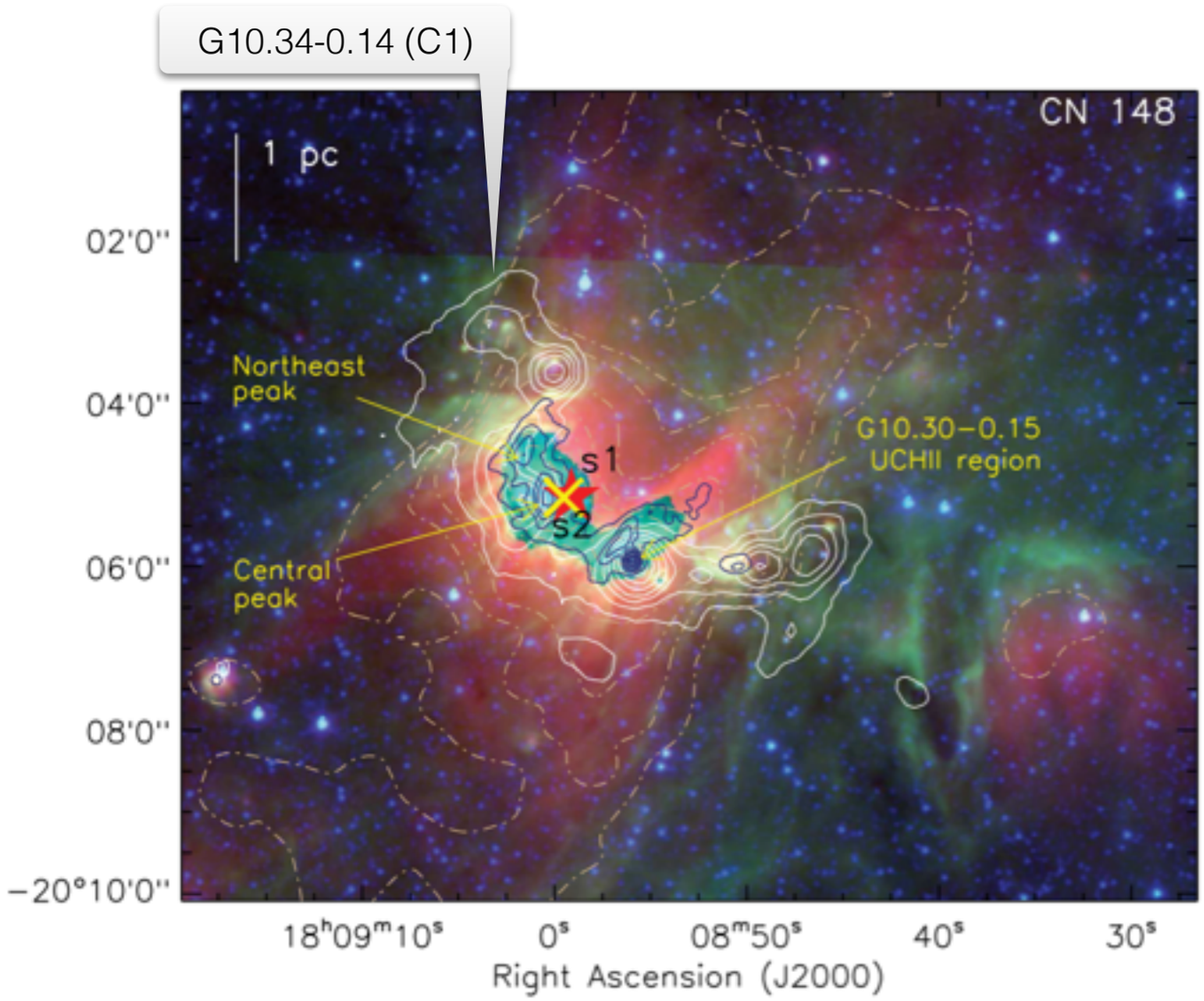
Methanol Maser Polarization of Massive SFR G10.34-0.14 with ALMA

Ji-hyun Kang, Do-Young Byun, Kee-Tae Kim, Jongsoo Kim, Aran Lyo, Woojin Kwon
(KASI)
Mi-Kyung Kim (NAOJ)
Wouter Vlemmings, Boy Lankhaar (Onsala Observatory)
and Gabriele Surcis (INAF-Cagliari)

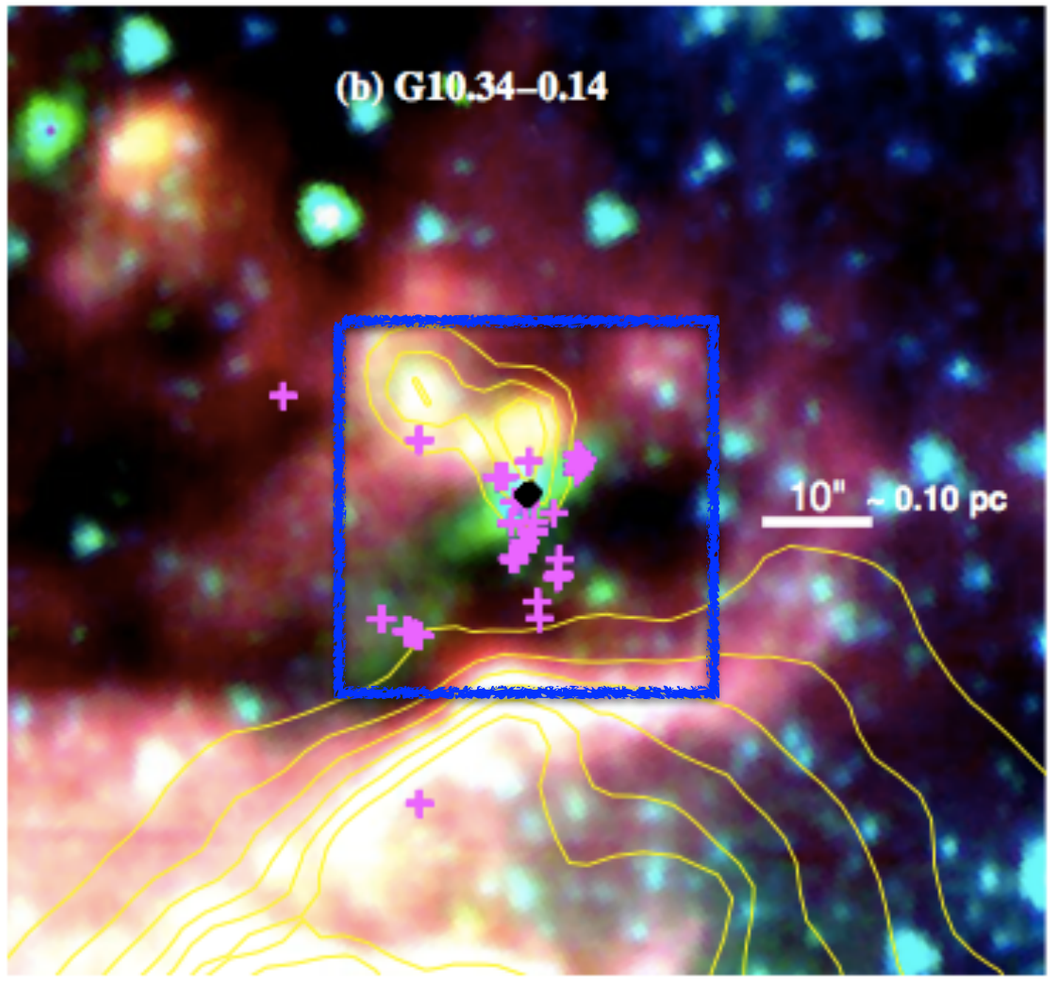
Introduction of G10.34-0.14



Dewangan+15

Spitzer 24um (red),
8.0um (green) 4.5um (blue),
ATLASGAL 870um (white contour)

CN148, W31 complex



Cyganowski+09

GLIMSPSE 8.0um (red), 4.5um (green)
3.6um (blue)
cross : VLA CH3OH masers,
magenta- 44GHz, black - 6.7GHz

Class I : collision

Class II : radiation

<1000AU
disk/core

10-100AU
cloudlet

0.1pc (=20000AU)
core/infall envelope

1pc
cloud

class I CH3OH
44/95GHz
10^5 cm-3
0.1-1pc

class II CH3OH
6.7GHz
10^7 cm-3

OH
10^5-8 cm-3
1-40mG

H2O
10^8-11 cm-3
15-650mG

Class I methanol maser polarisation survey with the KVN single dish

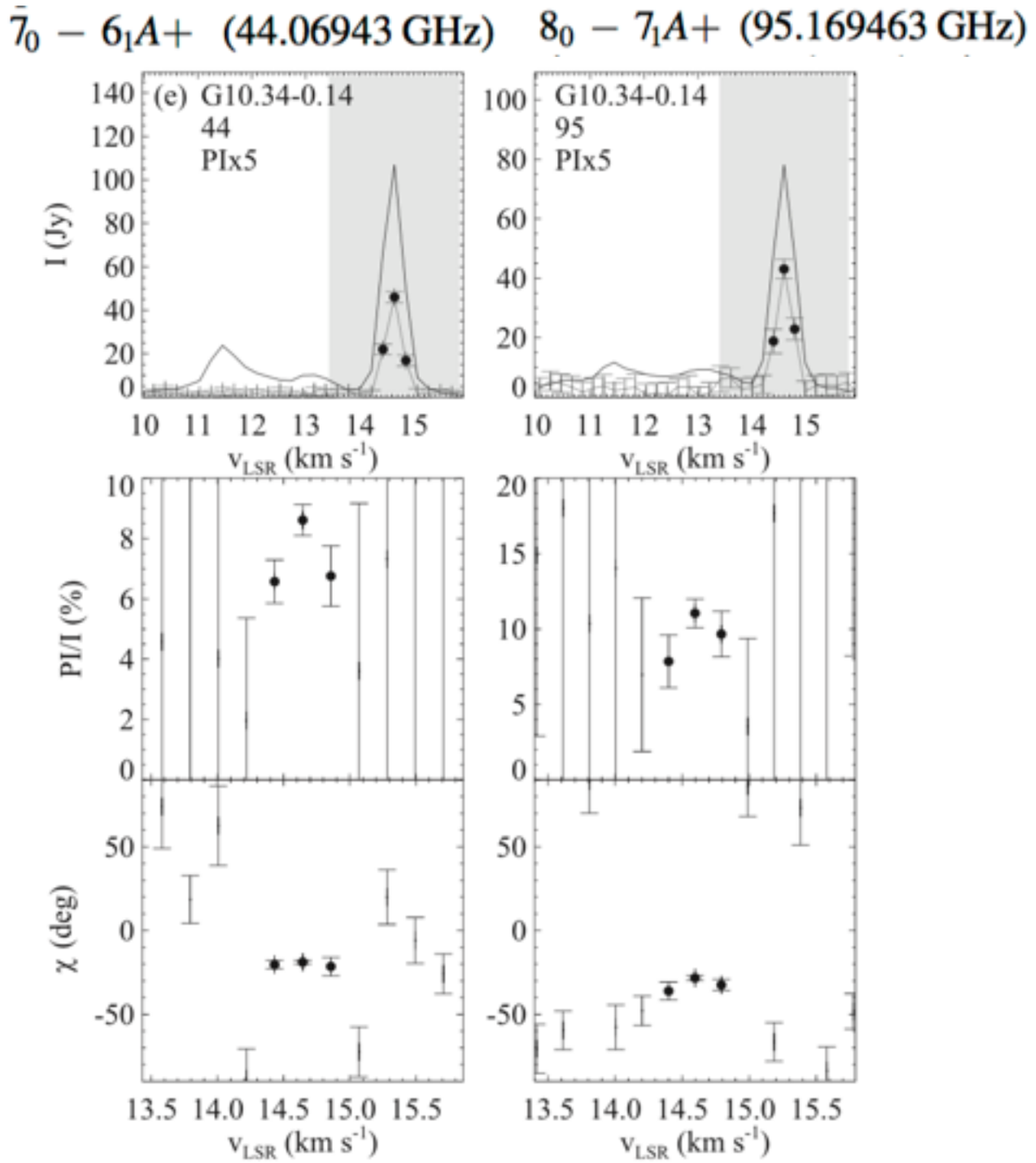
- Maser polarisations : dominated by turbulence ? or larger scale magnetic field ?

- only 3 polarisation papers (3 targets) were published at 44/95GHz CH3OH maser transitions - more observations needed for overall understanding.

- simultaneous polarisation observations in 44 / 95GHz CH3OH maser transitions (Kang+16)

- 39 massive star forming regions > 50 Jy - polarisation detected for 60% sources.

- known to trace similar regions - we confirmed that their polarisation properties are similar as well.



ALMA Cycle 4 Observation

Band 3 Observations
G10.34 : high fractional linear polarization, pol-detected in KVN VLBI.
angular resolution : 0.3” , v resolution : 0.1 km/s

Outlines
1. continuum/methanal lines : morphology and kinematics
2. methanol maser linear polarisation : ALMA 95GHz vs KVN VLBI 44GHz
3. chemical characteristics of mm continuum cores

Ecology of G10.34 studied by ALMA

ALL PRELIMINARY

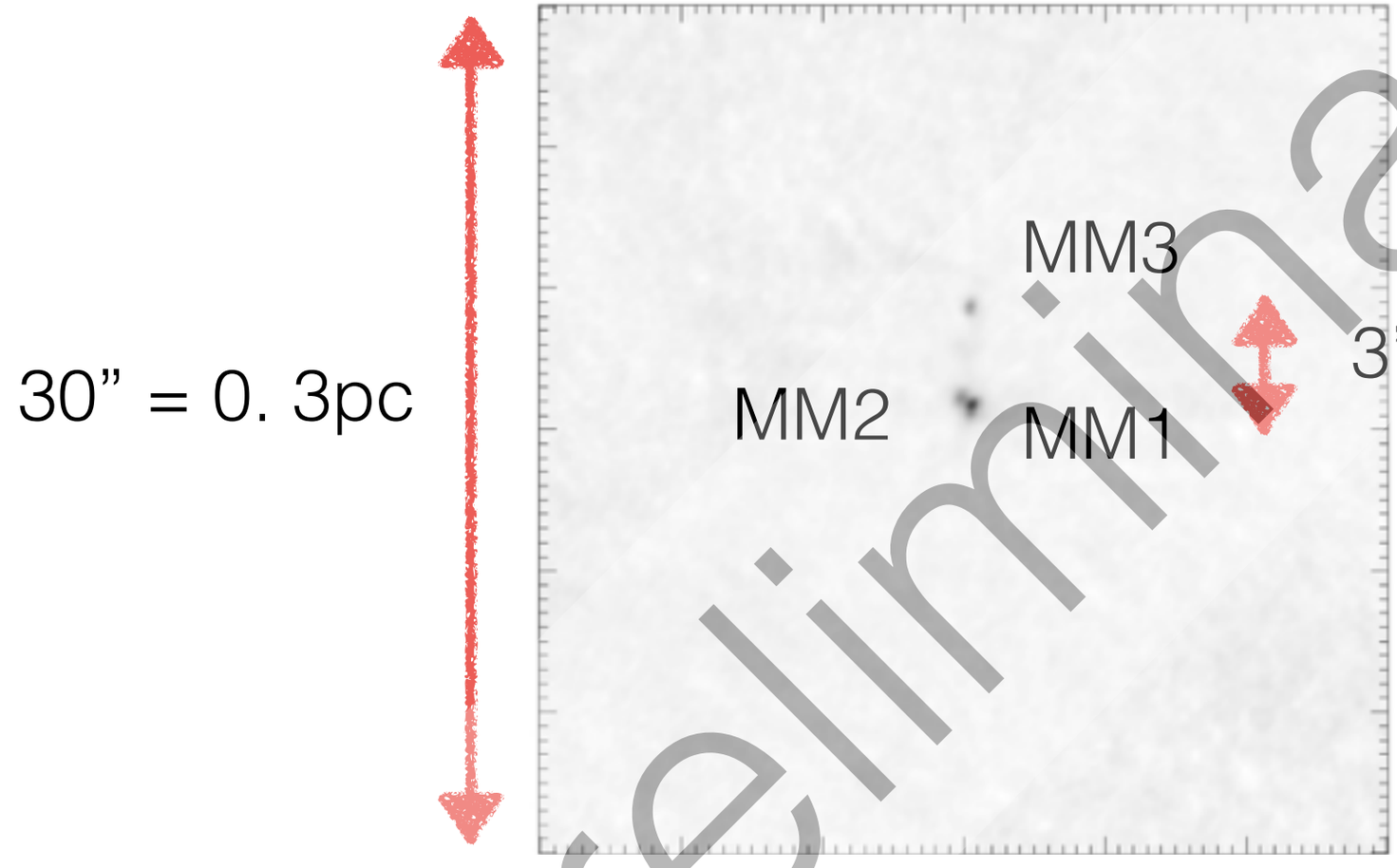
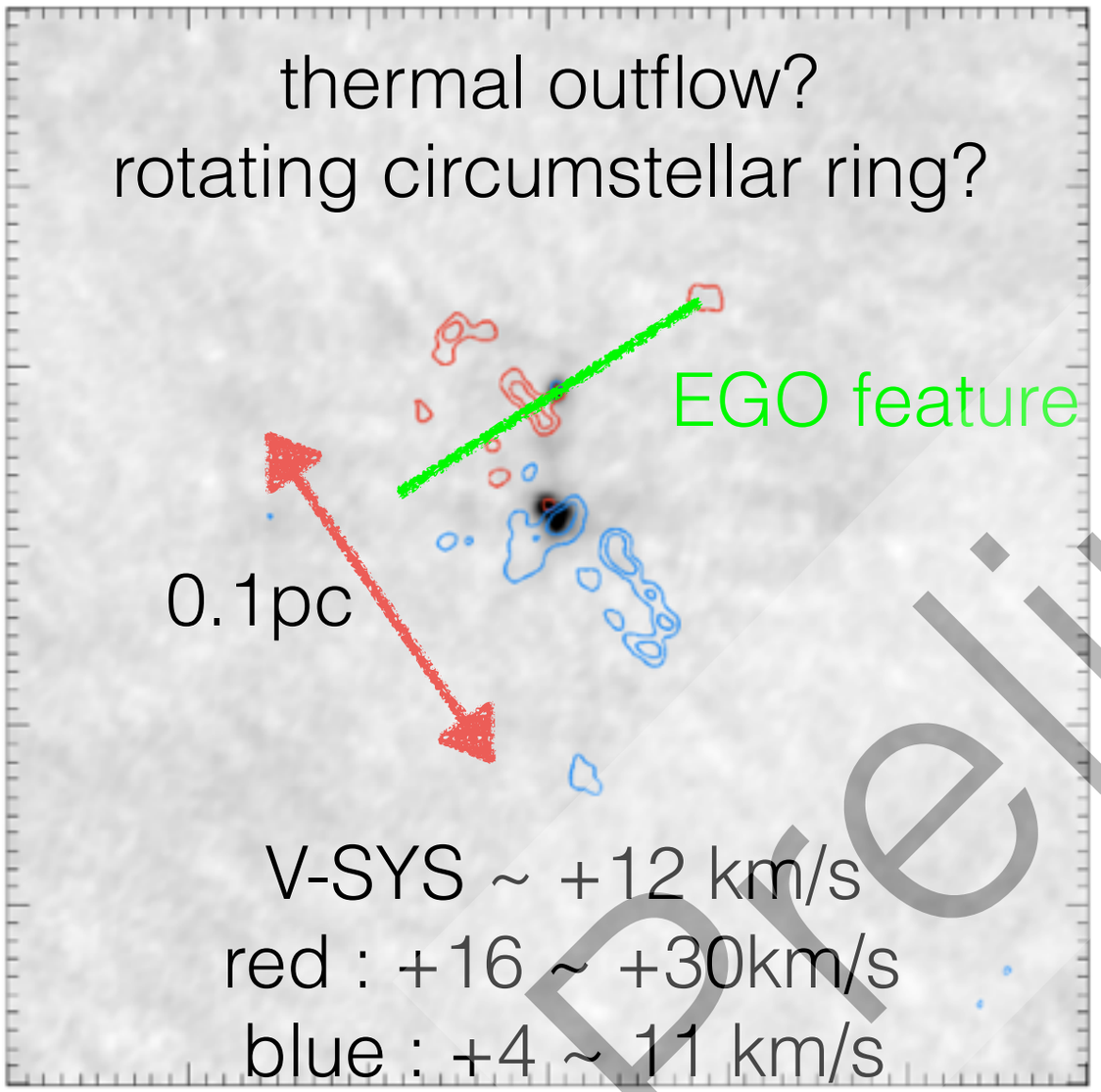


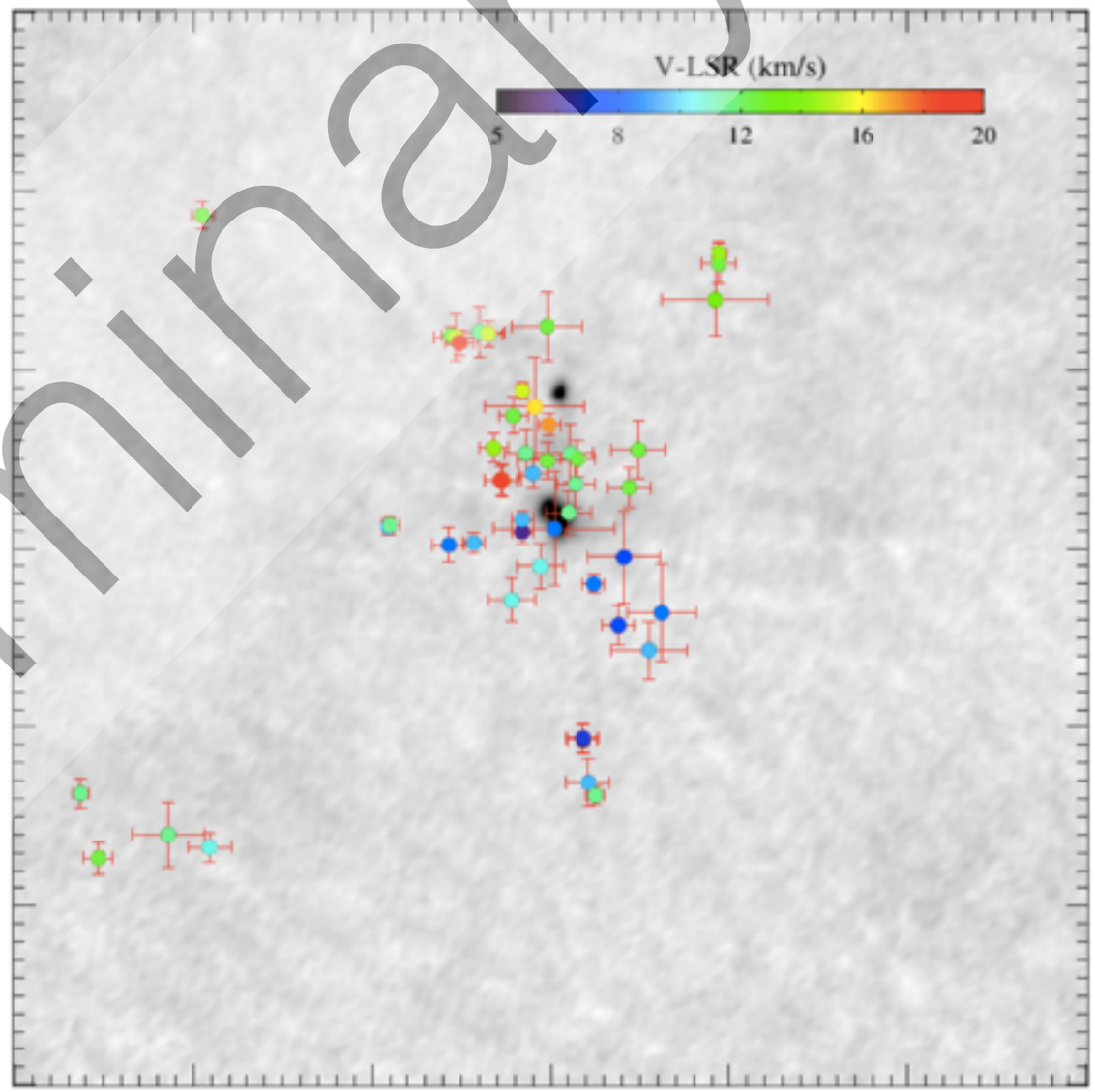
Table 1. Observed Properties of Continuum Sources

Source	Coordinates α (h m s)	Coordinates δ (° ′ ″)	Peak Intensity (mJy beam^{-1})	Flux Density (mJy)	Size (″ × ″)	Note
MM1	18 08 59.980	−20 03 39.14	4.00	8.36	0.50 × 0.40	
MM2	18 09 00.004	−20 03 38.89	2.74	3.53	0.62 × 0.54	
MM3	18 08 59.983	−20 03 35.66	2.26	3.91	0.46 × 0.36	

thermal / maser CH3OH

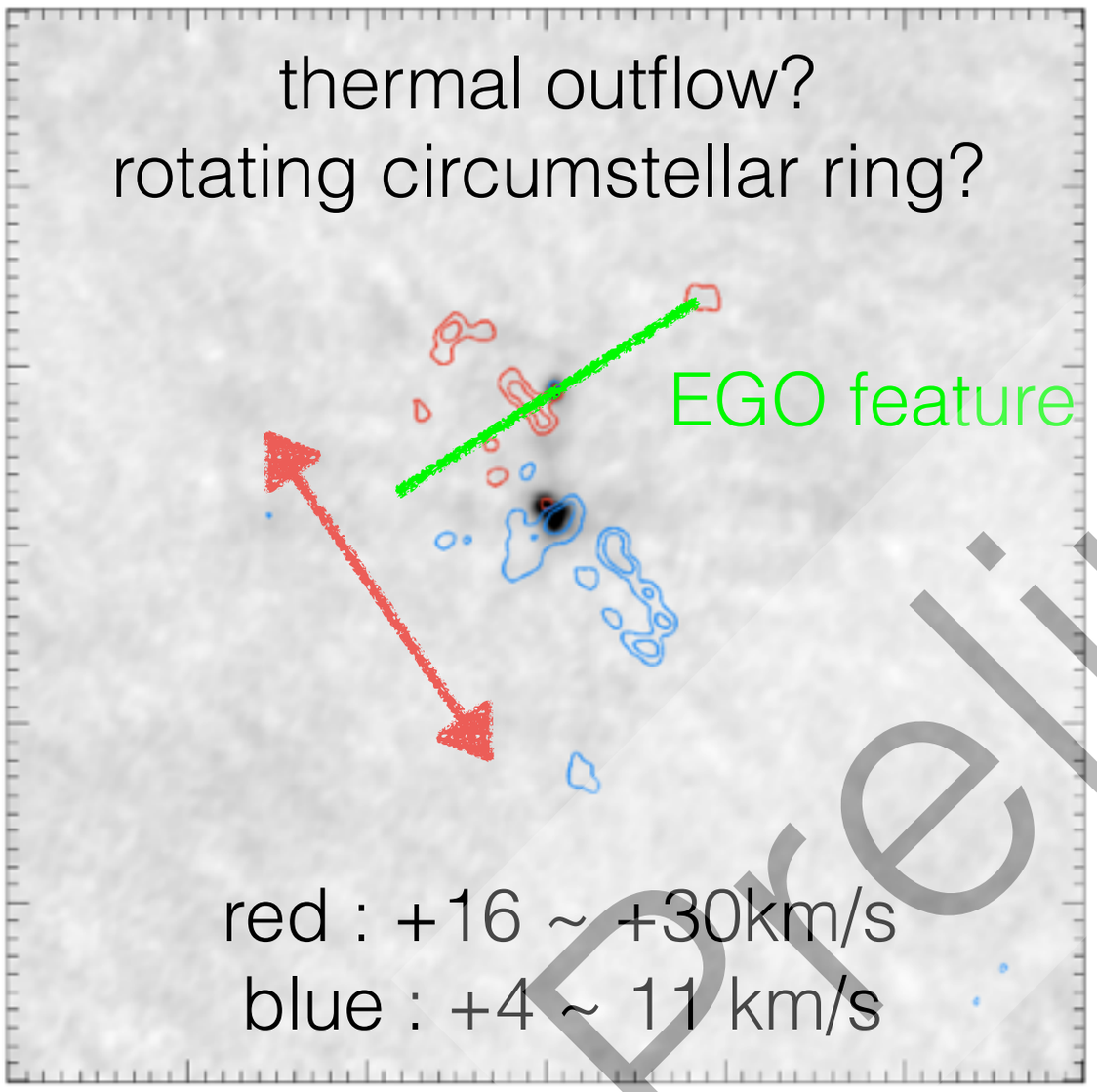
$8_0 - 7_1A+$ (95.169463 GHz)

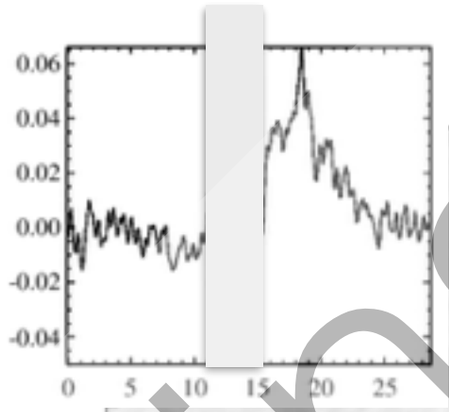


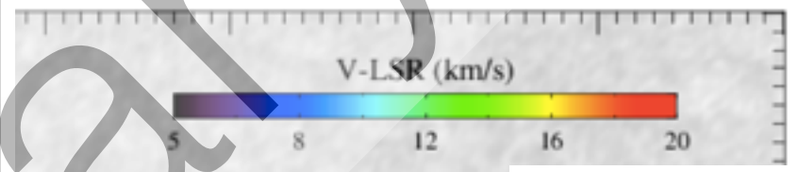


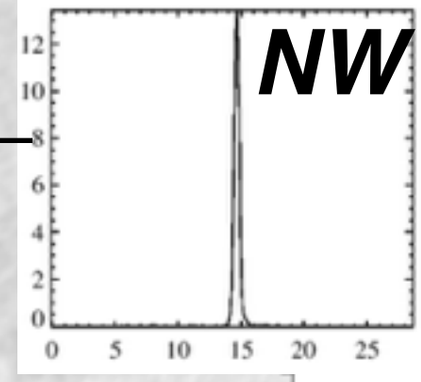
thermal / maser CH3OH

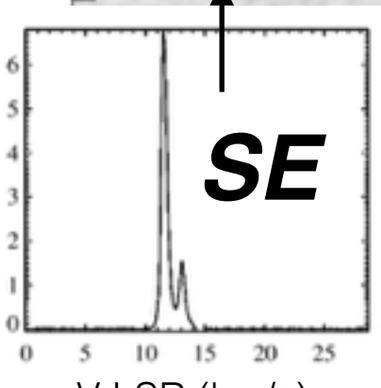
$8_0 - 7_1A+$ (95.169463 GHz)

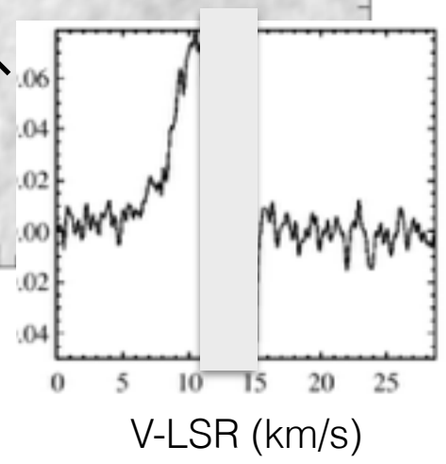




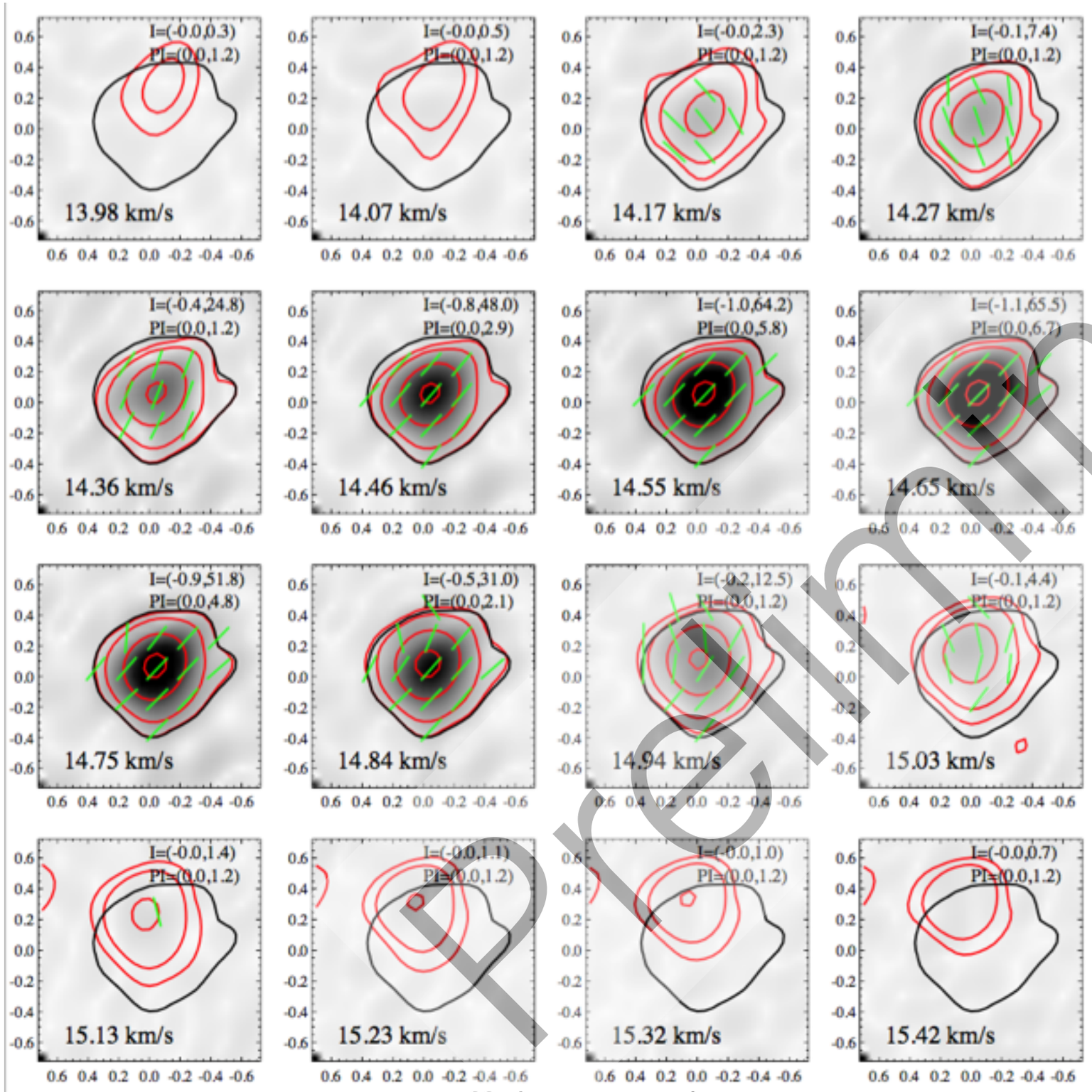


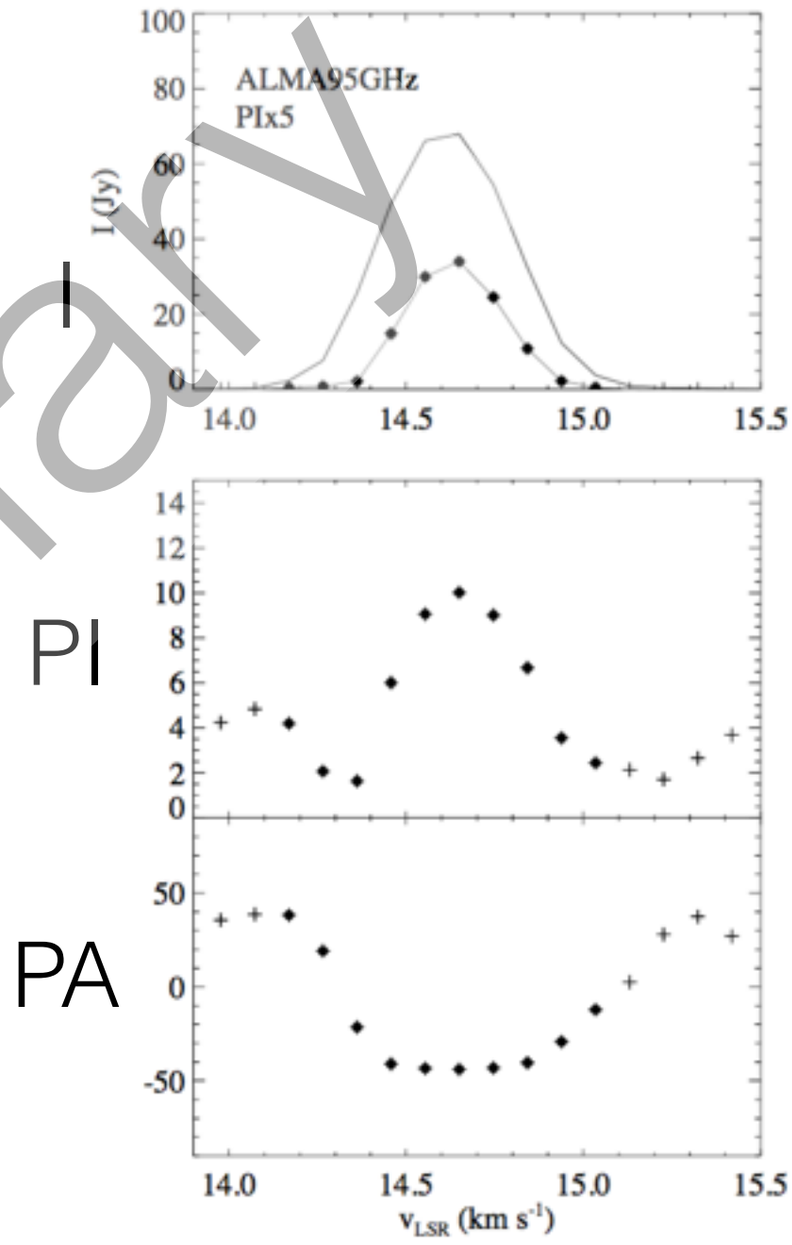






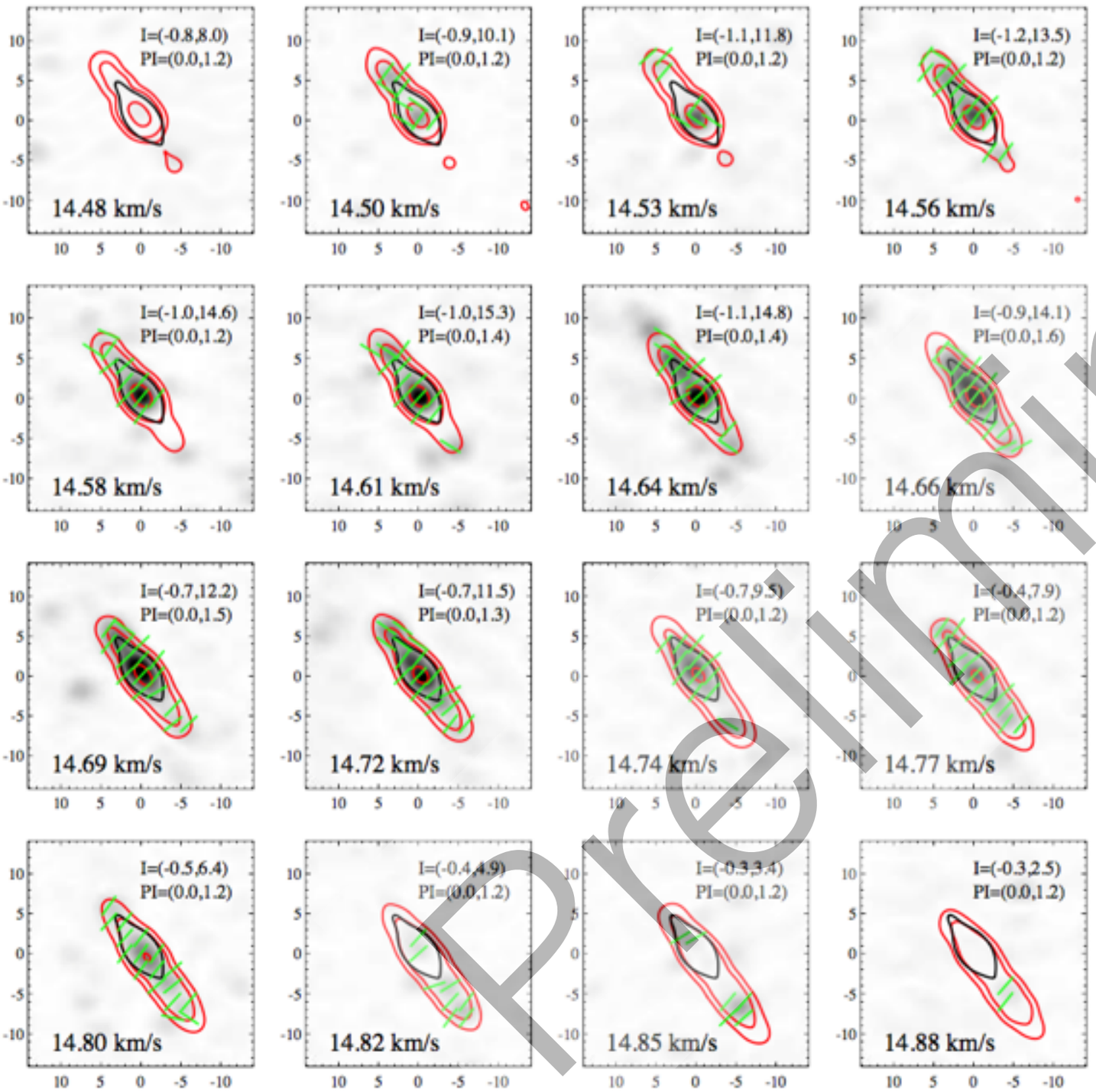
Maser polarisation (NW maser)

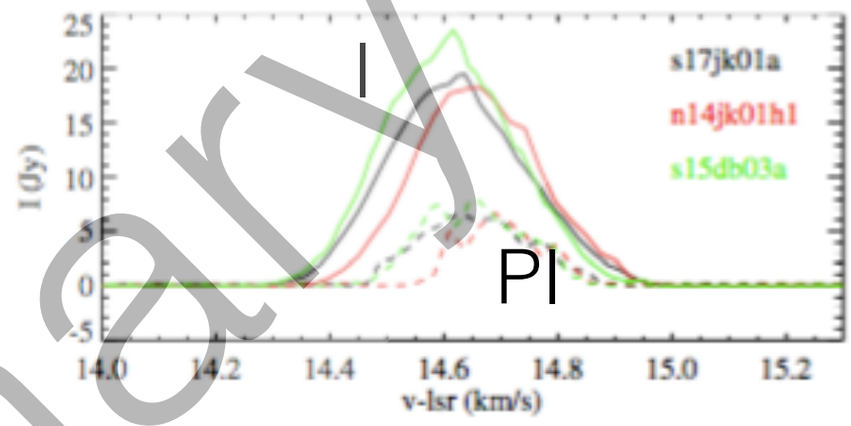


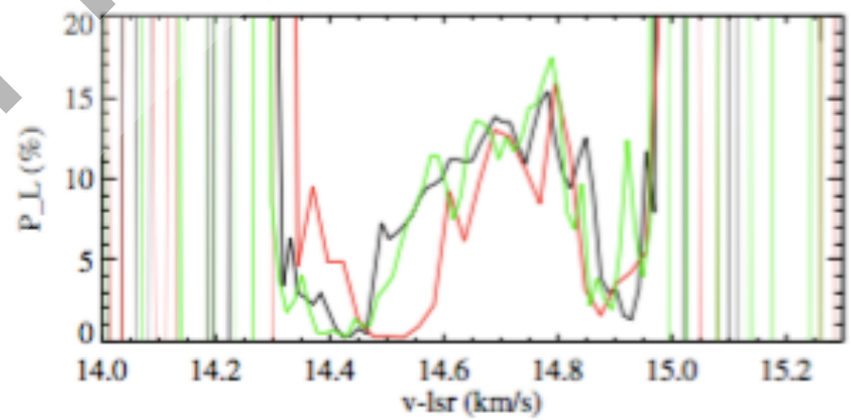


0”.5 = 0.005pc, 1000AU

KVN VLBI polarisation (NW maser)





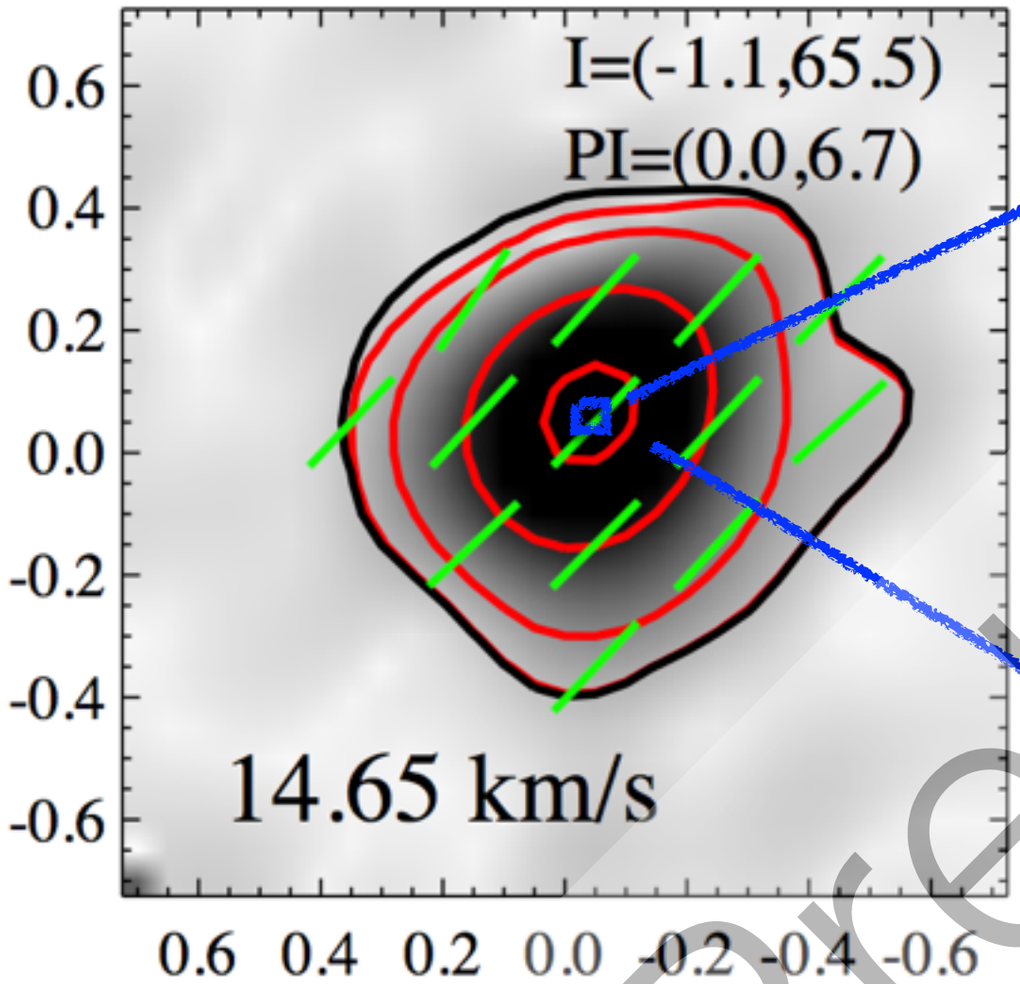


Kang+ in prep.

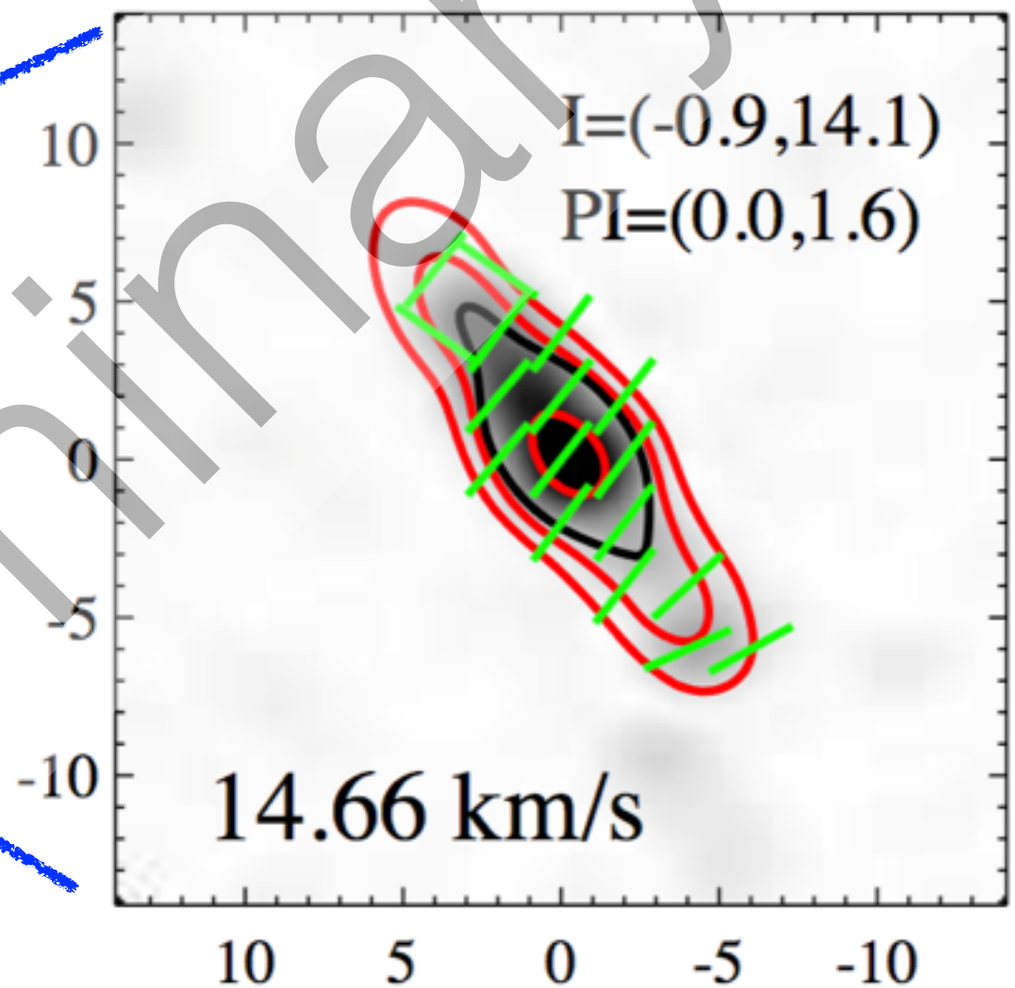
10mas = 20AU

ALMA vs KVN (600 AU to 6 AU)

95 GHz CH3OH



44 GHz CH3OH

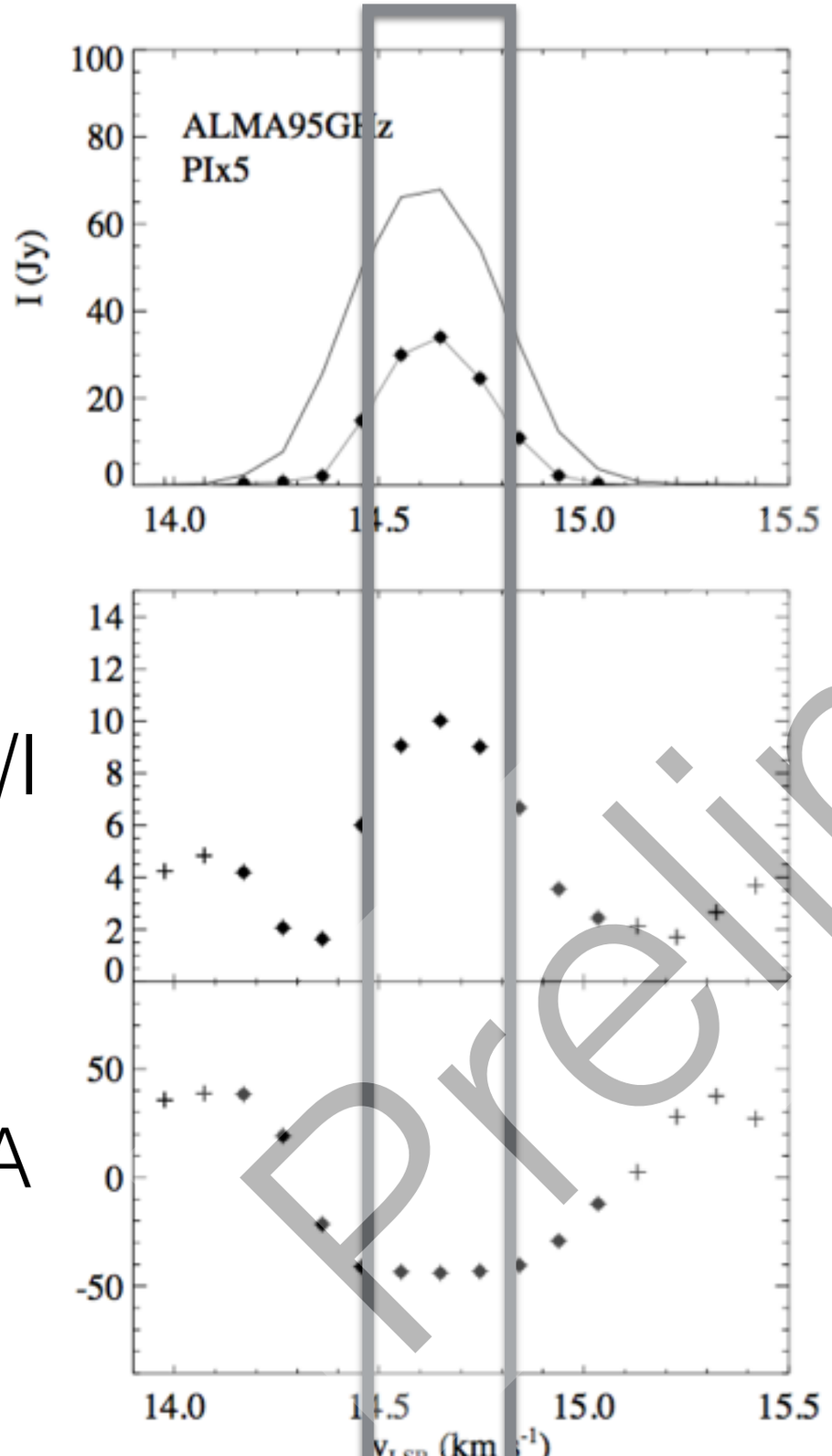


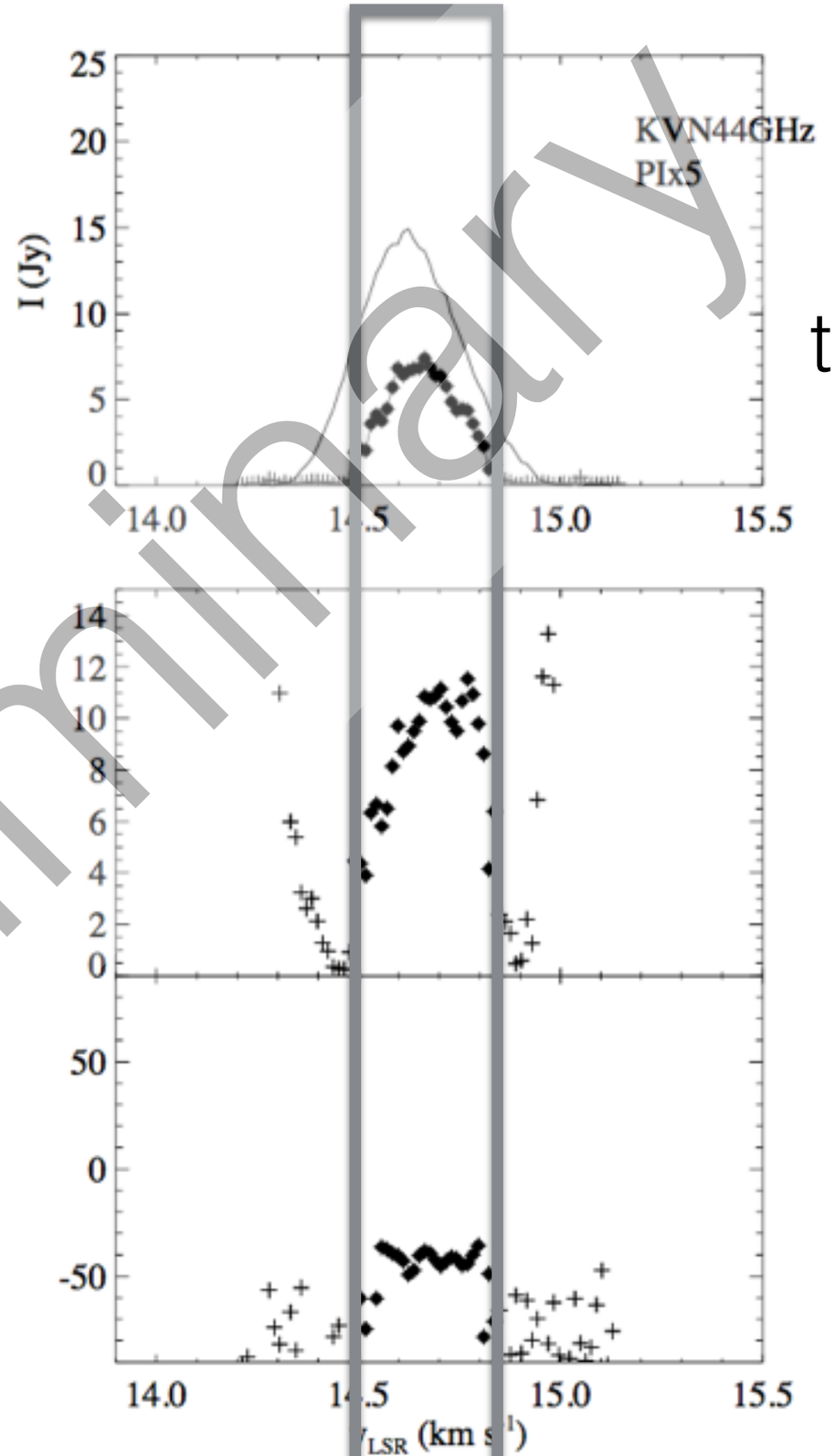
PA_ALMA,95GHz ~ - 44°
PA_KVNSD,95GHz = -29±3°

PA_KVNVLBI,44GHz ~ - 38°
PA_KVNSD,44GHz = -19±3°

ALMA vs KVN

I



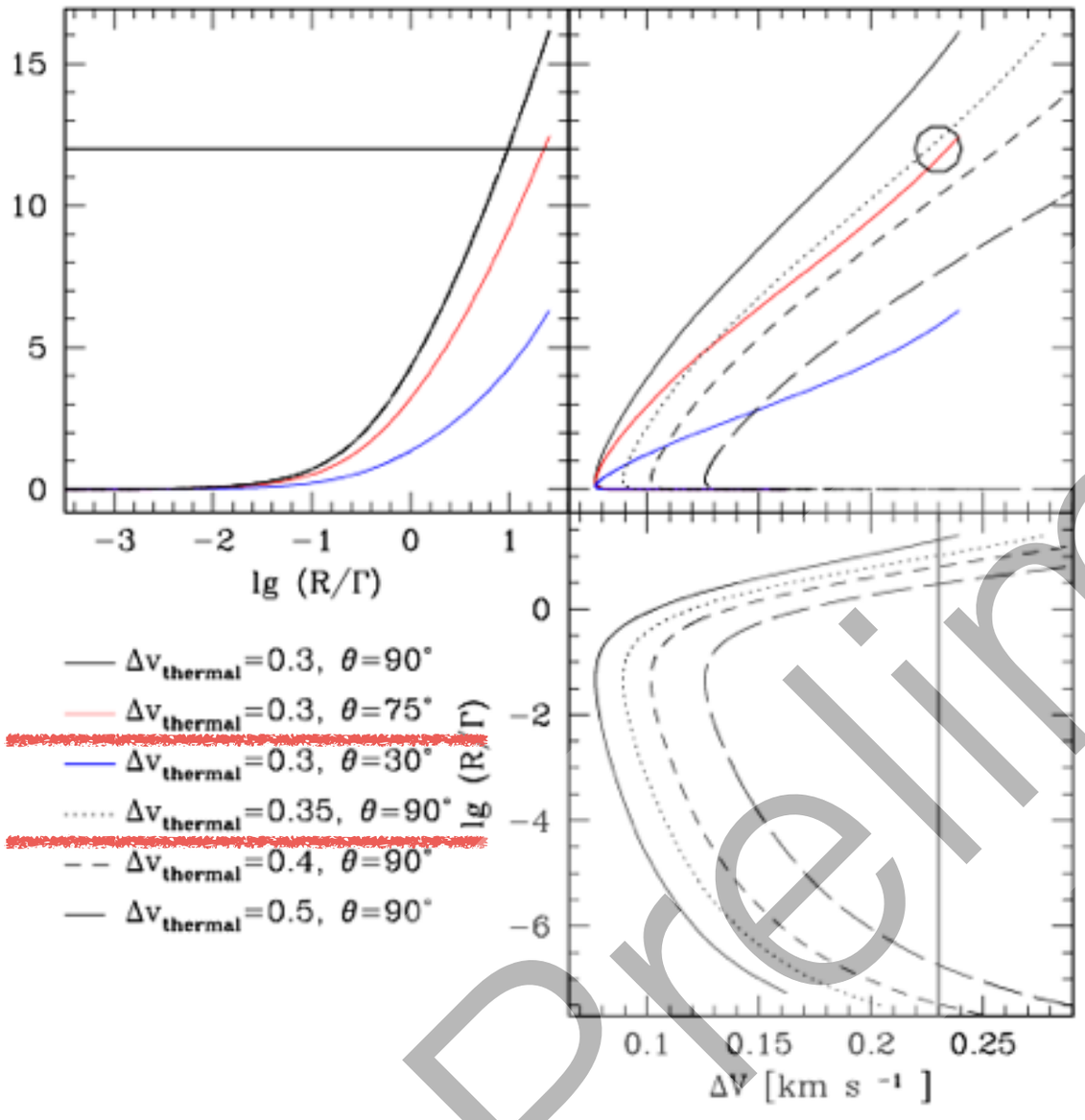


20% of total flux

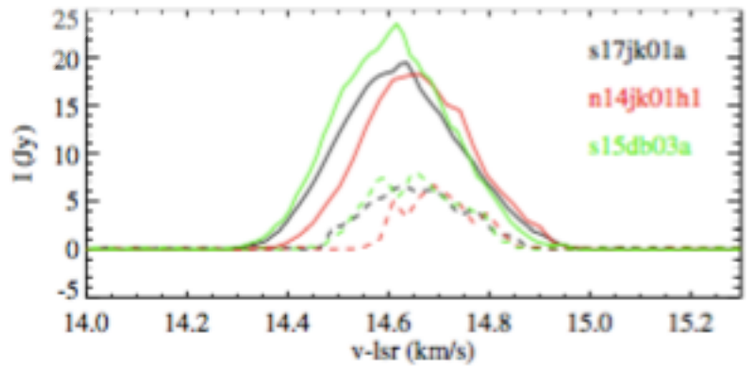
PI/I

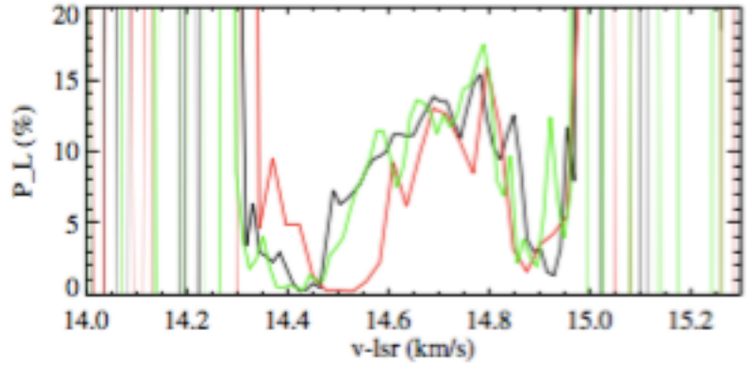
PA

Physical Parameters of 6AU-sized maser



- Full Radiative Transfer Code (Wouter Vlemmings +)
- Magnetic field in sky plane, thermal width of ~ 0.3 km/s ~ 140K
- moderately saturated.

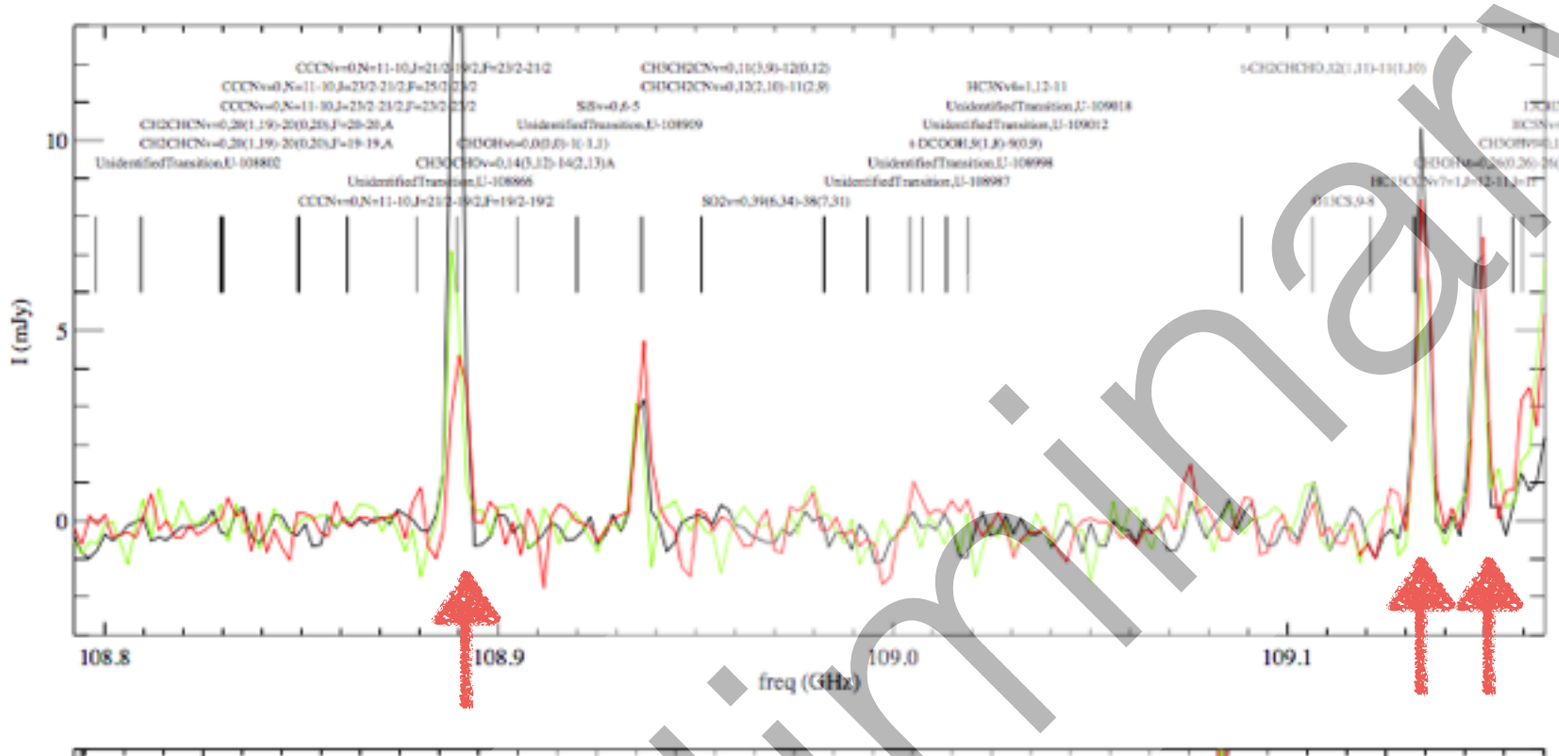




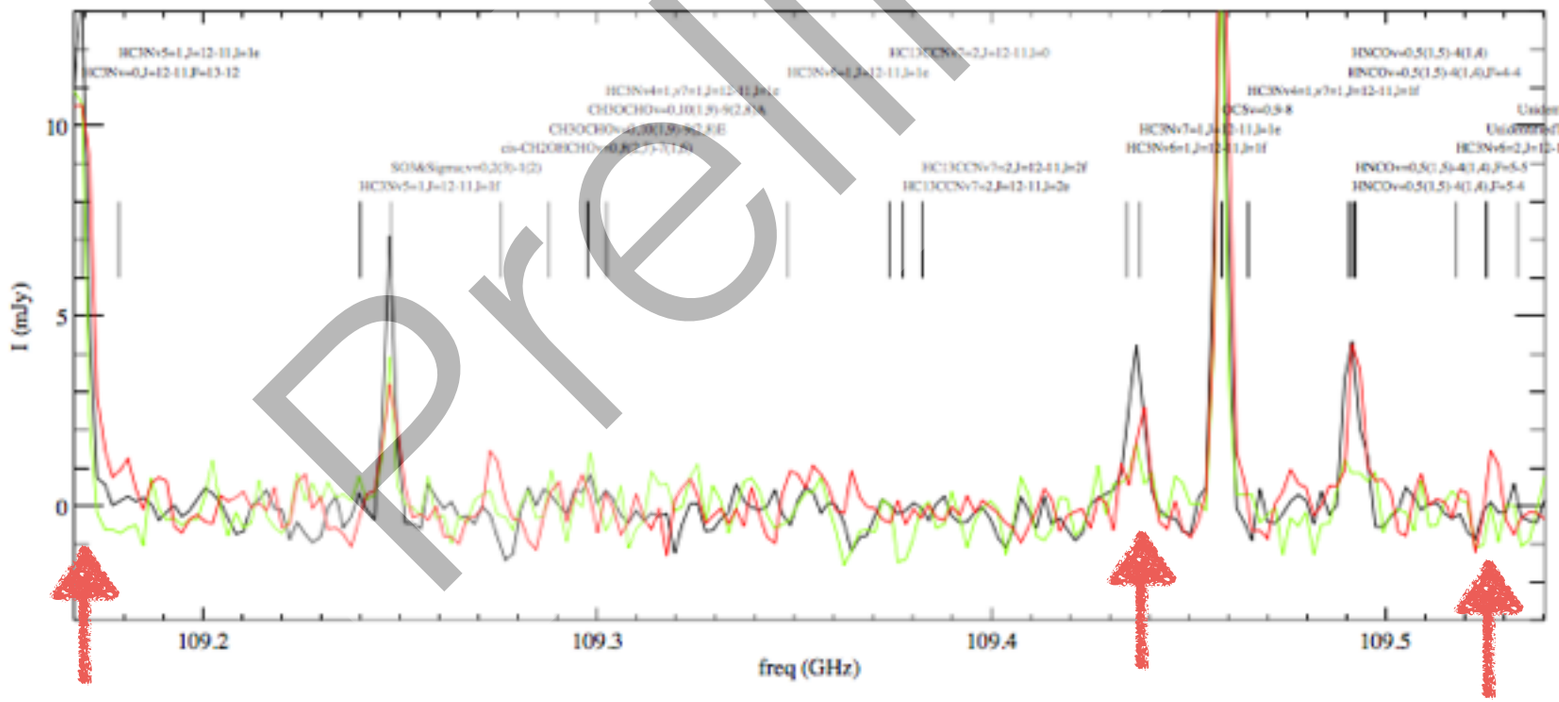
Kang+ in prep.

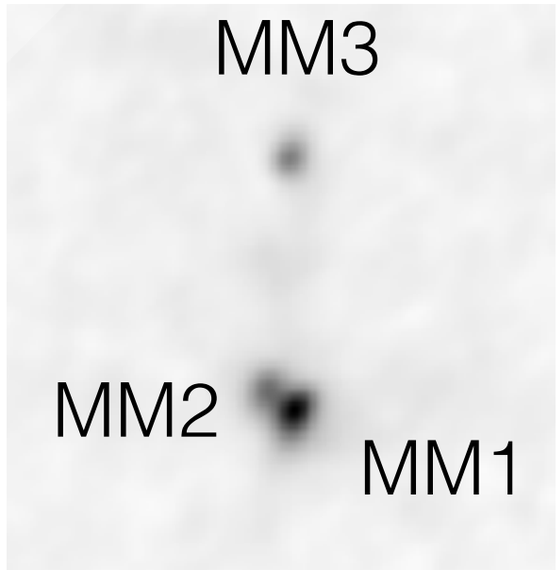
Chemistry and evolutionary stages of 3 continuum sources

CH3OH



HC3N





Black-MM3
Green-MM2
Red-MM1

Summary & Future Works

- Consistent magnetic field orientation from 6 AU to 1000 AU for class I methanol masers.

- Follow-up high resolution polarisation observations to understand the gap btw 6AU to 600 AU

- Fine comparison btw 44 and 95 masers/Chemistry of 3 mm continuum cores/Stokes V studies.

- Collaborations are welcomed!