

High-Mass Star Formation : Looking for Massive Pre-stellar Cores

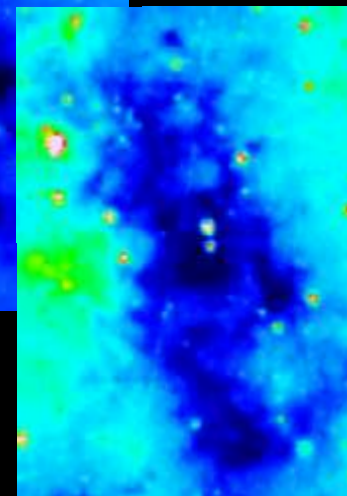
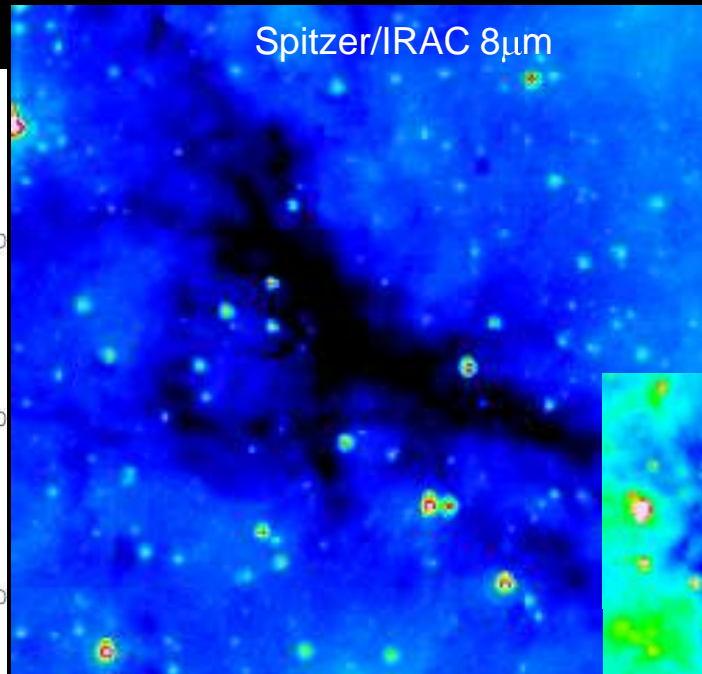
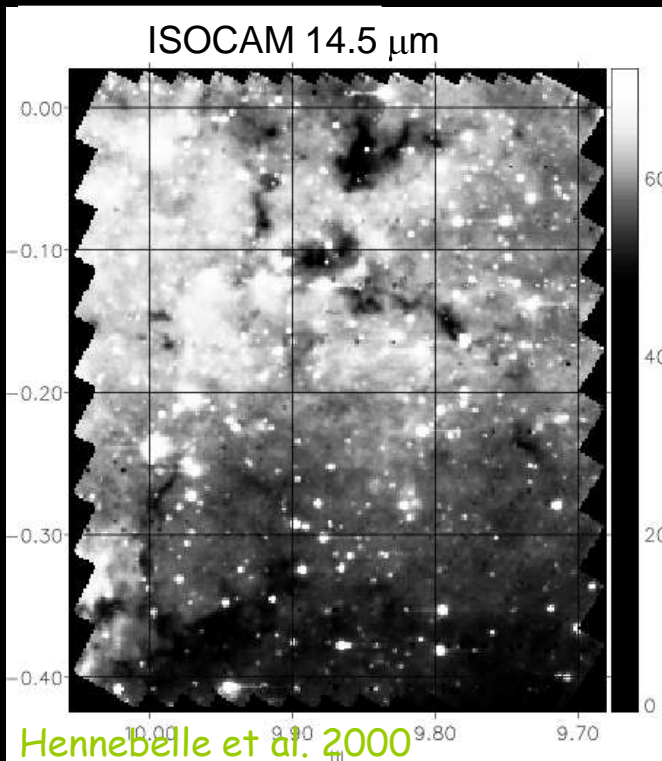
Christiaan Boersma
Roisin Ni Chuimin
Catherine Espaillat
Simone Fiedler
Antoine Gusdorf

Nguyen Luong Quang
Patricio Sanhueza
Sebastiano Spinelli
Tzu-Cheng Peng
Francesca Useli

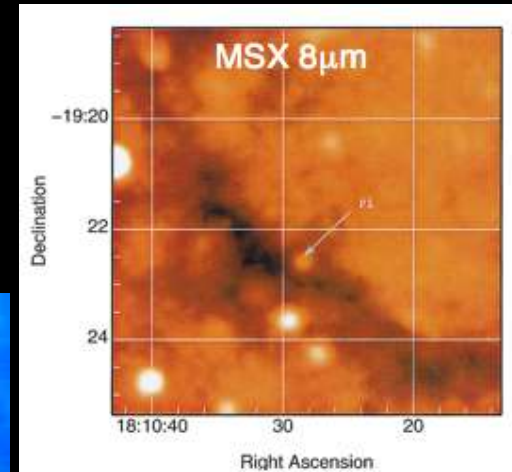
Advisors:
Philippe André
Nicolas Peretto

Infrared Dark Clouds (IRDCs)

- ISO, MSX, & Spitzer have identified dark extinction features against the bright mid-IR Galactic background



Spitzer/IRAC 8 μm



Properties of IRDCs

- $> 10,000$
- Cold (< 25 K)
- Dense ($> 10^5 \text{ cm}^{-3}$)
- Column density $\sim 3 \times 10^{22} - 10^{25} \text{ cm}^{-2}$
- Mass $\sim 1 - 10^4 M_{\odot}$
- Size $\sim 0.1 - 10 \text{ pc}$

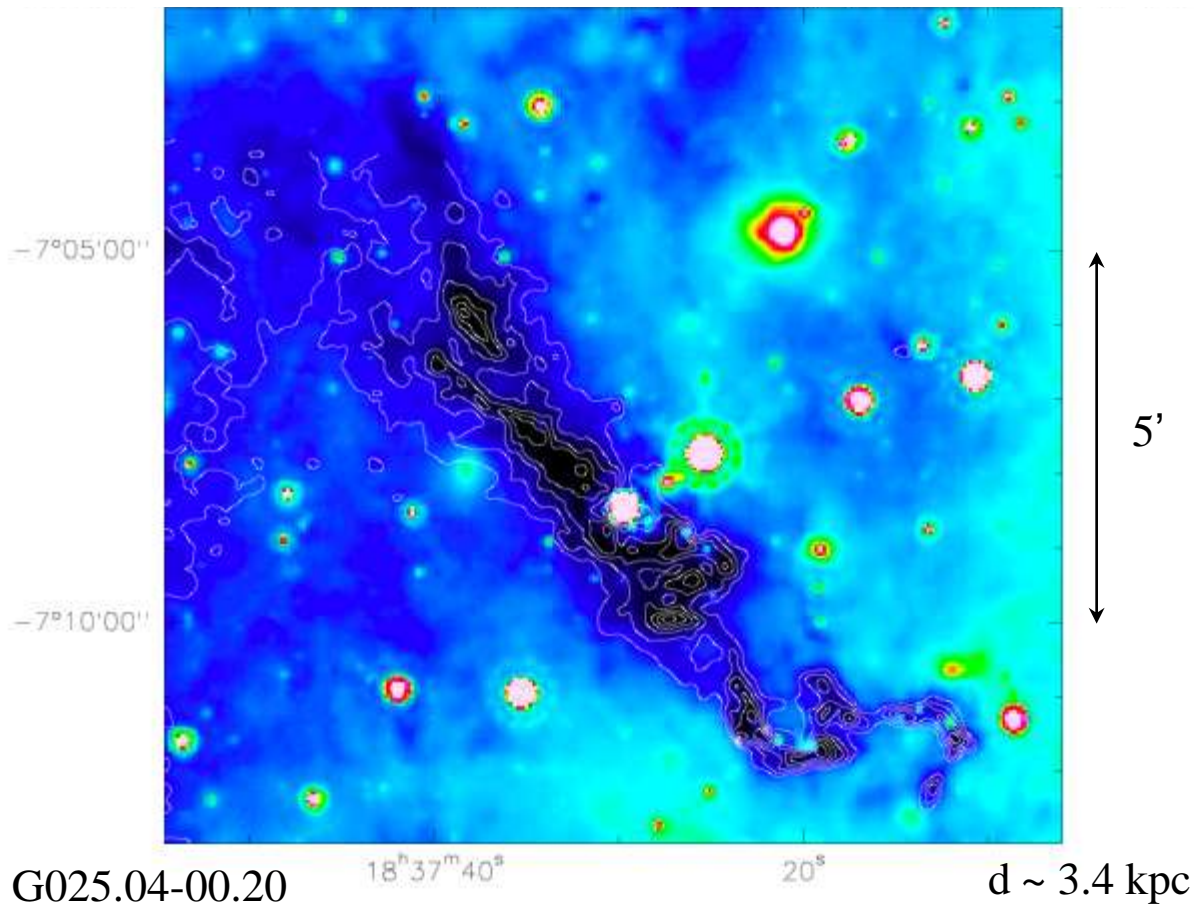
Perrault et al. 1996, Egan et al. 1998, Bacmann et al. 2000,
Simon et al. 2006, Rathborne et al. 2006

Searching for initial conditions of high-mass star formation

- Motivation : identify precursor regions of high-mass star formation
- Fragmentation → Dense clumps that are forming stellar clusters
 - Estimation of mass → distinguish between low or high mass star formation

MAMBO-2 mapping of the IRDC G025.04-00.20

MIPS 24 μm emission (color) + IRAC 8 μm absorption (contours)

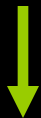


- Identify candidates from IR extinction maps
- $A_V \sim 70$
- Map with bolometer
 - Identify cores to estimate properties

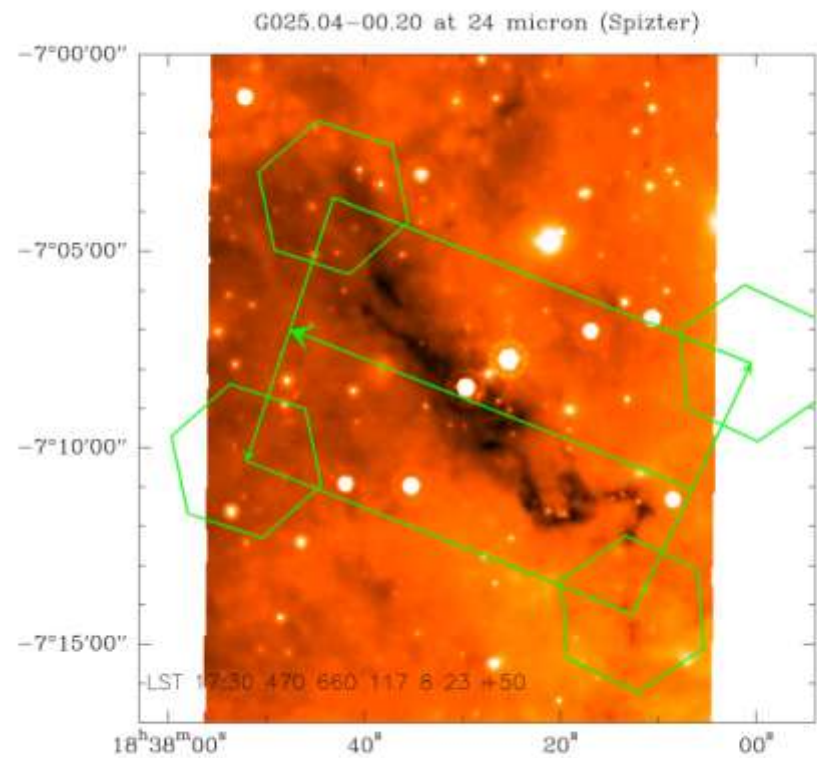
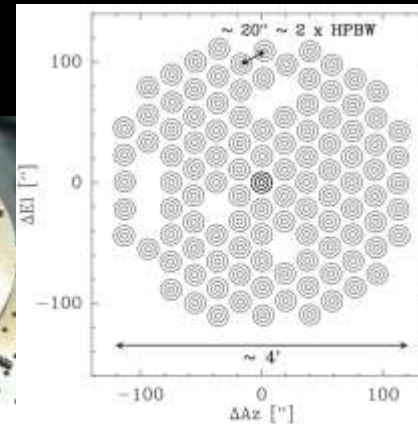
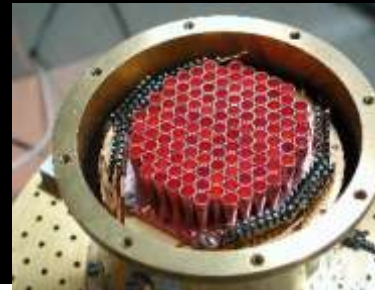
Preparation

Map parameters:

- Map size : 470" x 660"
- Bolometer number : 117
- Scan velocity : 8"/s
- Scan step : 23"
- Beam throw : 50", 70"
- Wobbler rotational angle : +45 , +55
- LST : 19:00, 20:00



Time estimator



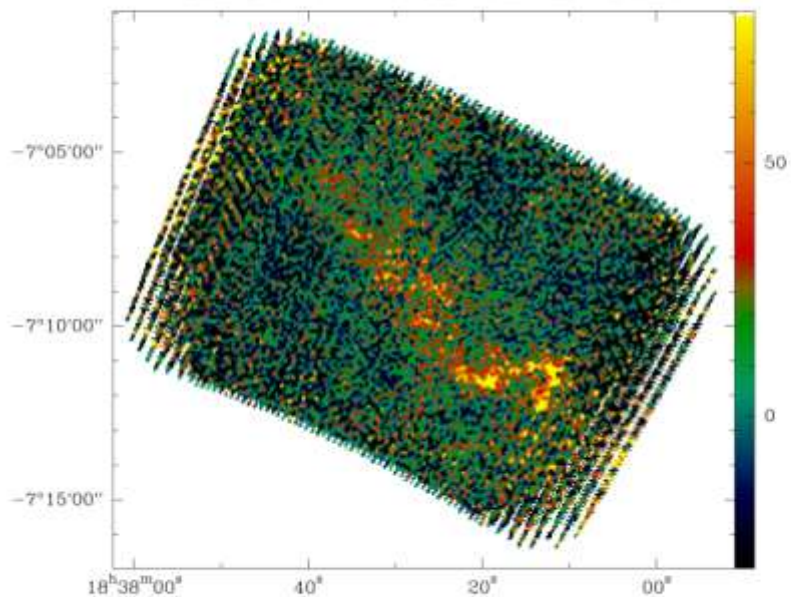
Observations

- Skydip
- Pointing
- Focus
- Calibration (ON-OFF)
G34.3 (20 Jy/beam)
- Observing modes :
On-The-Fly Mapping
Wobbler switching



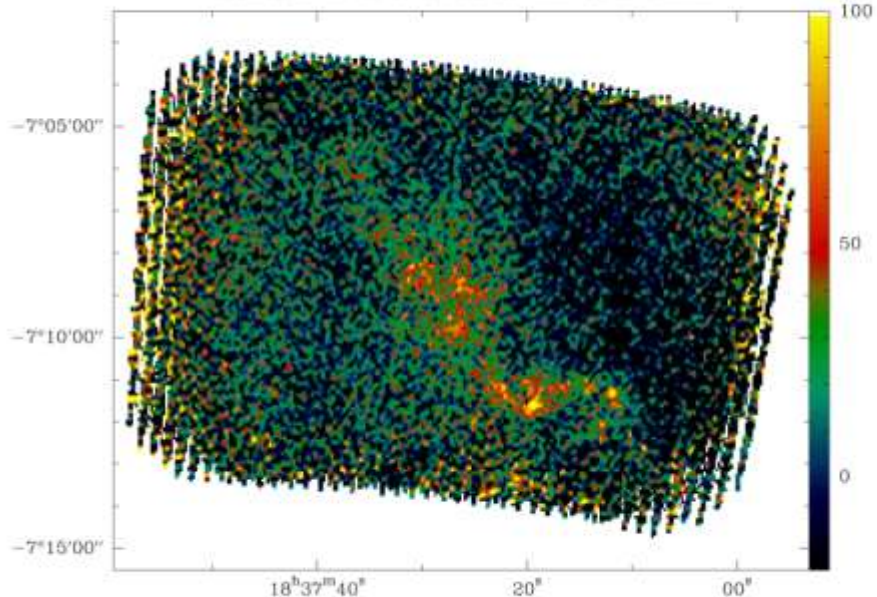
First map

iram30m-abba-20071001s162-imb csf at 1.2mm

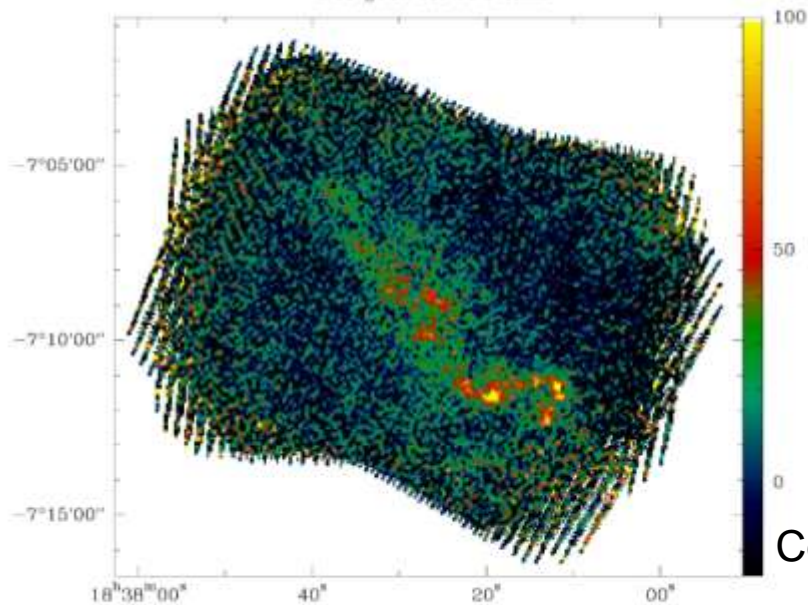


Second map

iram30m-abba-20071001s164-imb csf at 1.2mm



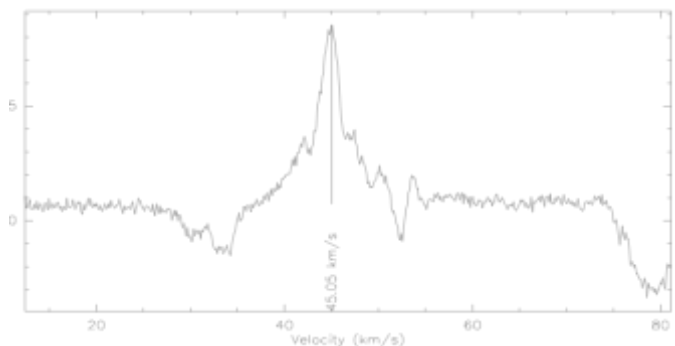
irde g025 csf at 1.2mm



Combined map

Results

463: 2 G025.04 PEAK 12CO(2-1) 30M-V03-A230 O: 03-OCT-2007 R: 03-OCT-2007
RA: 18:37:19.300 DEC: -07:11:36.00 (2000.0) Offs: 0.0 0.0 Eq
Unknown Tau: 0.2186 Tsys: 347.5 Time: 5.498 Et: 36.64
N: 542 ID: 270.5 VO: 46.90 Dv: -0.1270 LSR
FO: 230538.000 DF: 9.7656E-02 FI: 239052.297

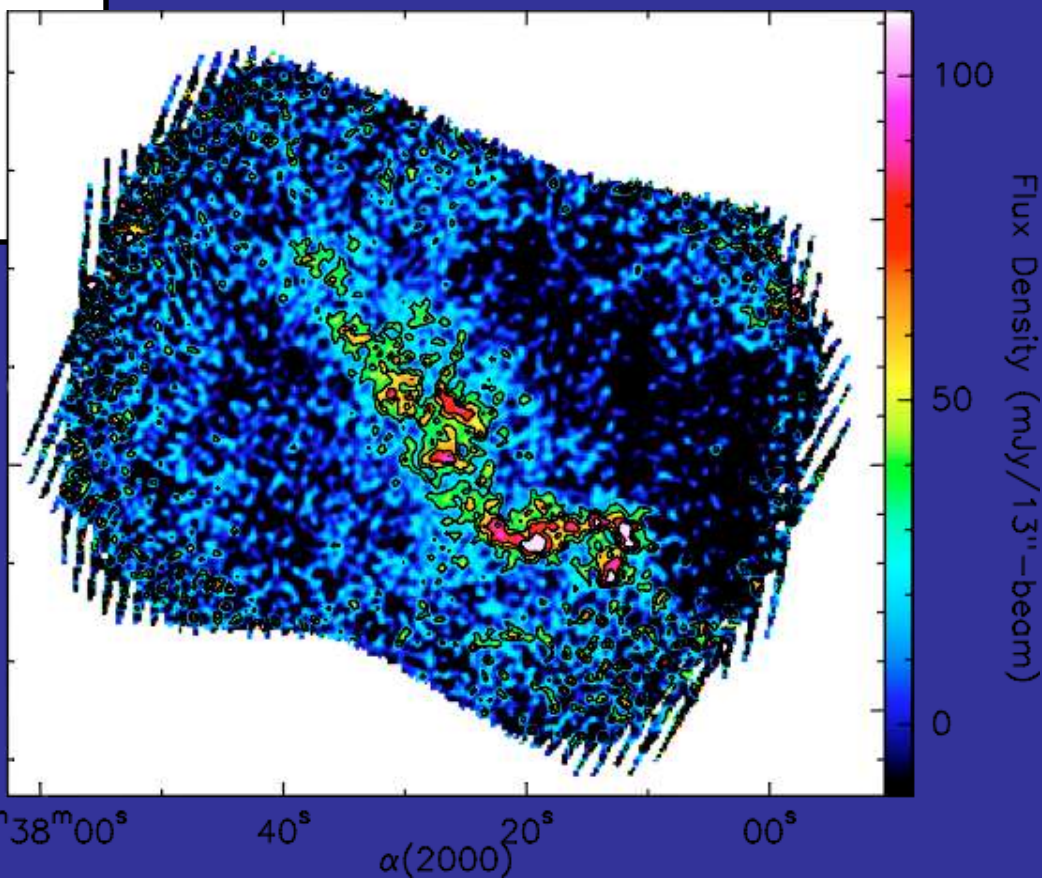


$v = 45 \text{ km/s}$

$d = 3.4 \text{ kpc}$

$\langle \text{rms} \rangle = 13 \text{ mJy/beam}$

$\delta(2000)$
 $-7^{\circ}10'00''$



The entire filament

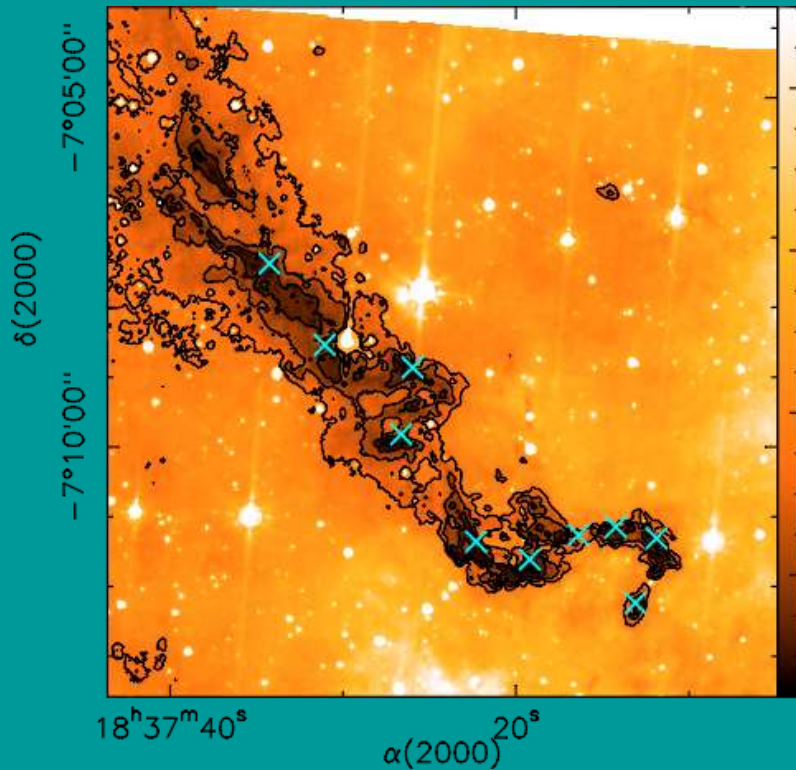
- | | | | |
|------------|-----------------|------------------------|------------------|
| Properties | Flux | 20 | Jy |
| | Size | 11.3 x 3.41 | pc ² |
| | Mass | 2.6 x 10 ⁴ | M _⊙ |
| | N _{H2} | 4.9 x 10 ²² | cm ⁻² |
| | n _{H2} | 3.2 x 10 ⁴ | cm ⁻³ |

min
max
avg

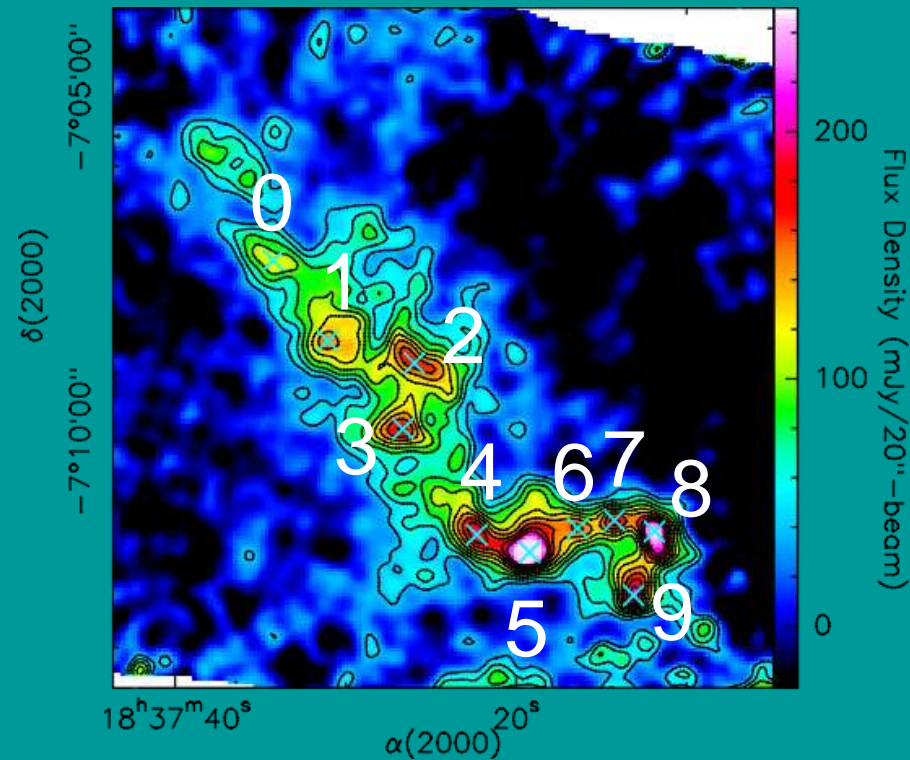
	integrated intensity (mJy)	mass (Msun)	col density (cm ⁻²)	d (pc)	vol density (cm ⁻³)
min	191.1	225.8	9.6e+22	0.41	1.04e+05
max	755.4	892.7	7.6e+22	0.93	37000
avg	438.4	518.1	1.0e+23	0.63	85000

Conclusion

- Clearly identified massive, star-less, clumps
- Need higher resolution to probe individual cores
- Heterodyne observation also required (kinematics)



Spitzer IRAC 8 micron



Mambo 1.2 mm