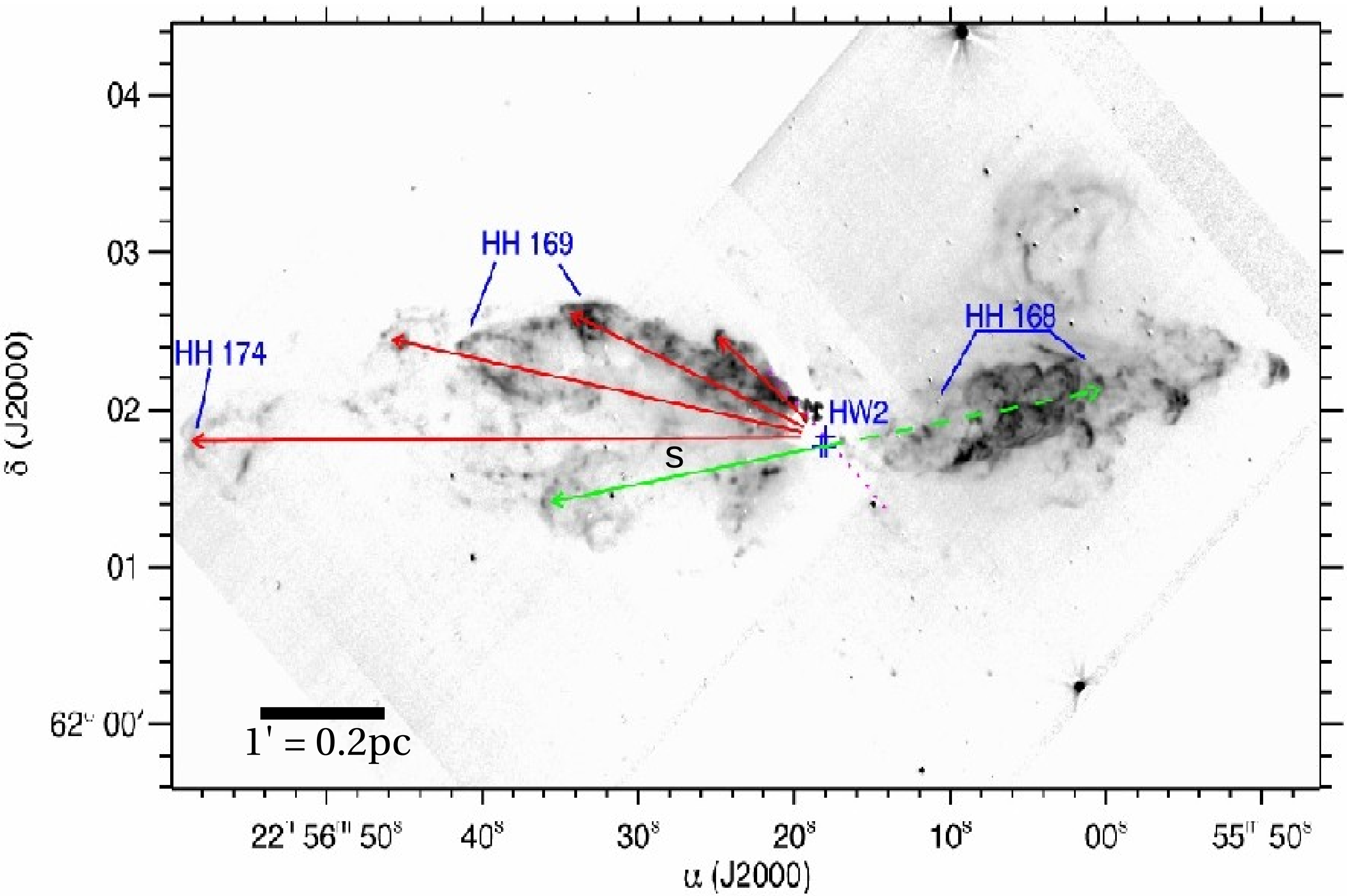


Gemini Observatory/Colin Aspin

Variabele extinction HM SF regions

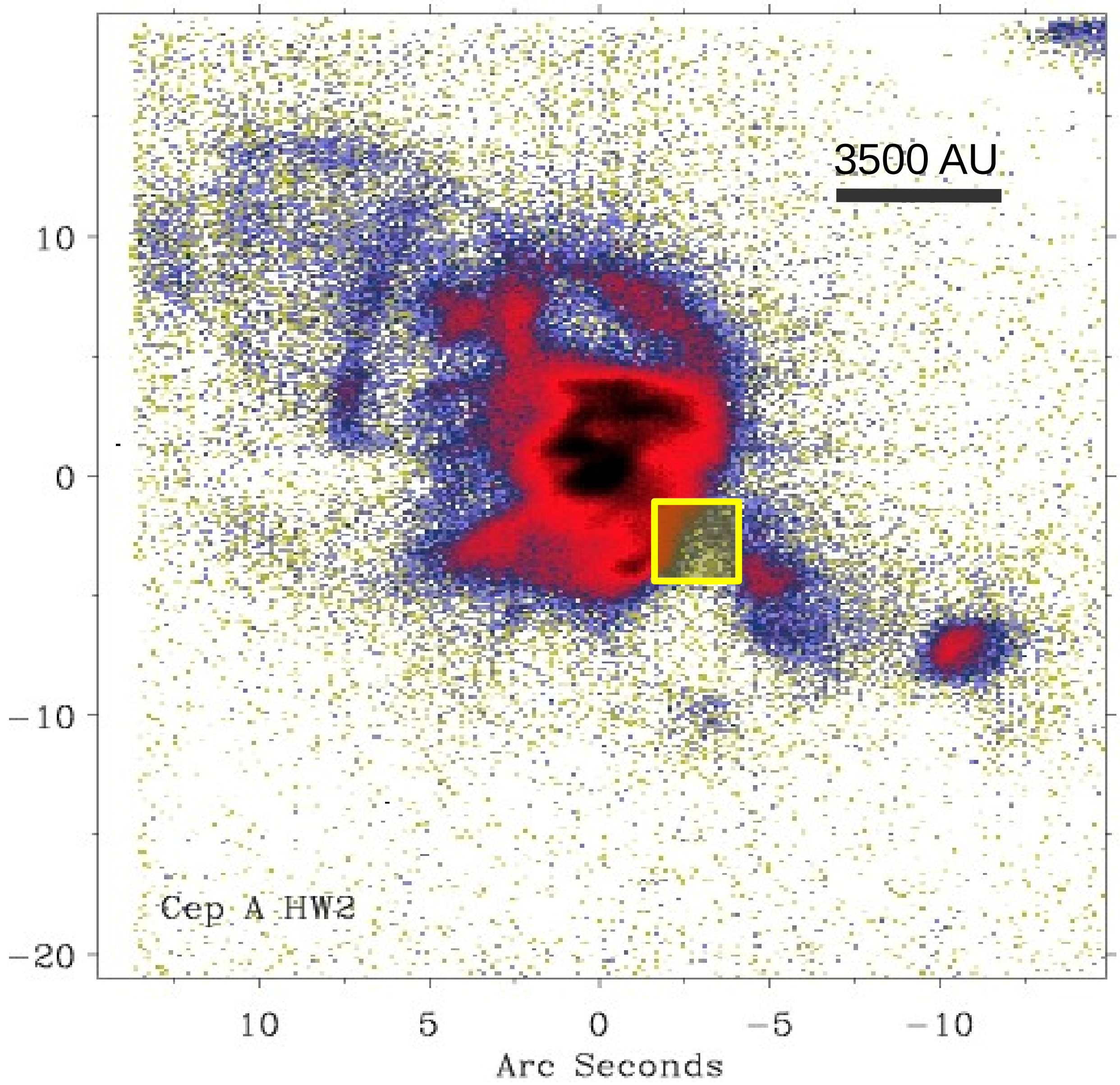


… and in H_2



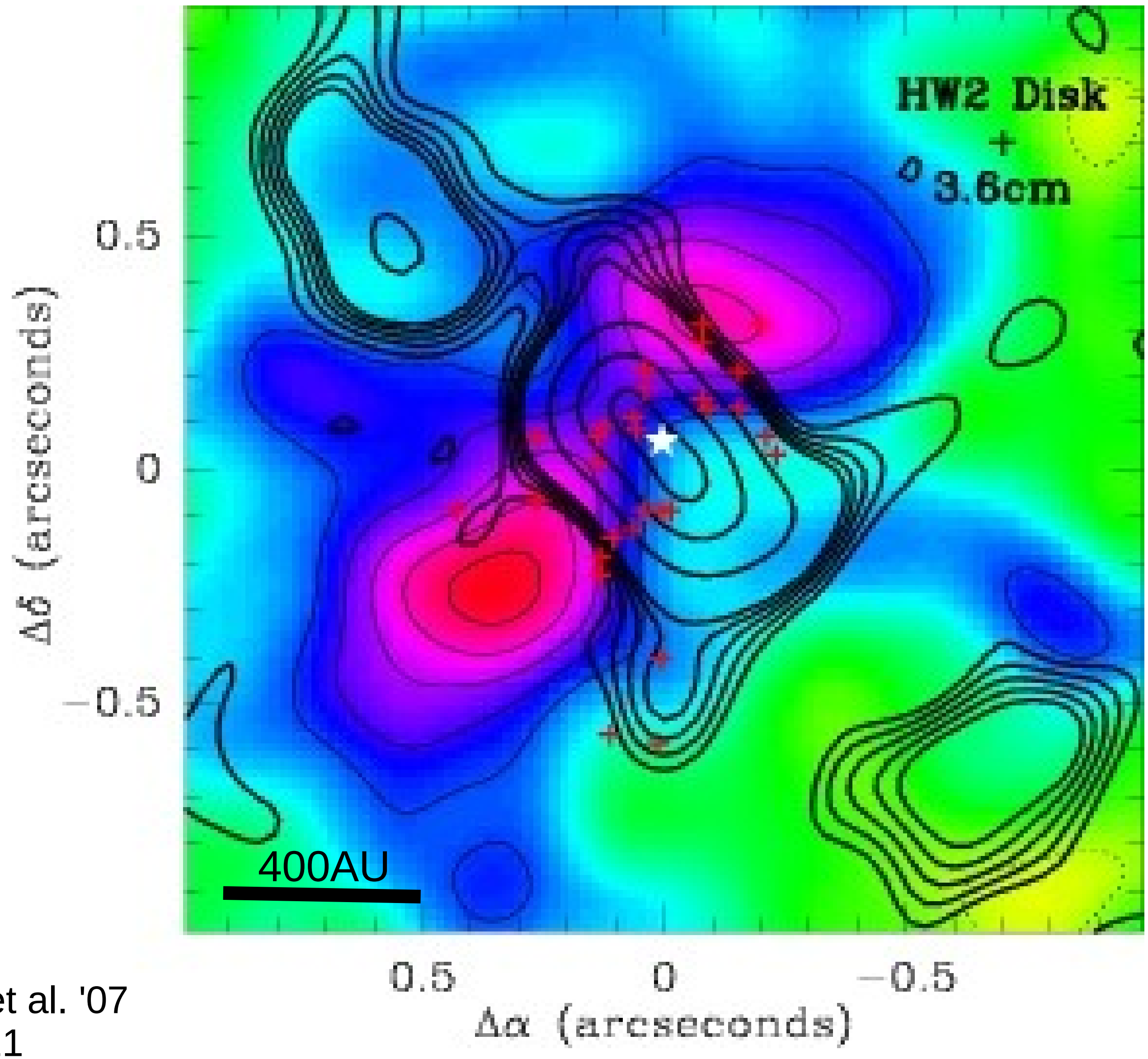
Cunningham et al. '09

… and at 24 microns



de Wit et al. '09

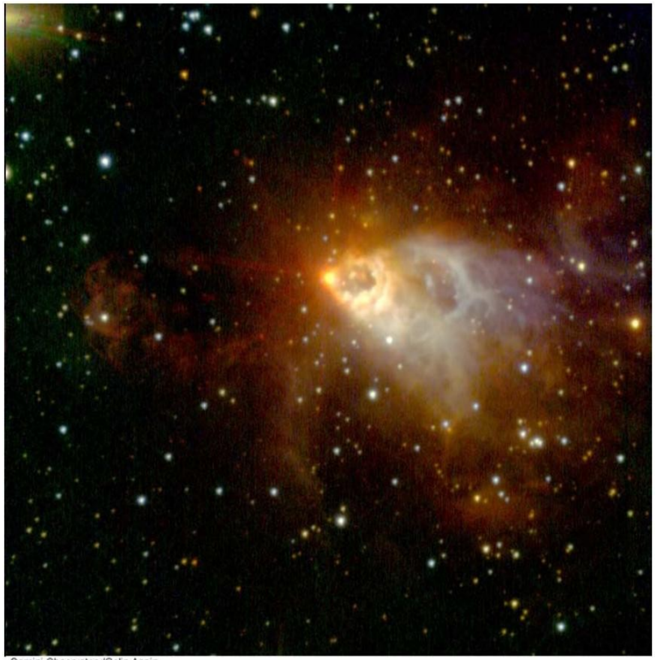
… and in radio (contours) and SO_2 (7mm, VLA).



Jimenez-Serra et al. '07
Torrelles et al. '11

Results

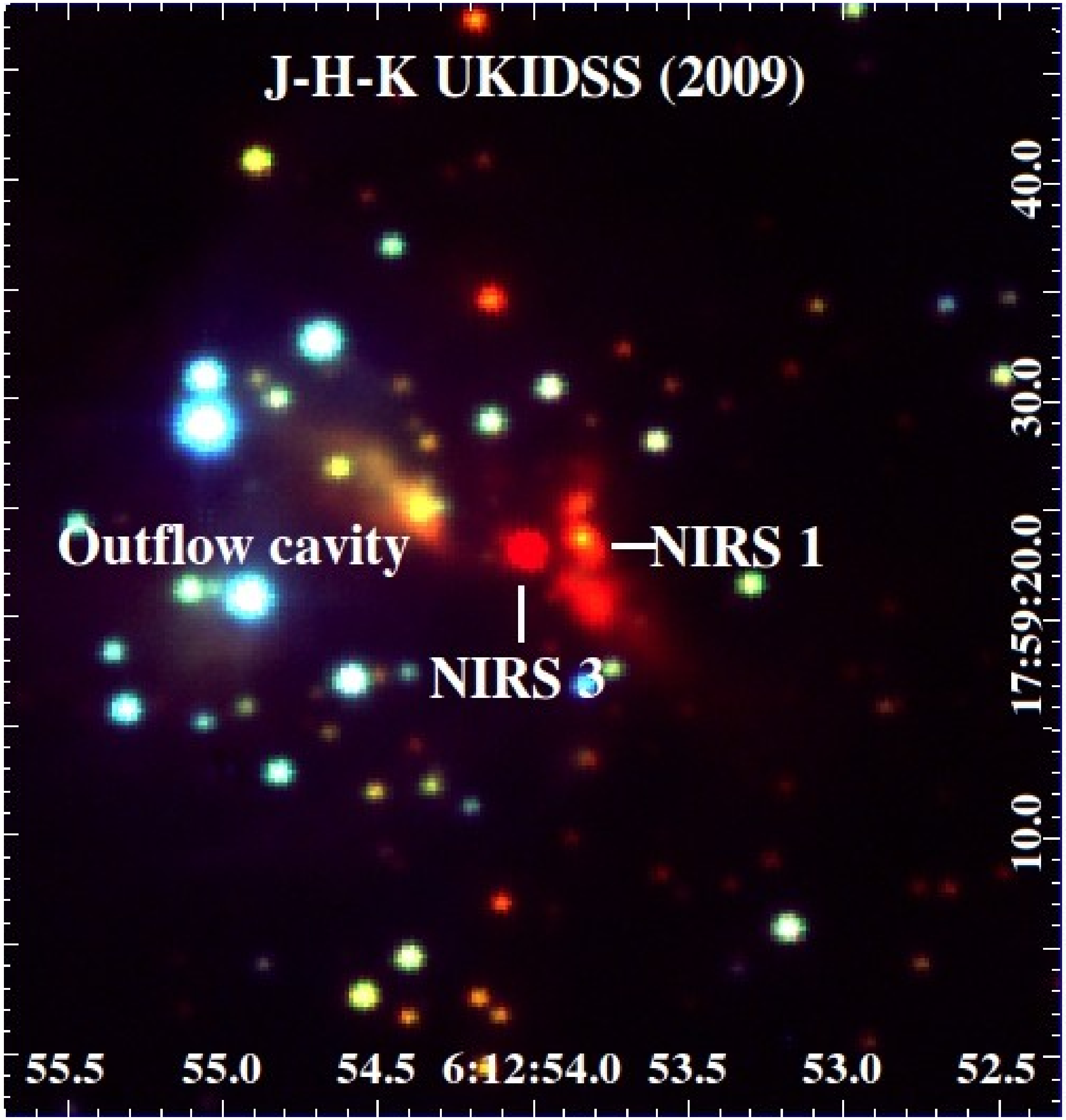
An accretion burst in a massive YSO



Gemini Observatory/Colin Aspin

S255 – NIRS 3

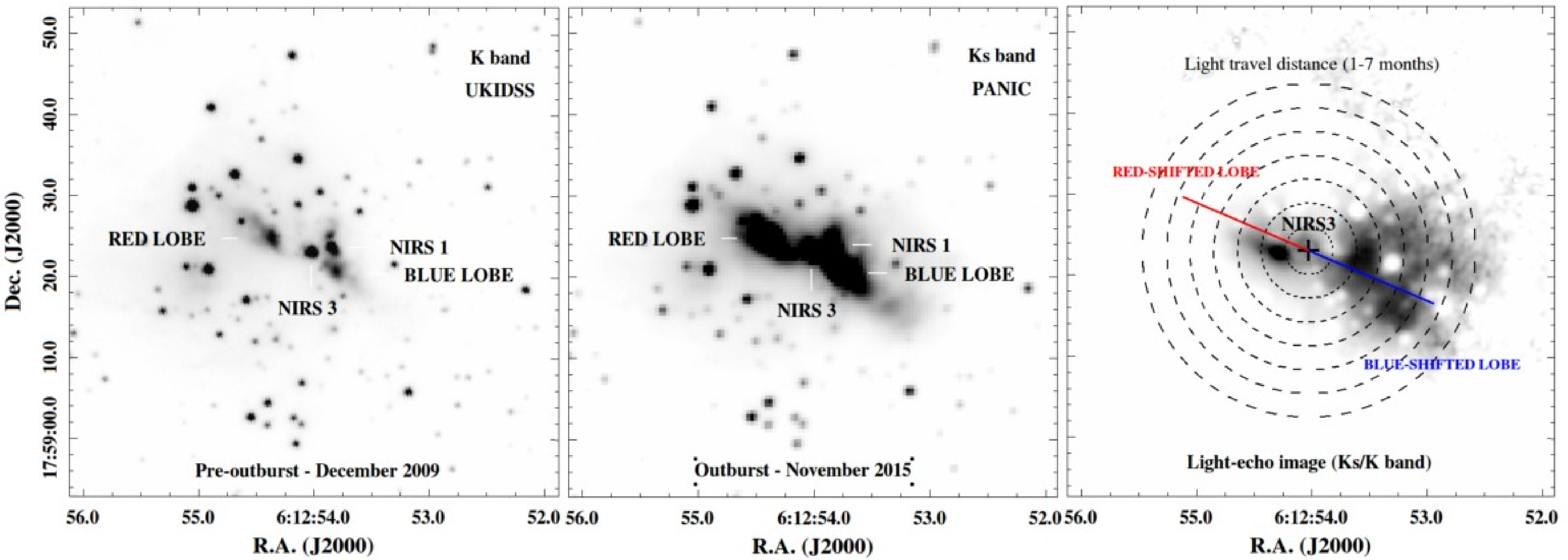
Caratti o Garatti+ (2016, Nature)



- Star forming region at 1.8 kpc
- Two main IR sources of L ~ 10^4 L_o
- NIRS3 M ~ 20 Mo
- Well studied region
- NIRS3 disk bearing (Boley+ 2013)

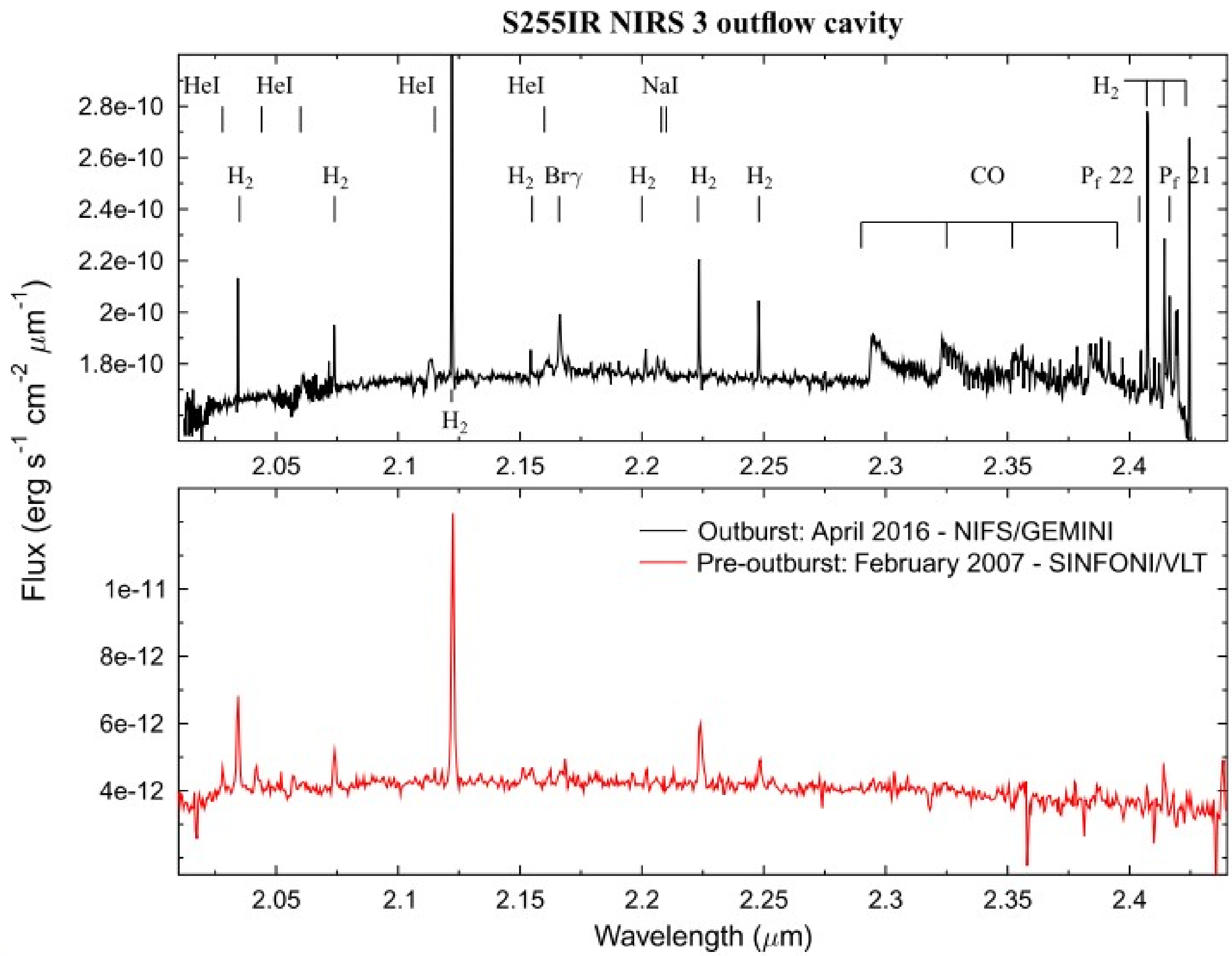
The S255-IRS3 burst

The brightning of the near-IR outflow cavities and central source reveal light echo with t_Burst > 4 months ...



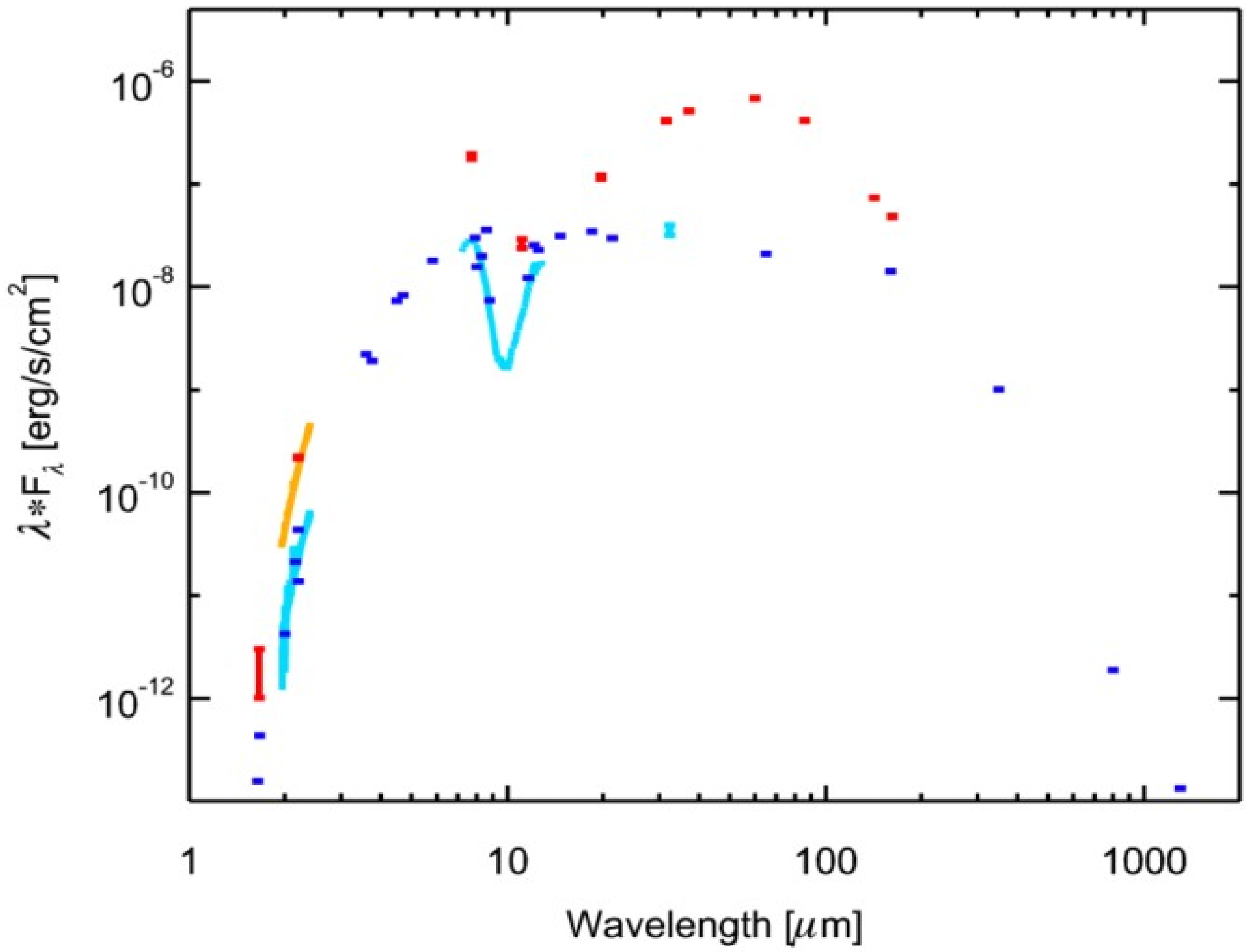
Accretion tracers

The dusty walls of the cavity act like a mirror …



The derived accretion rate

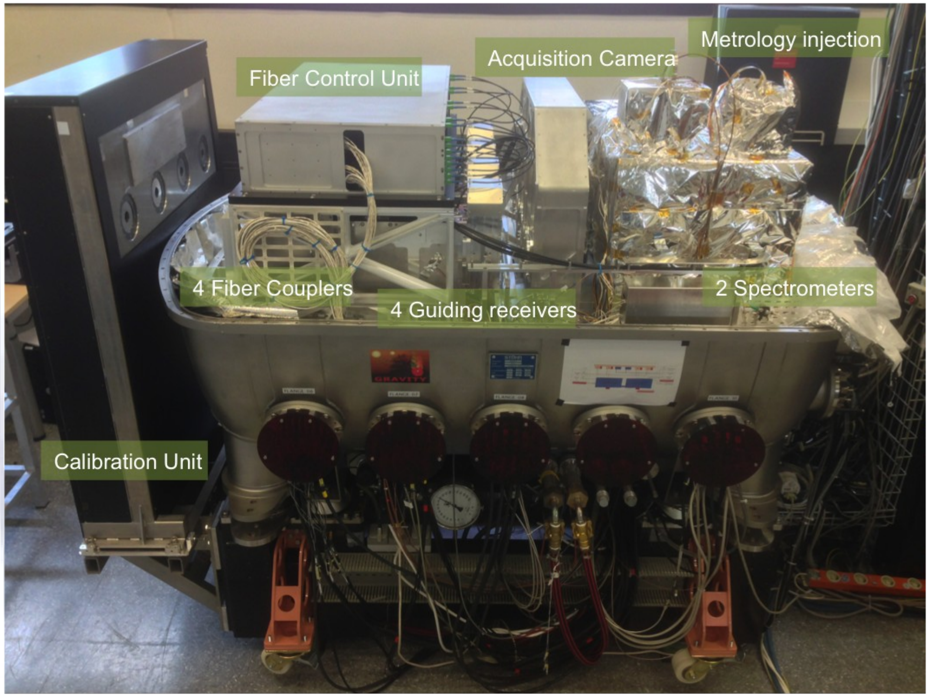
The L_{bol} increased to $1.7 * 10^5\ L_o$ from which: $M_{acc} \sim 6 * 10^{-3}\ M_o/yr$

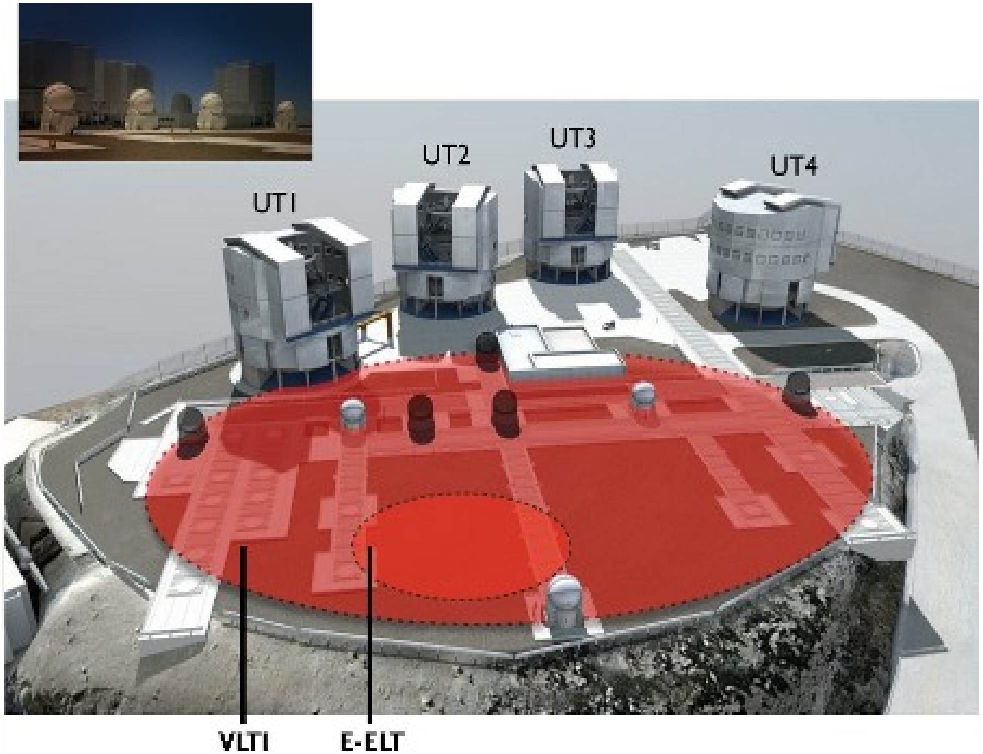


Discovery of a binary massive YSO
Kraus+ (2016, ApJ)

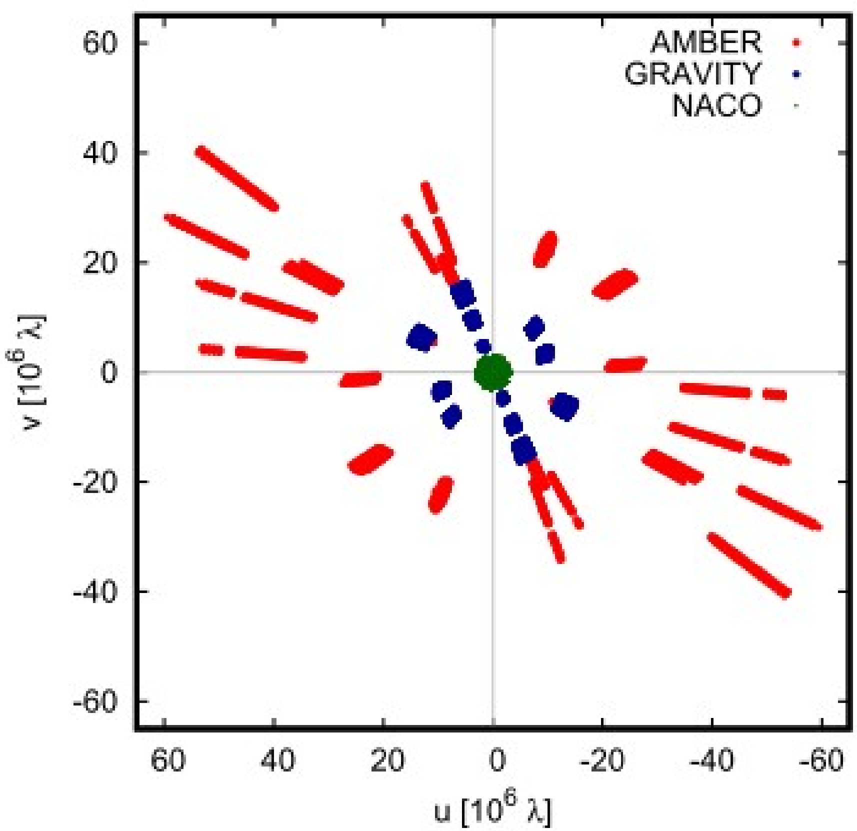
- Low, medium, high (4000)
- Modes: Single field, dual field
- K=6.5+3 (AT), K=9.5+3 (UTs)
- Goal: K=14 (UTs, dual field)

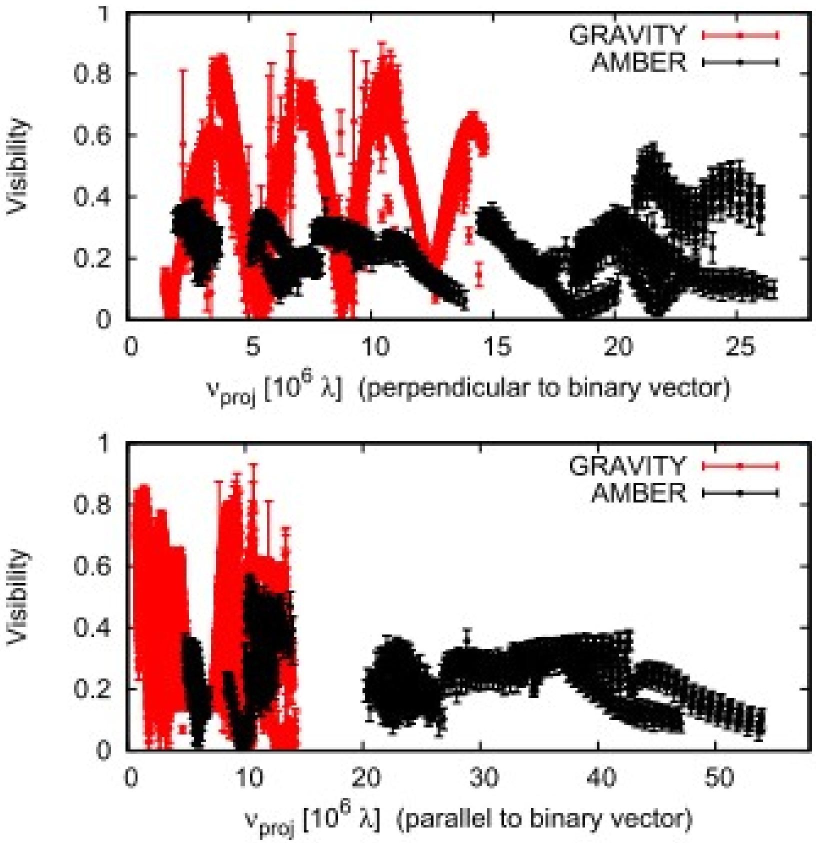
- Baseline max: 140 meters
- UT and AT operations





Interferometric SV data

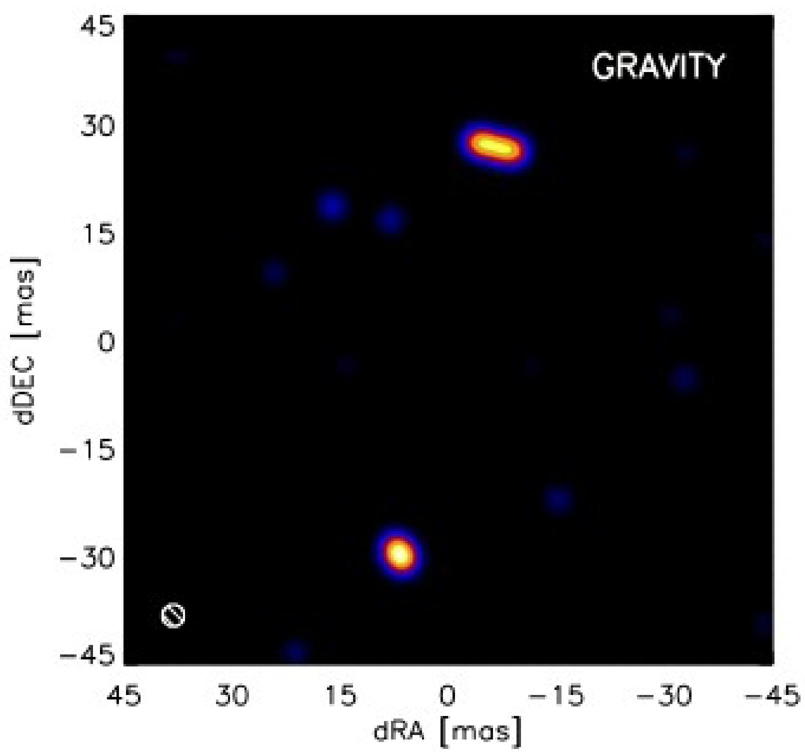


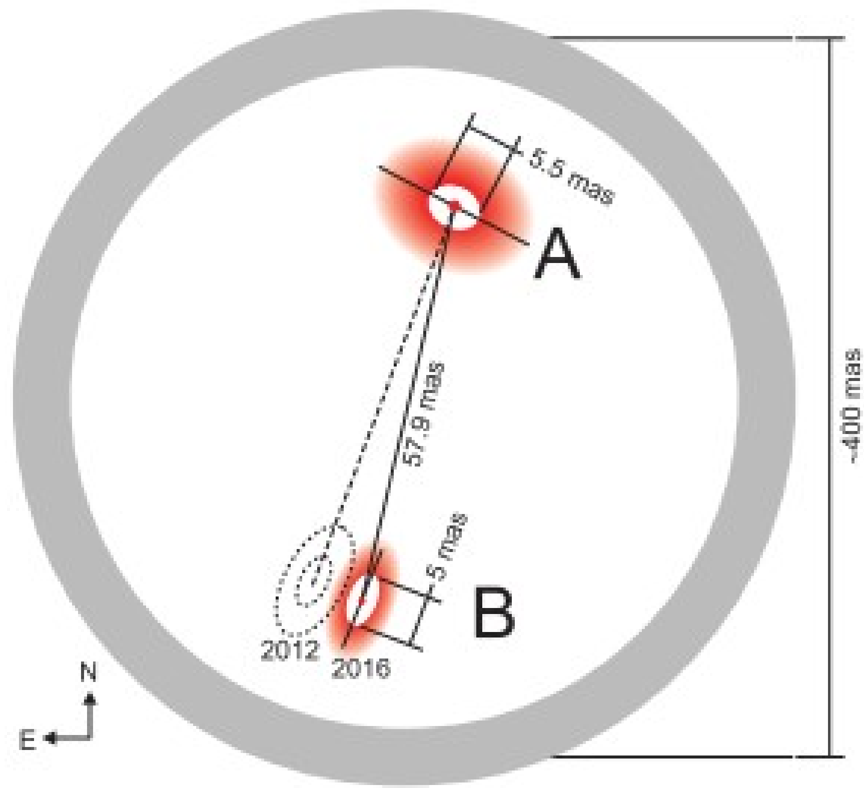


Discovery of a high-mass protobinary

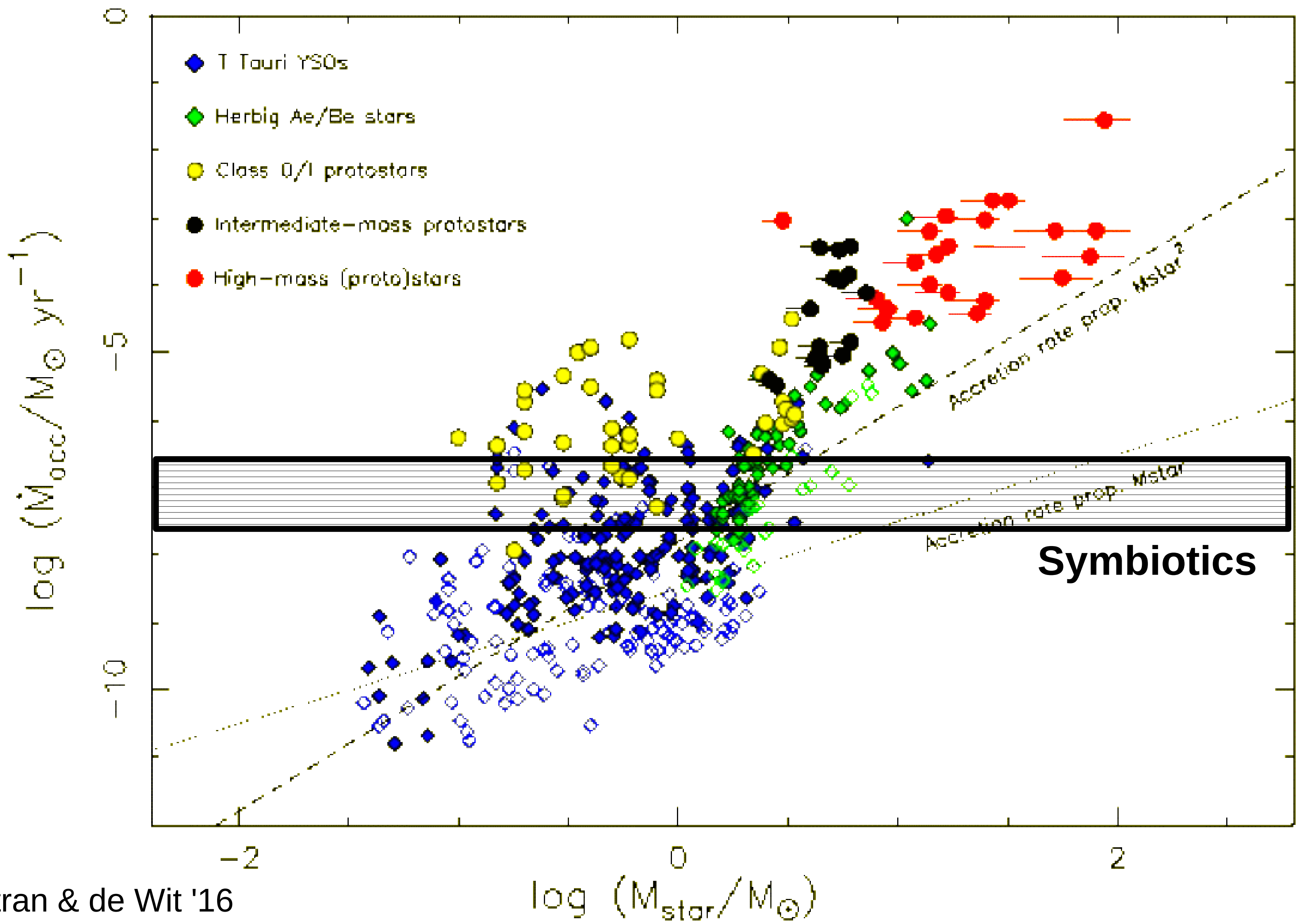
- IRAS 17216-3801
- 3 Kpc
- 6 * 10^4 L_o

- 170 AU separation
- Masses: 20 and 18 M_0

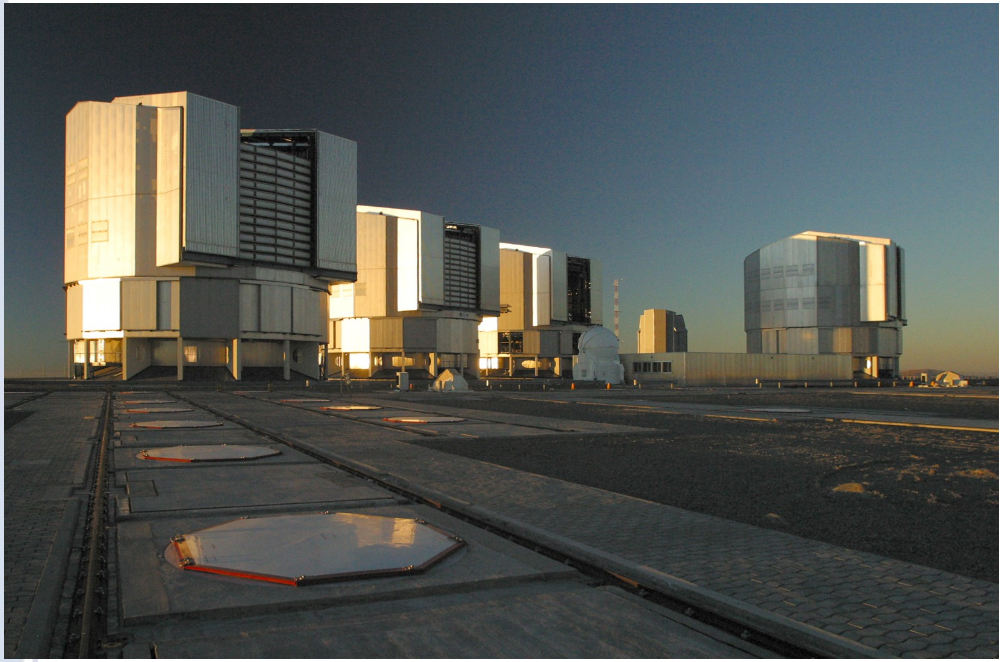




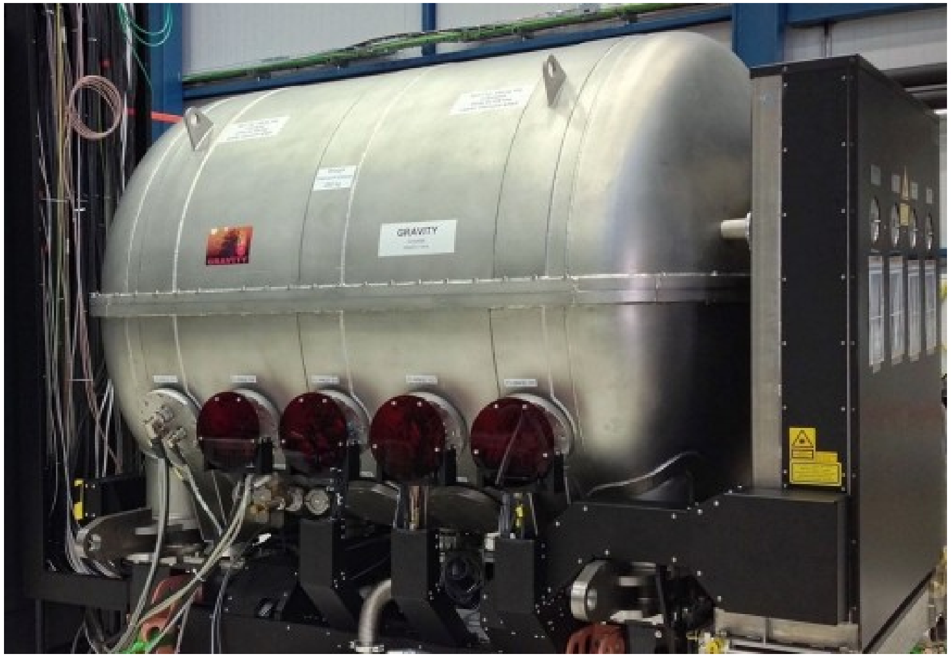
Mass accretion rates



Beltran & de Wit '16

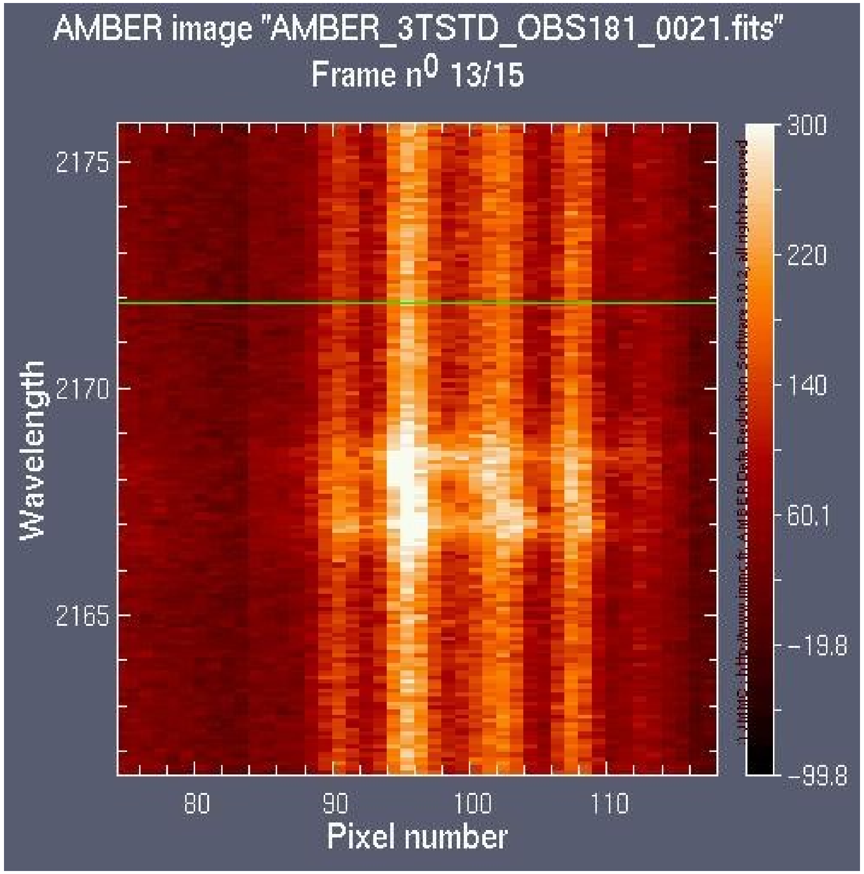


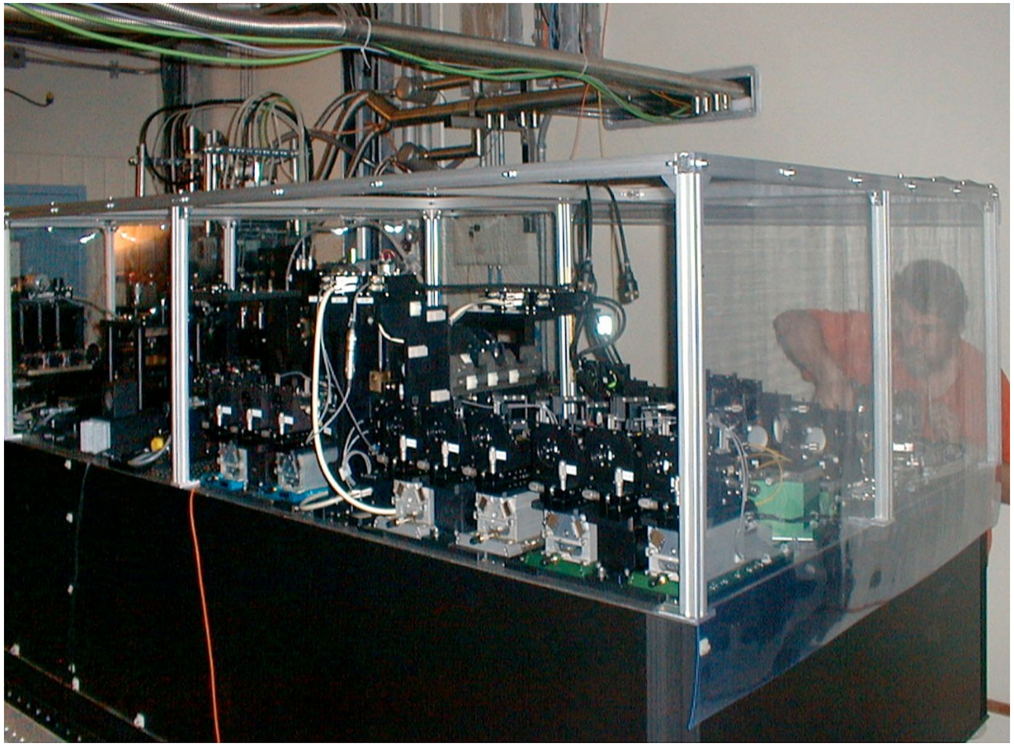
Gravity



THANK YOU!

K-band fringes from AMBER

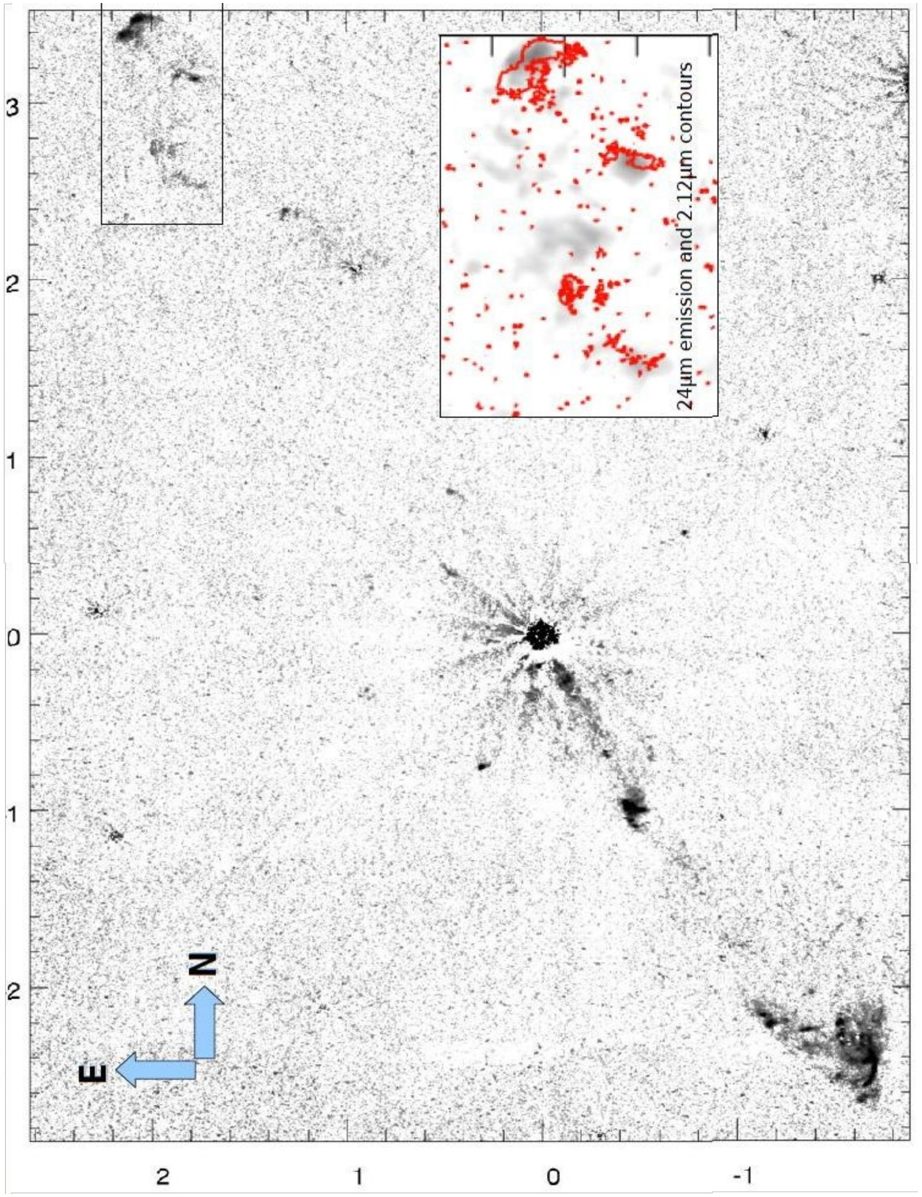




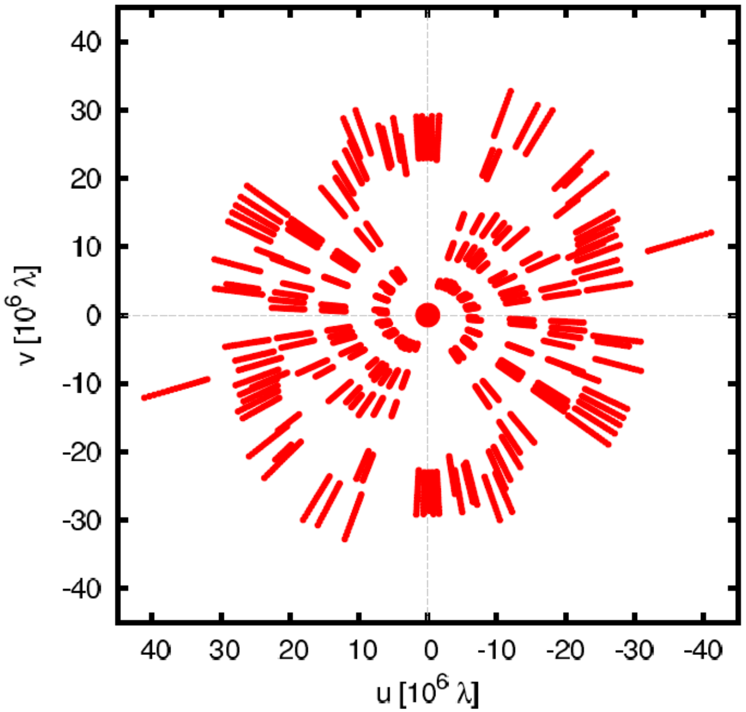
… lots of glass

The best candidate to do so

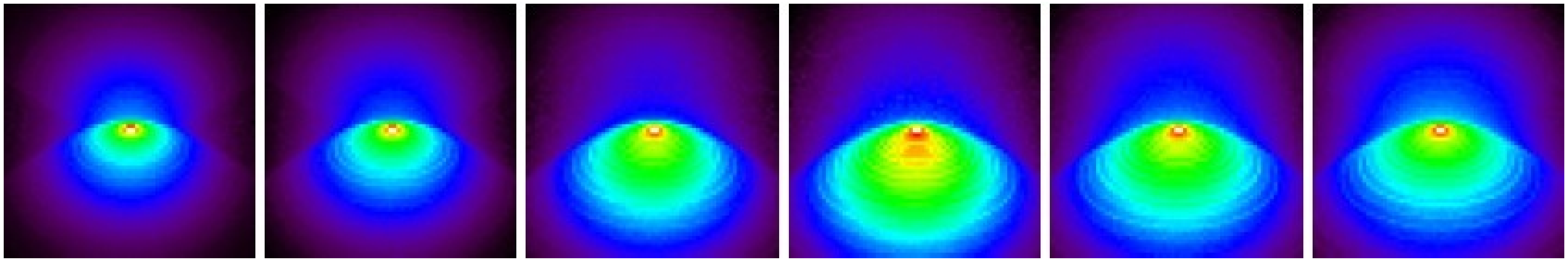
H2 - continuum

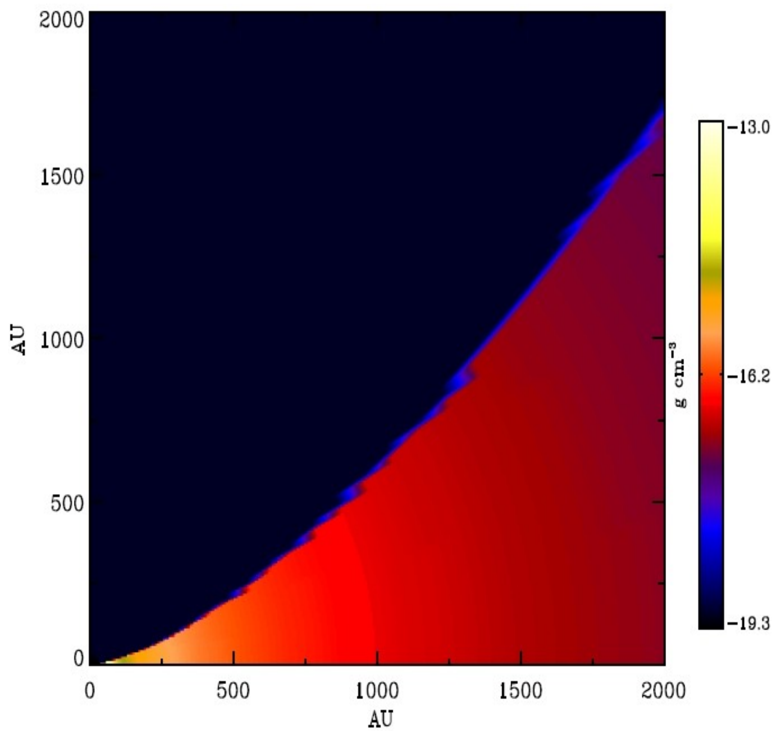


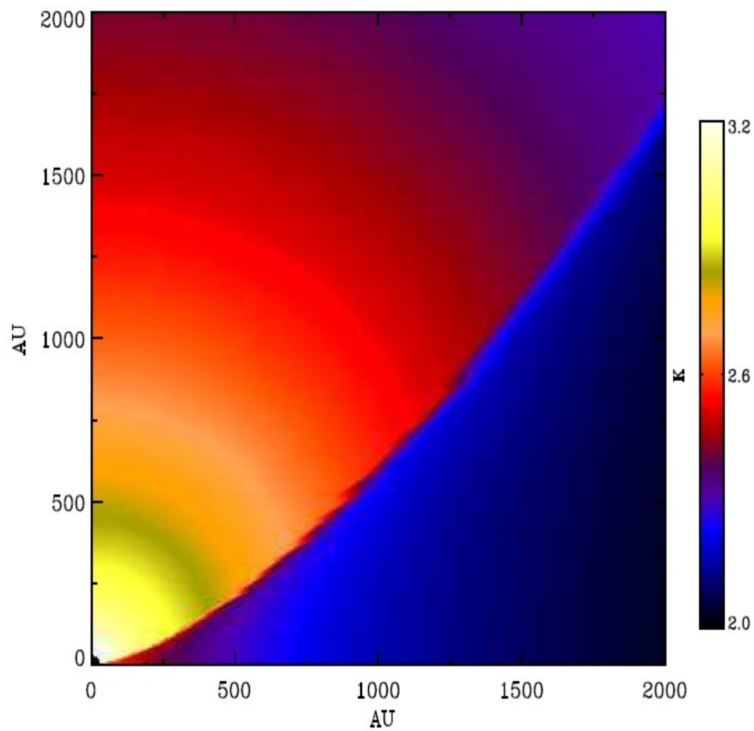
Spat. Resolution 2.4 mas (8.4 AU)



in pictures:

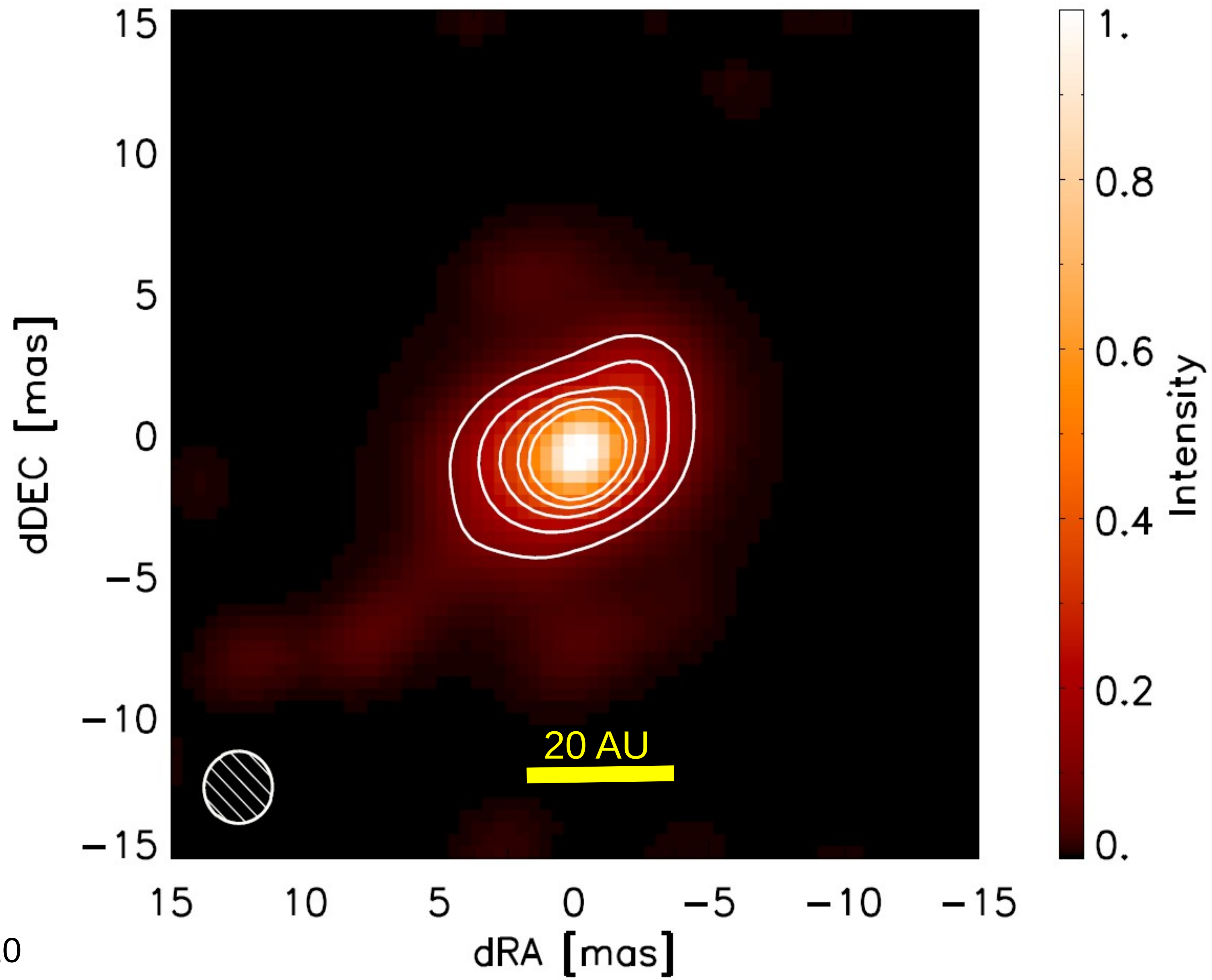




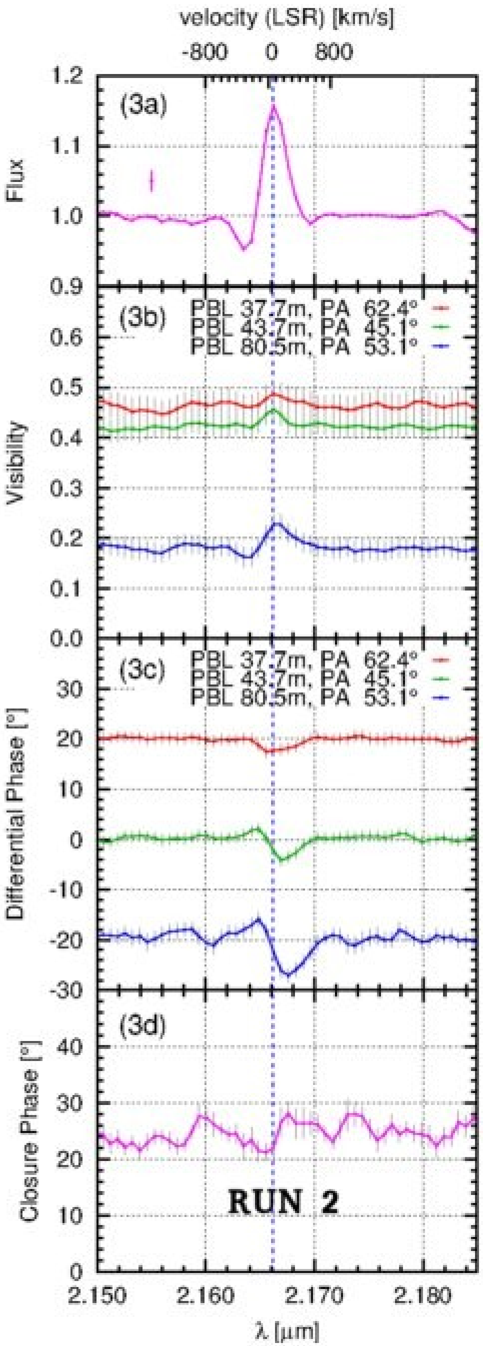


Boley et al. 2016
de Wit et al. 2011

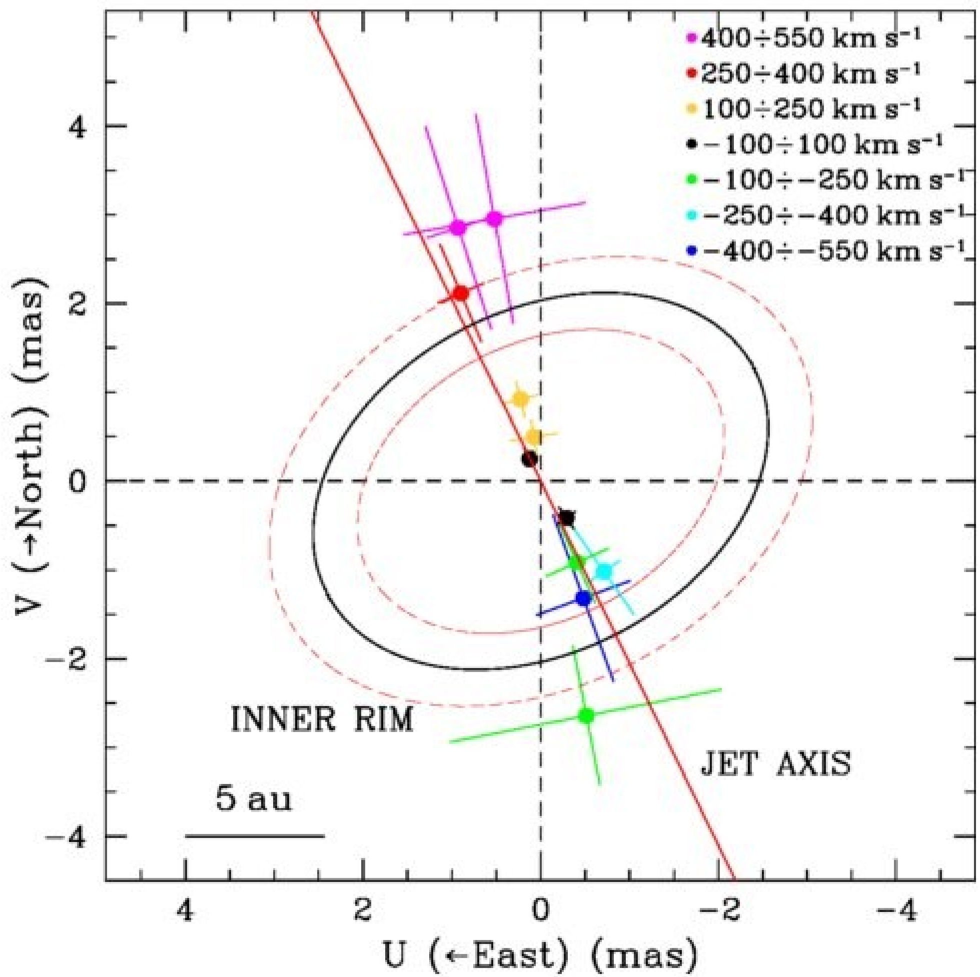
Result 1: a disk at 20 AU



Kraus et al. '10

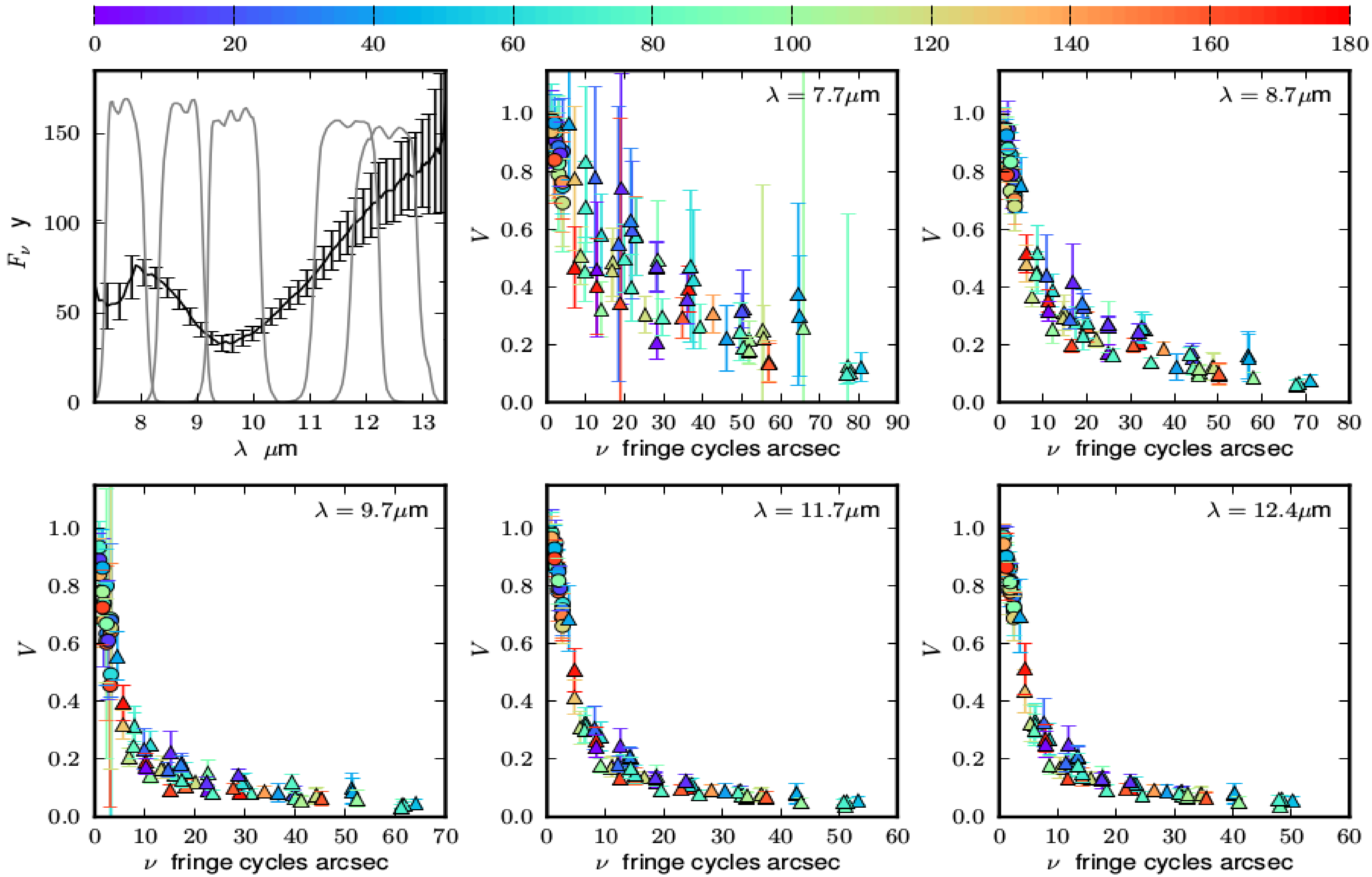


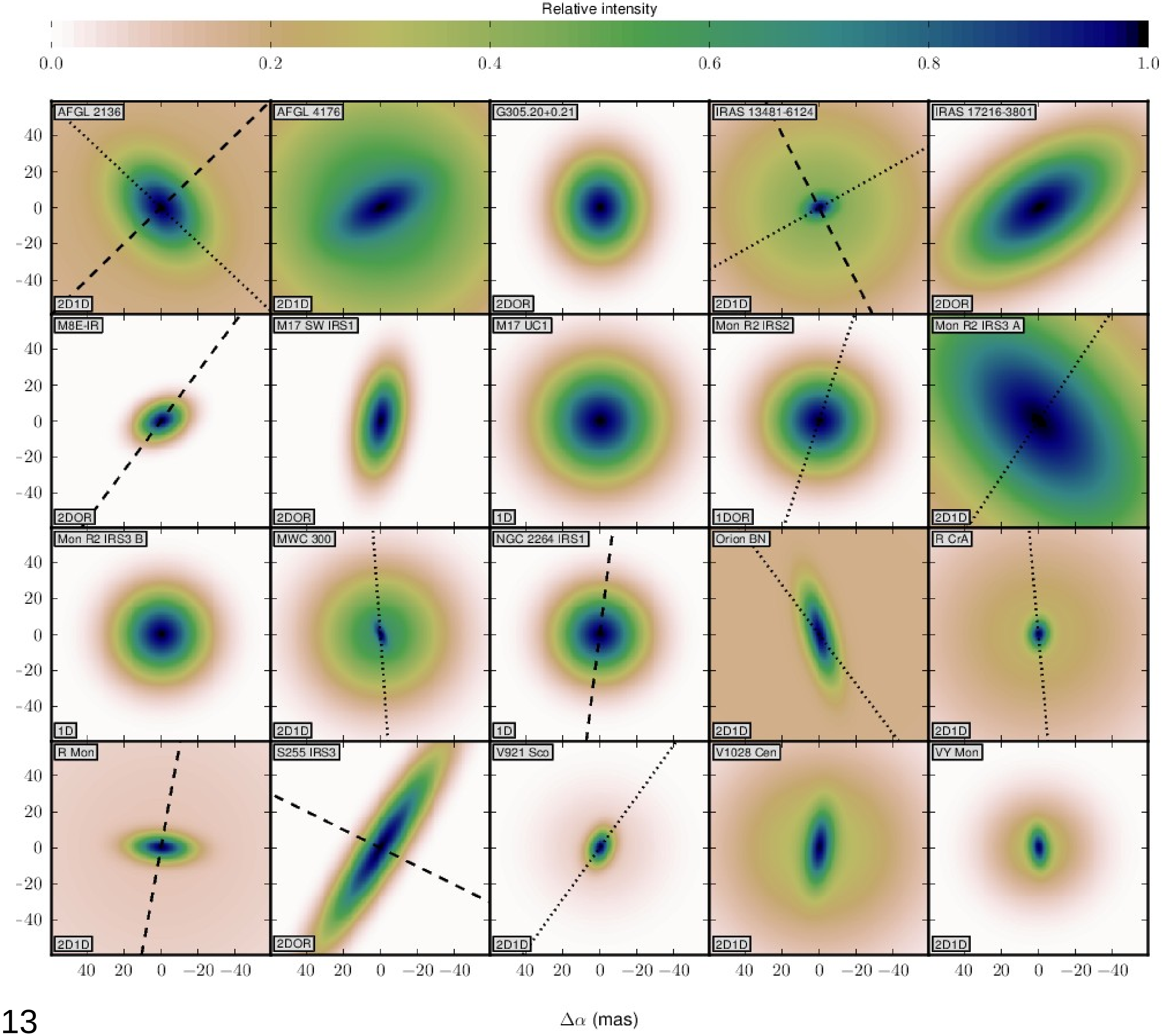
Result 2: astrometry



Caratti o Garatti et al. '16

Result 3: we see cavity emission





Boley et al. '13

Is it a rim?