

The Soul of High-Mass Star Formation Conference

Puerto Varas, Chile, March 16, 2015



NGC 6334 V

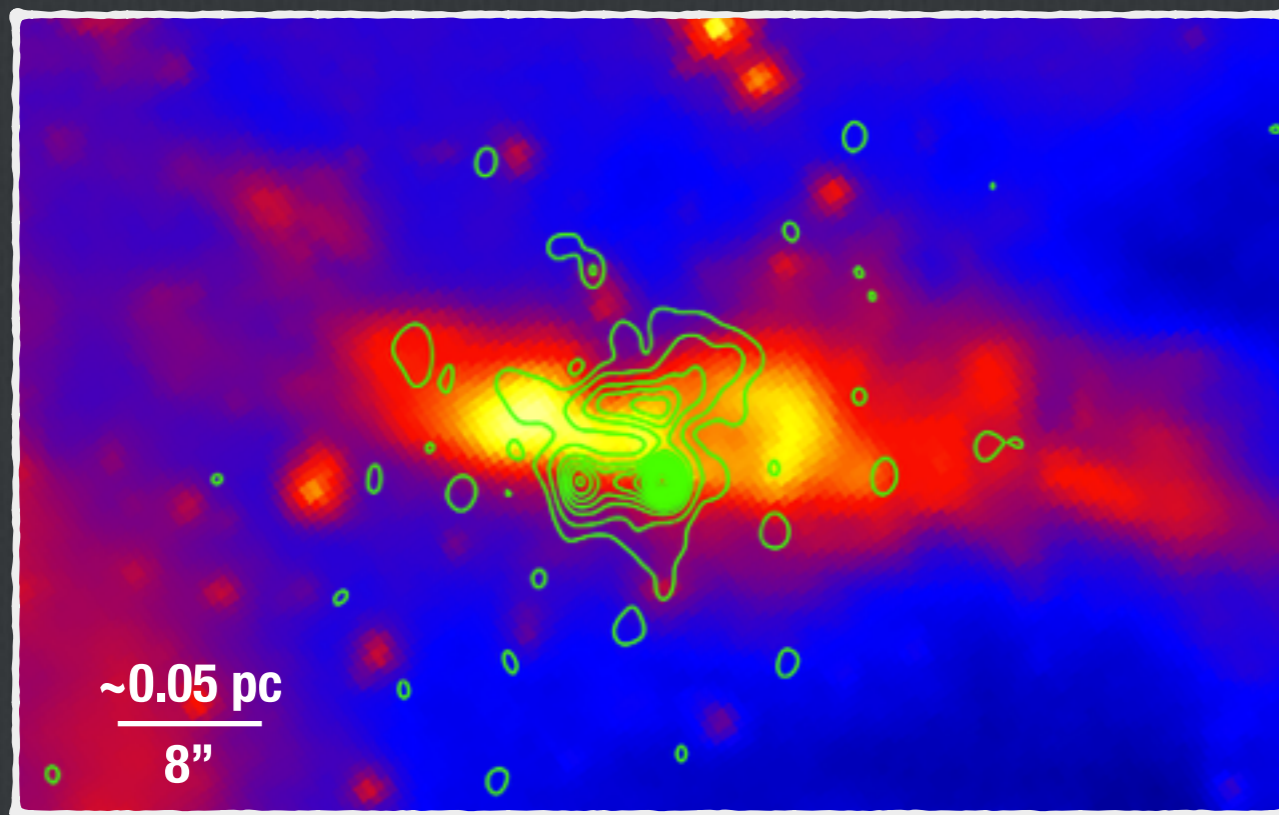
SMA spectro-polarimetric observations towards an intermediate/high-mass star forming region

Carmen Juárez

in collaboration with

Josep Miquel Girart, Ya-Wen Tang, Patrich Koch and H. Baobab Liu

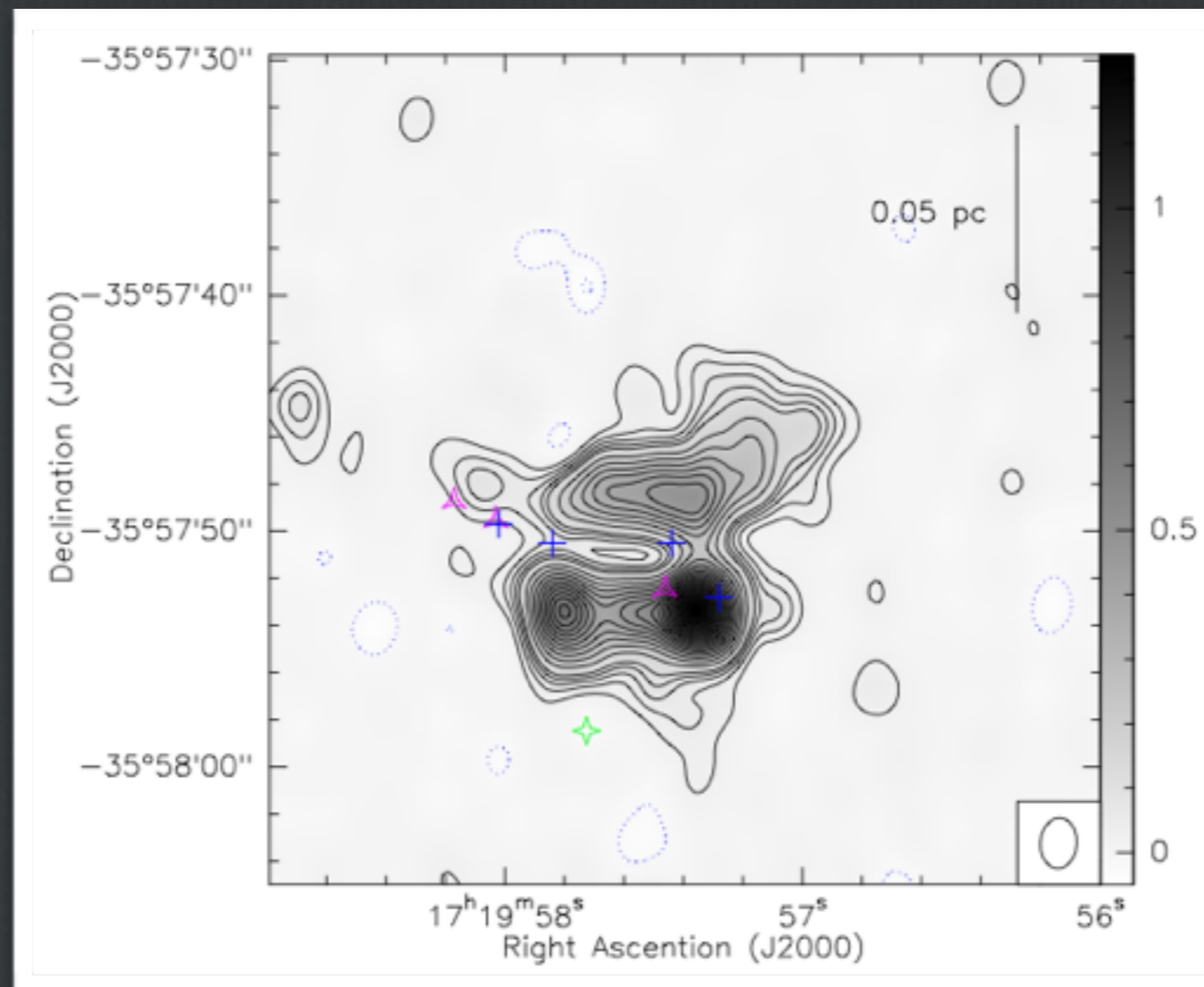
Introduction



Spitzer 4.5 μm

- SMA legacy project “Filaments, star formation and magnetic fields”: 345 GHz polarization observation of a sample of 21 massive star forming regions.
- The goal is to make progress in understanding the role of the magnetic field in the formation of filaments, dense cores and massive stars.
- NGC 6334 V: $d \sim 1.3$ kpc, $L_{\text{bol}} \sim 10^5 L_{\text{Sun}}$
- Star formation activity: CO outflow, OH maser, far infrared emission, ...

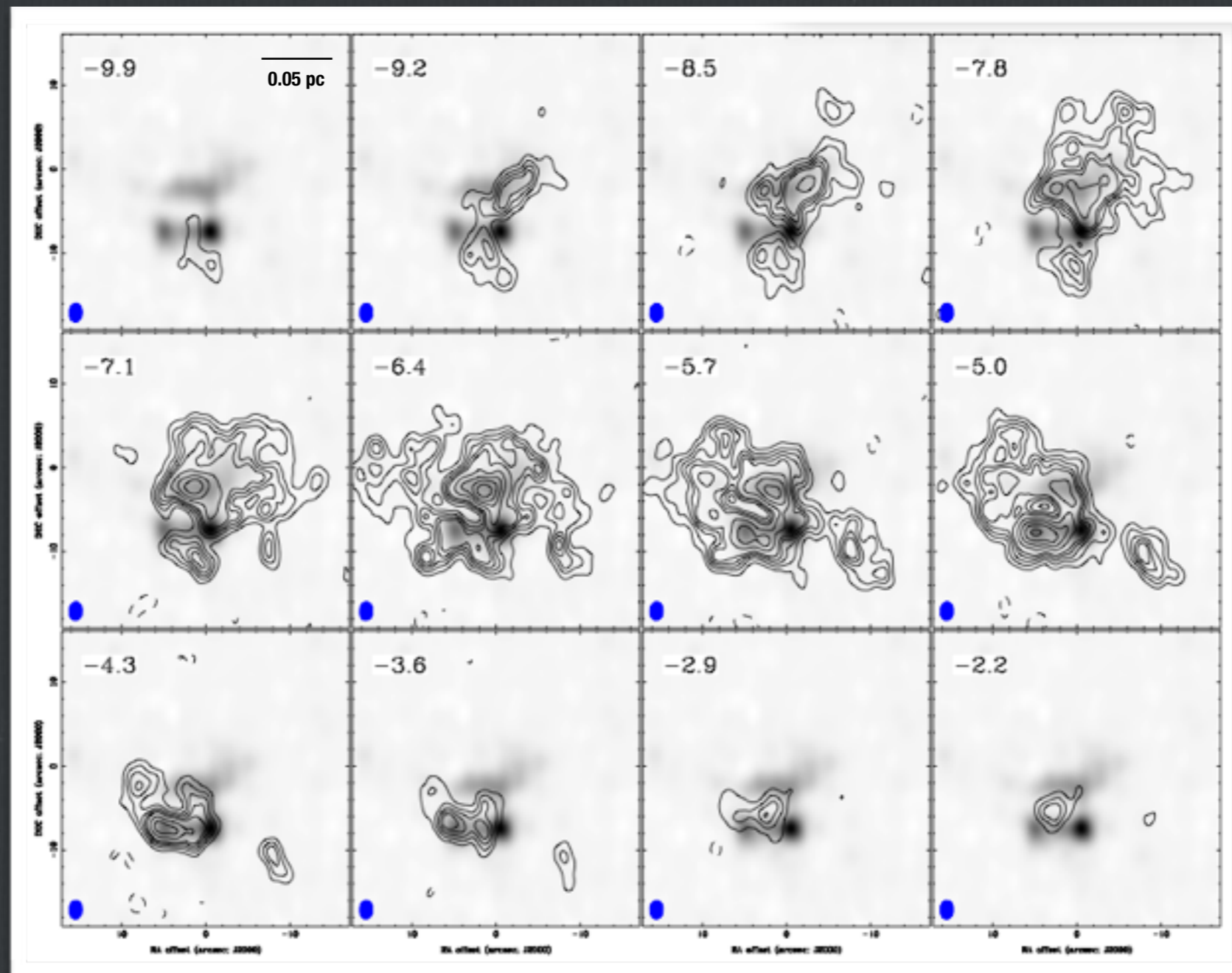
870 micron dust continuum



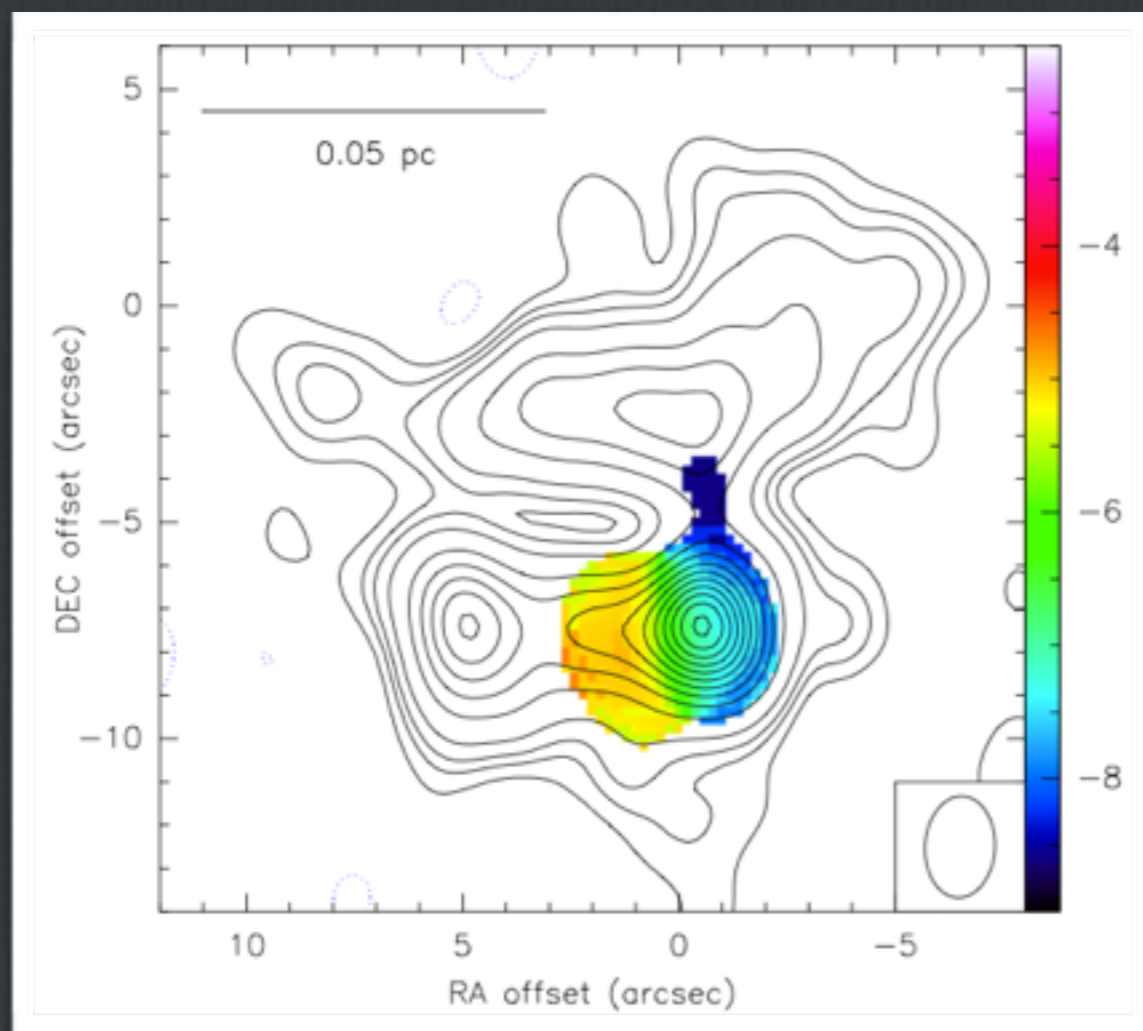
Total mass $\sim 10\text{-}22 M_{\text{Sun}}$, main core mass $\sim 3\text{-}7 M_{\text{Sun}}$.

Molecule	Transition	Frequency (GHz)	E_L (K)	ρ^1 (cm ⁻³)	Note
Hot core tracers					
SO ₂	21(2,20)-21(1,21)	332.09143	204	9.93×10^6	
SO ₂	16(4,12)-16(3,13)	346.52388	148	1.16×10^8	Blended
SO ₂	19(1,19)-18(0,18)	346.65217	152	4.82×10^7	Shock tracer
³⁴ SO ₂	16(4,12)-16(3,13)	332.83622	147		
³⁴ SO ₂	19(1,19)-18(0,18)	344.58104	151		
³⁴ SO ₂	11(4,8)-11(3,9)	344.99816	82		
³⁴ SO ₂	8(4,4)-8(3,5)	345.16866	54		
³⁴ SO	7(8)-6(7)	333.90098	64		
CH ₃ OH	18(2,16)-17(3,14)	344.10913	403		
CH ₃ OH	19(1,19)-18(2,16)++	344.44390	435		
CH ₃ OCHO	31(0,31)-30(1,30)	333.44902	244		
CH ₃ OCH ₃	19(1,19)-18(0,18)AA	344.35806	151		
CH ₃ OCH ₃	11(3,9)-10(2,8)EE	344.51538	56		
HC ₃ N	J=38-37	345.60901	307		
HCO	4(0,4)-3(0,3)	346.70849	25		
Dense core tracers					
SO	8(8)-7(7)	344.31061	71	8.51×10^6	Shock tracer
SO ₂	4(3,1)-3(2,2)	332.50524	15	2.34×10^7	
SO ₂	13(2,12)-12(1,11)	345.33854	76	2.20×10^7	Shock tracer
CH ₃ OH	7(1,7)-6(1,6)	335.58200	63	1.77×10^6	
HC ¹⁵ N	(4-3)	344.20011	25	1.18×10^8	
NS	J=15/2-13/2	346.22116	54		
H ¹³ CO ⁺	4-3	346.99835	25	7.83×10^6	
Outflow tracers					
CO	3-2	345.7959	16	3.62×10^4	
SiO	8-7	347.33058	58	2.00×10^7	Shock tracer

H^{13}CO^+ 4-3



Hot core



CH_3OCHO 31(0,31)-30(1,30)

□ $^{34}\text{SO}_2$, SO_2 , CH_3OH , CH_3OCH_3 ,
 HC_3N

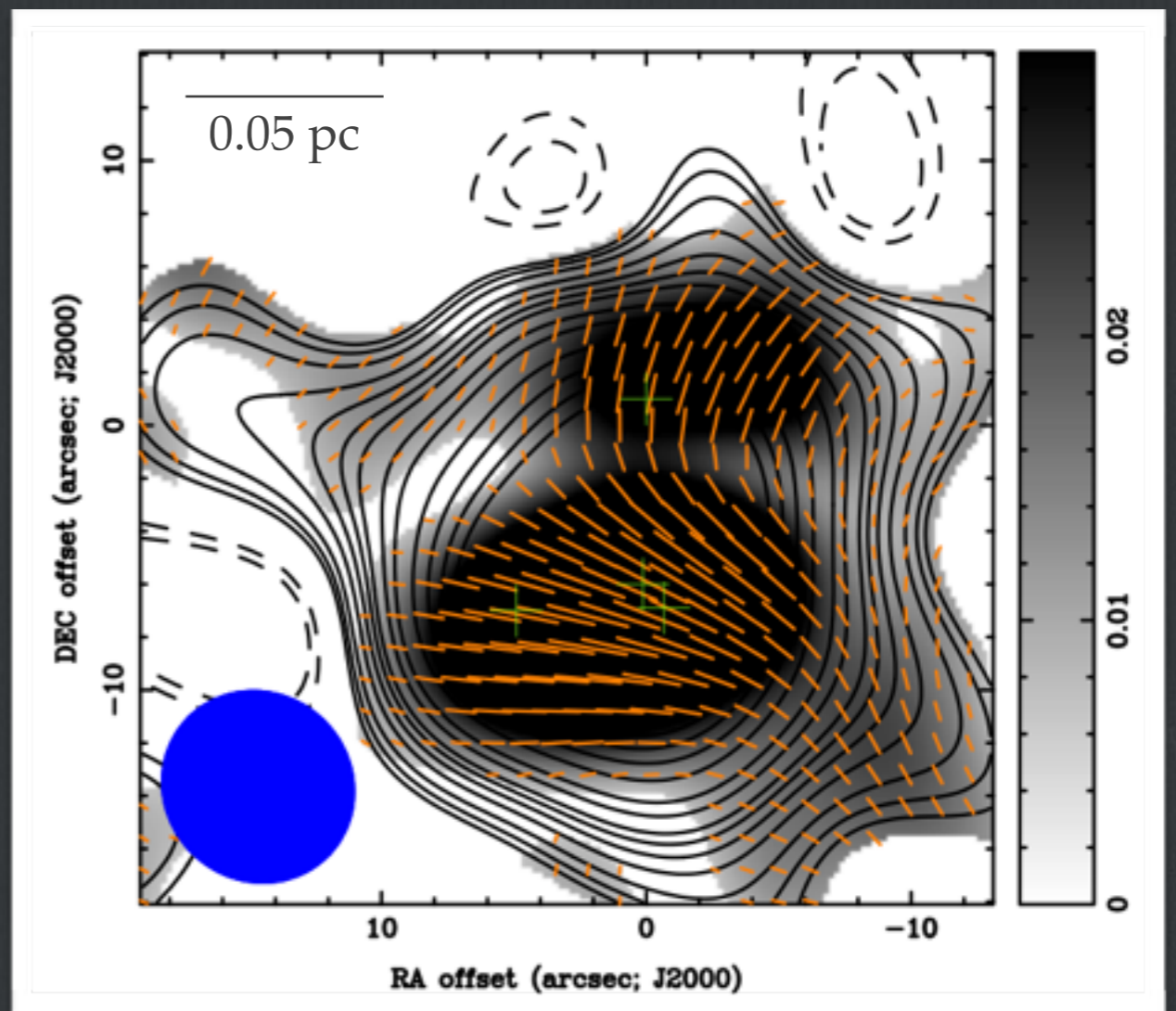
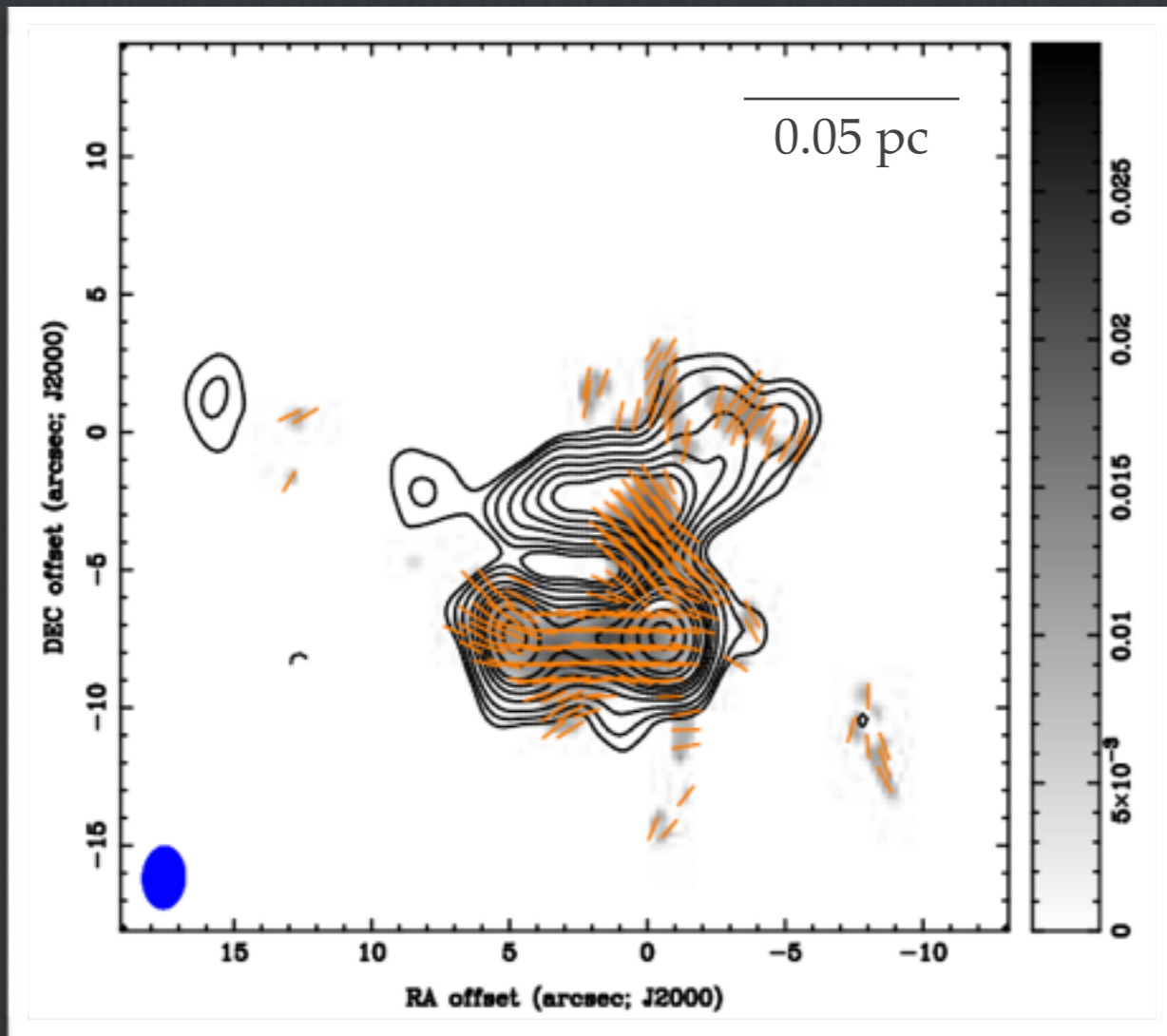
$$\frac{GMm}{r^2} = \frac{mv^2}{r}$$



$M \sim 4 M_{\text{Sun}}$

Gravitationally bound

Polarization



Summary

- The dust emission presents three main cores, one of them being more active presenting emission from many molecules and higher velocity dispersion (hot core).
- The estimated total mass is $\sim 10^{-22} M_{\text{Sun}}$. The hot core mass is $\sim 3-7 M_{\text{Sun}}$ and agrees with a gravitationally bound system.
- H^{13}CO^+ 4-3 and CH_3OH 7(1,7)-6(1,6) transitions trace extended emission with “ring” like shape and clear E-W velocity gradients.
- Spitzer 4.5 μm shows clear E-W molecular outflow.
- Polarization data shows strong detection with the magnetic field following the dust continuum structure.