Spatio-kinematic structure at the base of the protostellar jet from L1448C(N)

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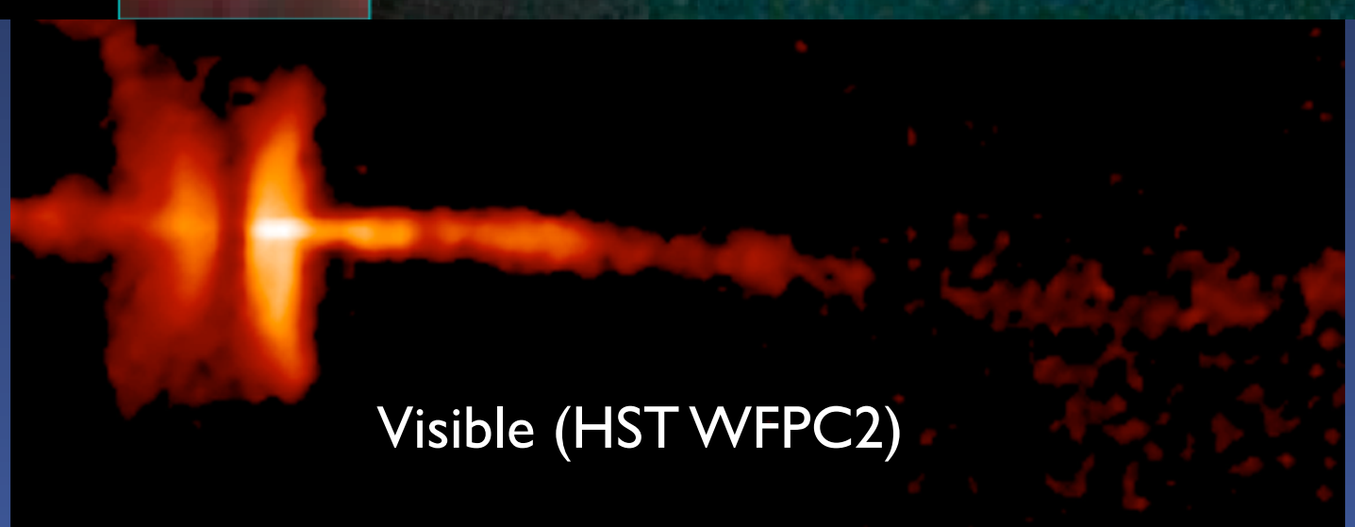
Highly collimated jets from YSOs

Class 0: HH212

Class I: HH111

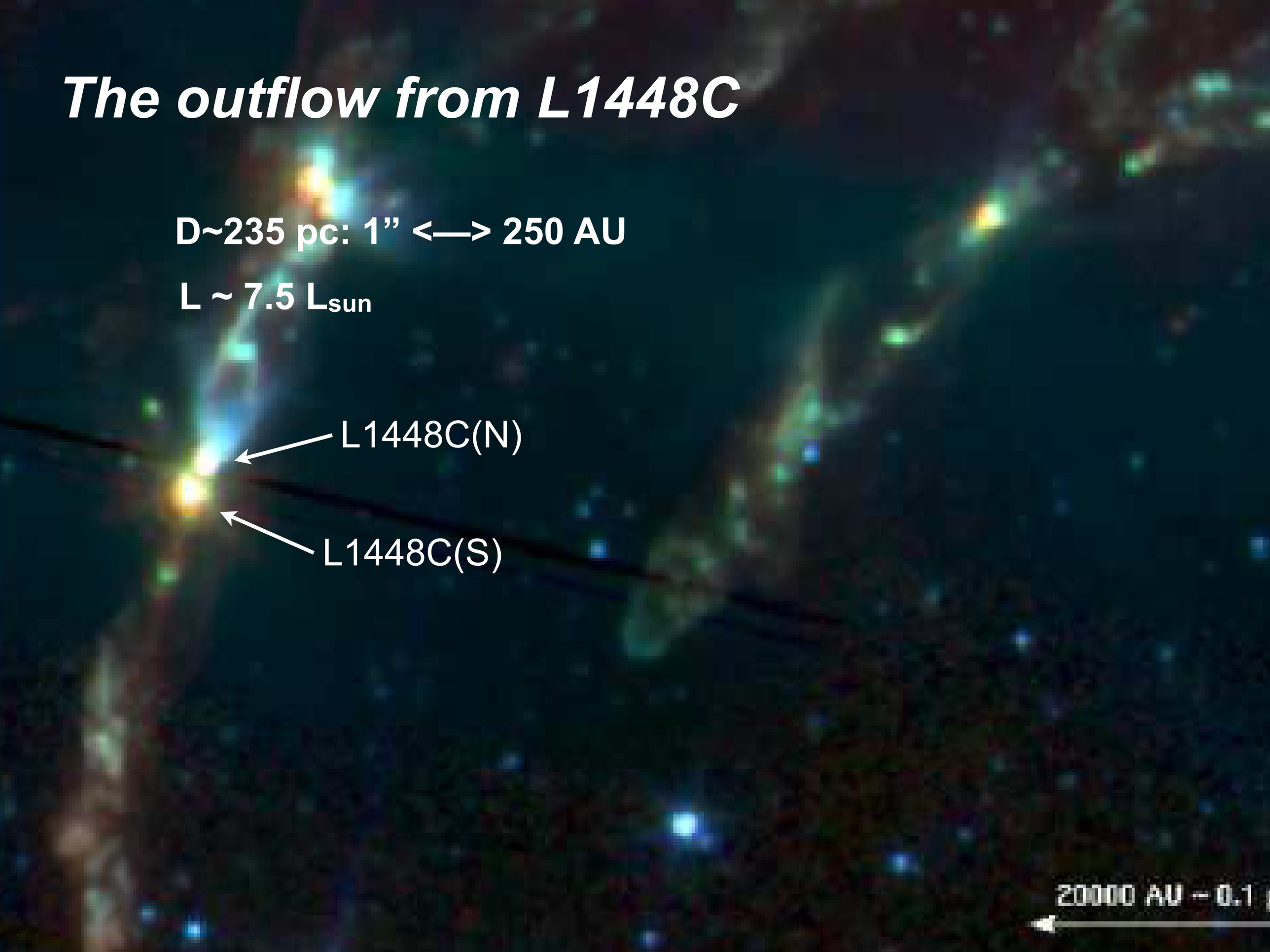


Class II: HH30

The outflow from L1448C

D~235 pc: 1” <—> 250 AU

L ~ 7.5 L_{sun}



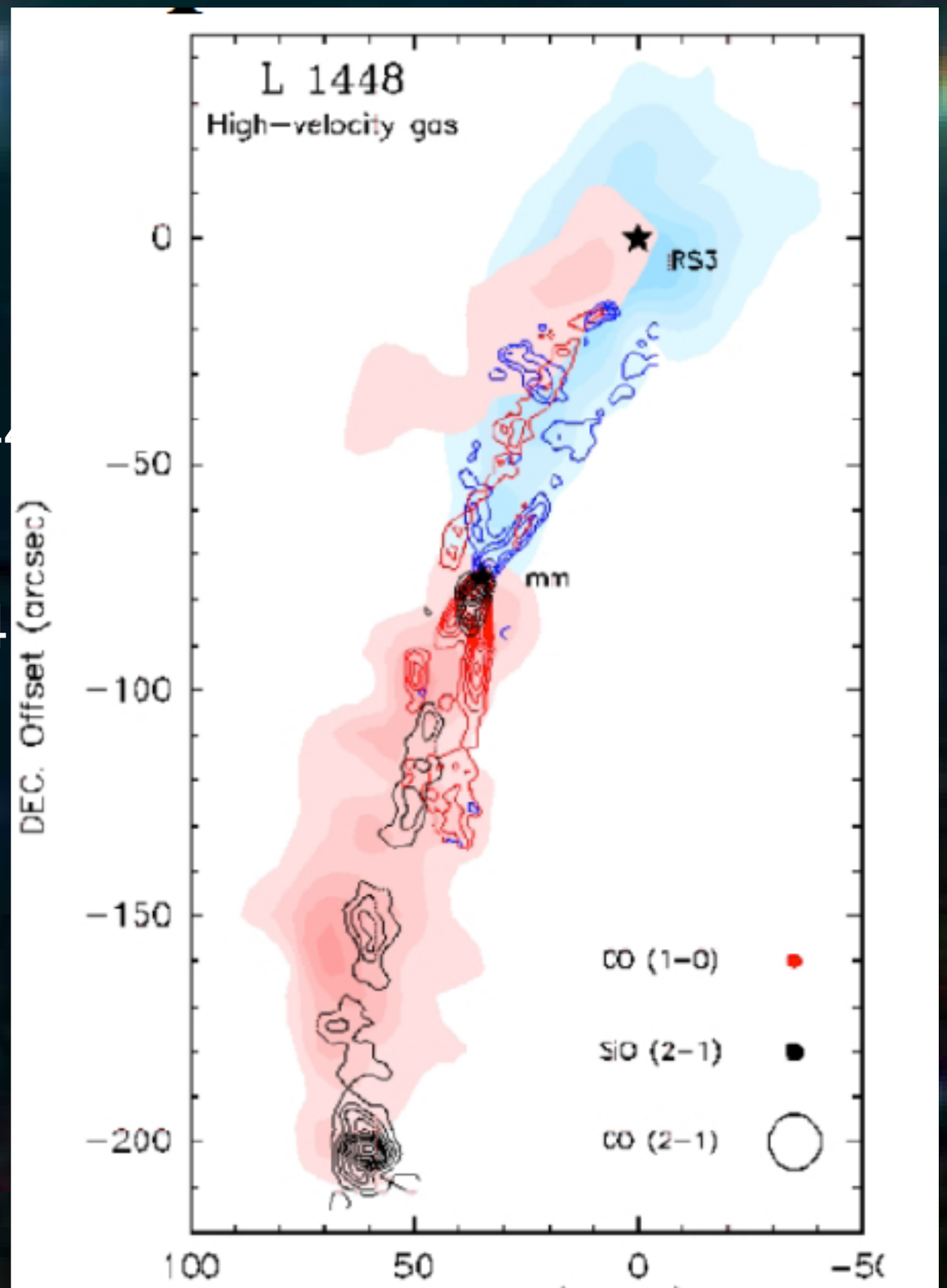
The outflow from L1448C

D~235 pc: 1”

L ~ 7.5 L_{sun}

L144

L144

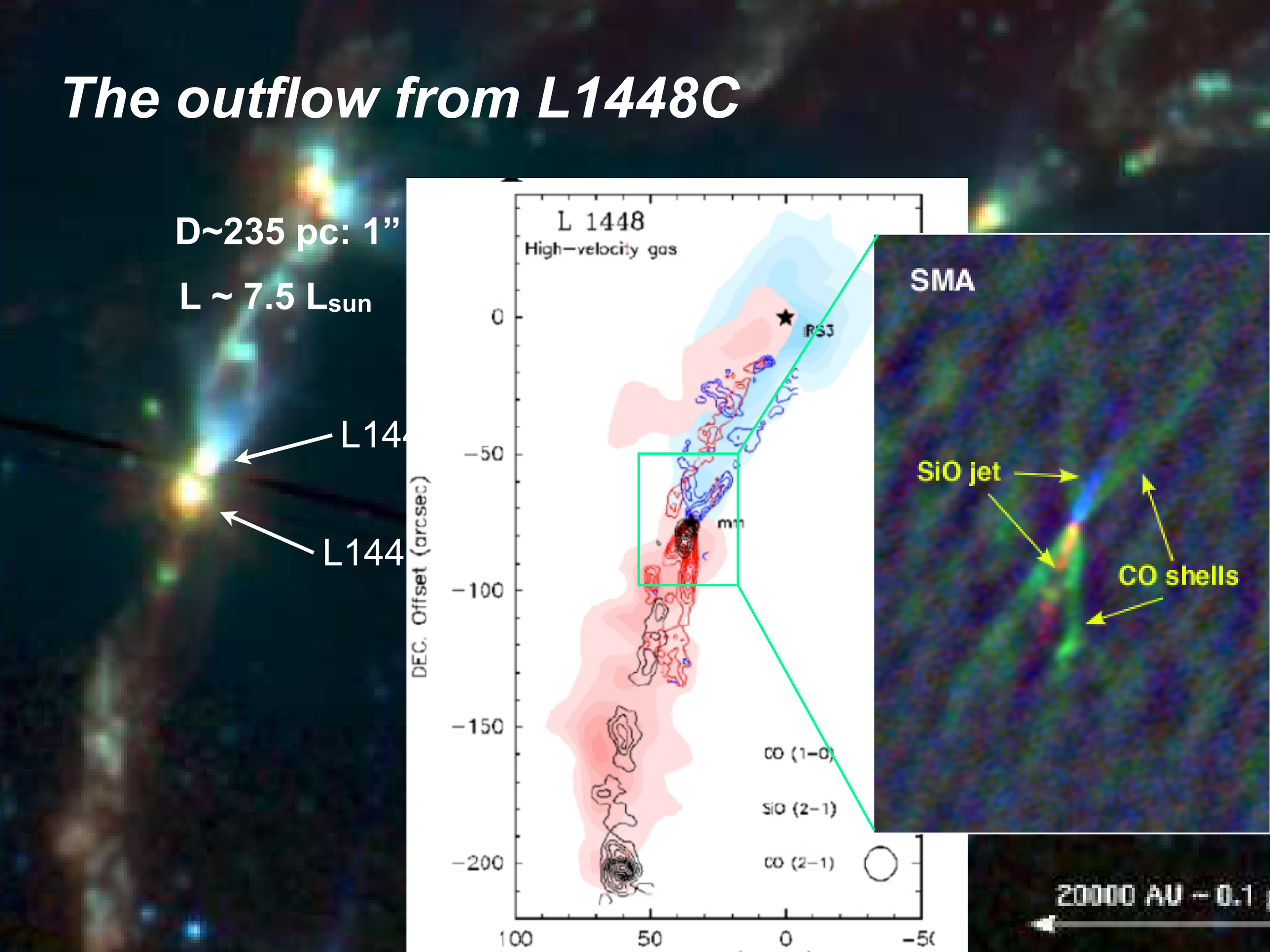


20000 AU ~ 0.1

The outflow from L1448C

D~235 pc: 1”

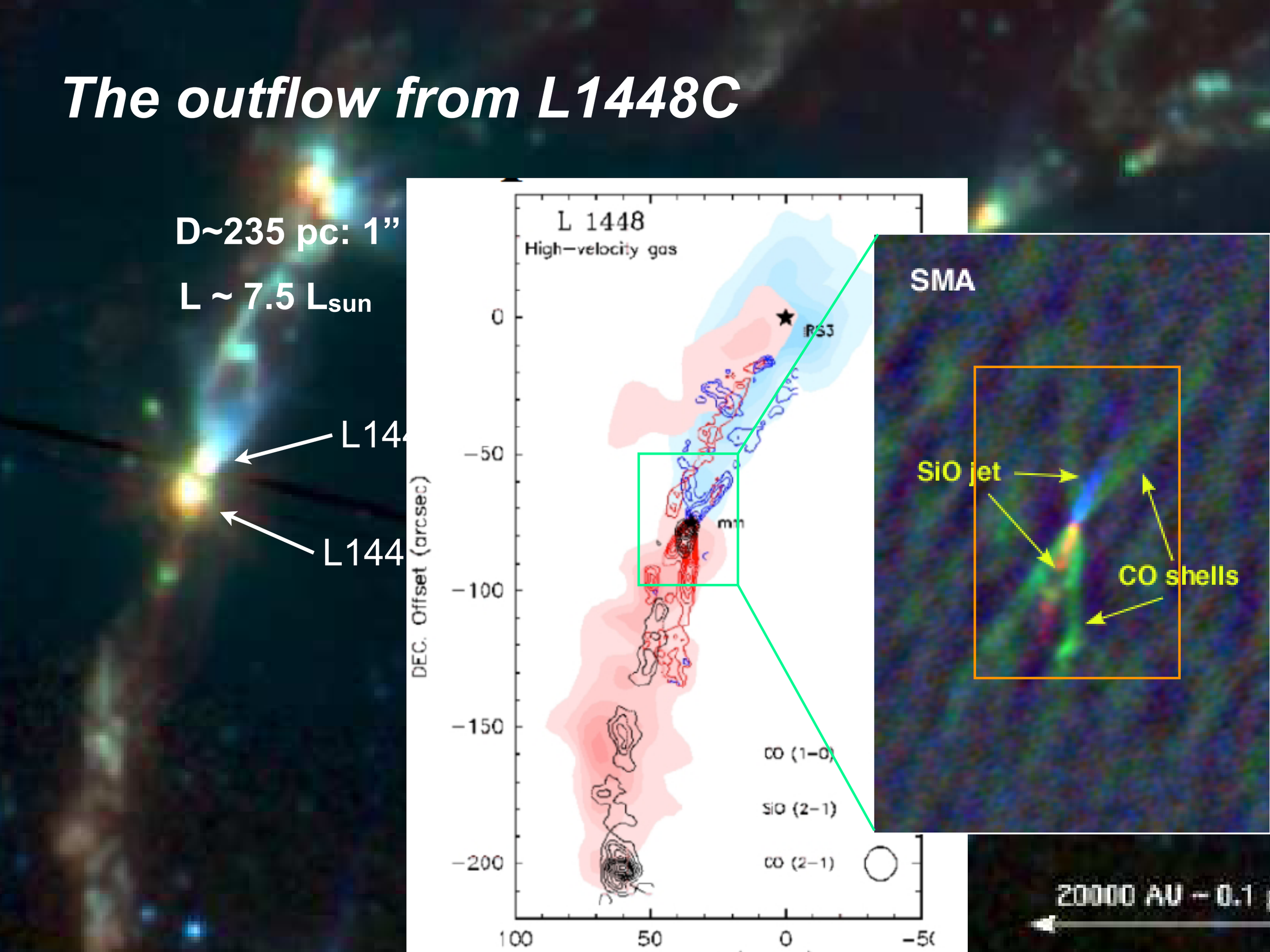
L ~ 7.5 L_{sun}



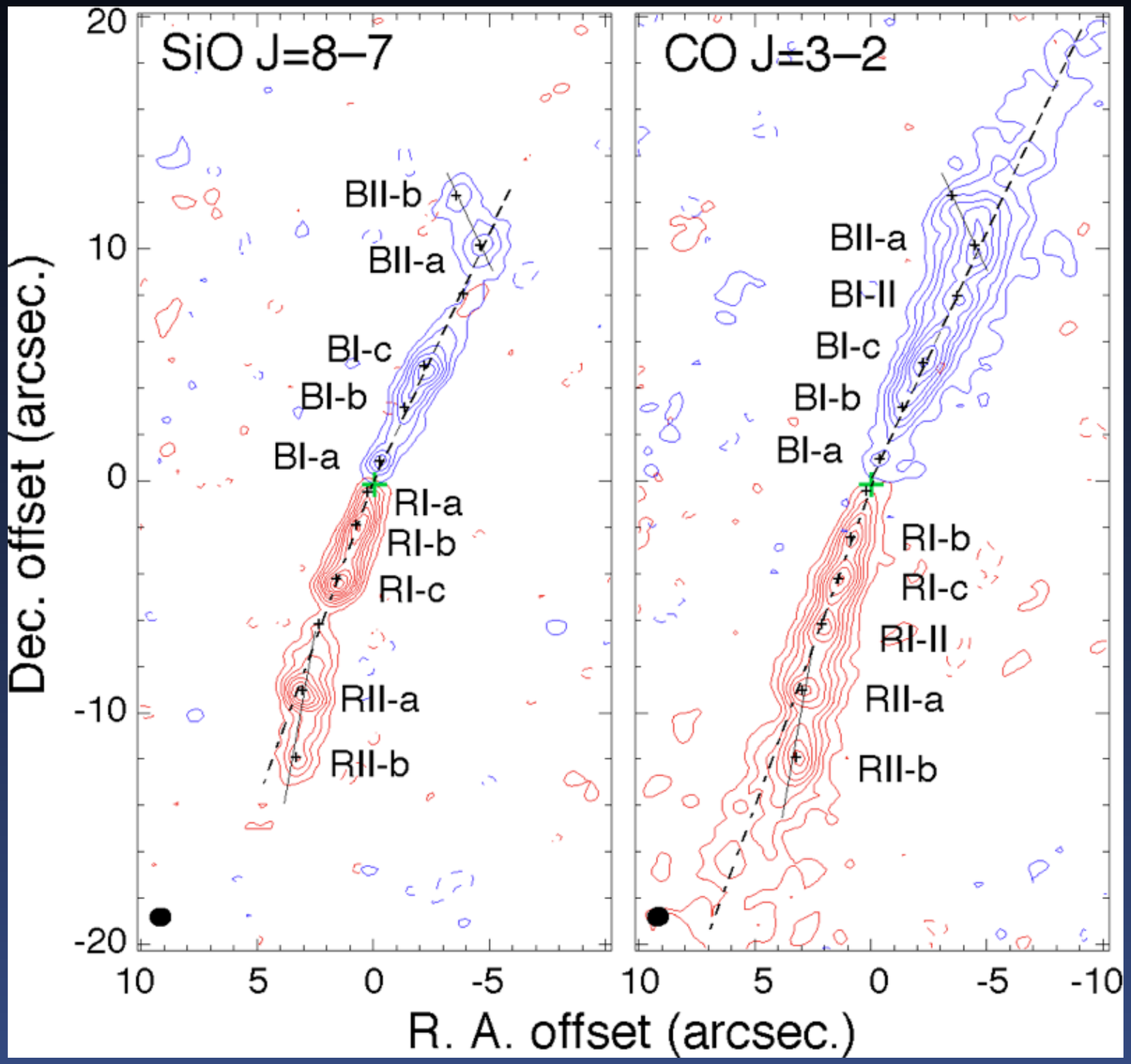
The outflow from L1448C

D~235 pc: 1”

L ~ 7.5 L_{sun}



The EHV molecular jet from L1448C(N)



~1" (235 AU) resolution

Hirano et al. (2010)

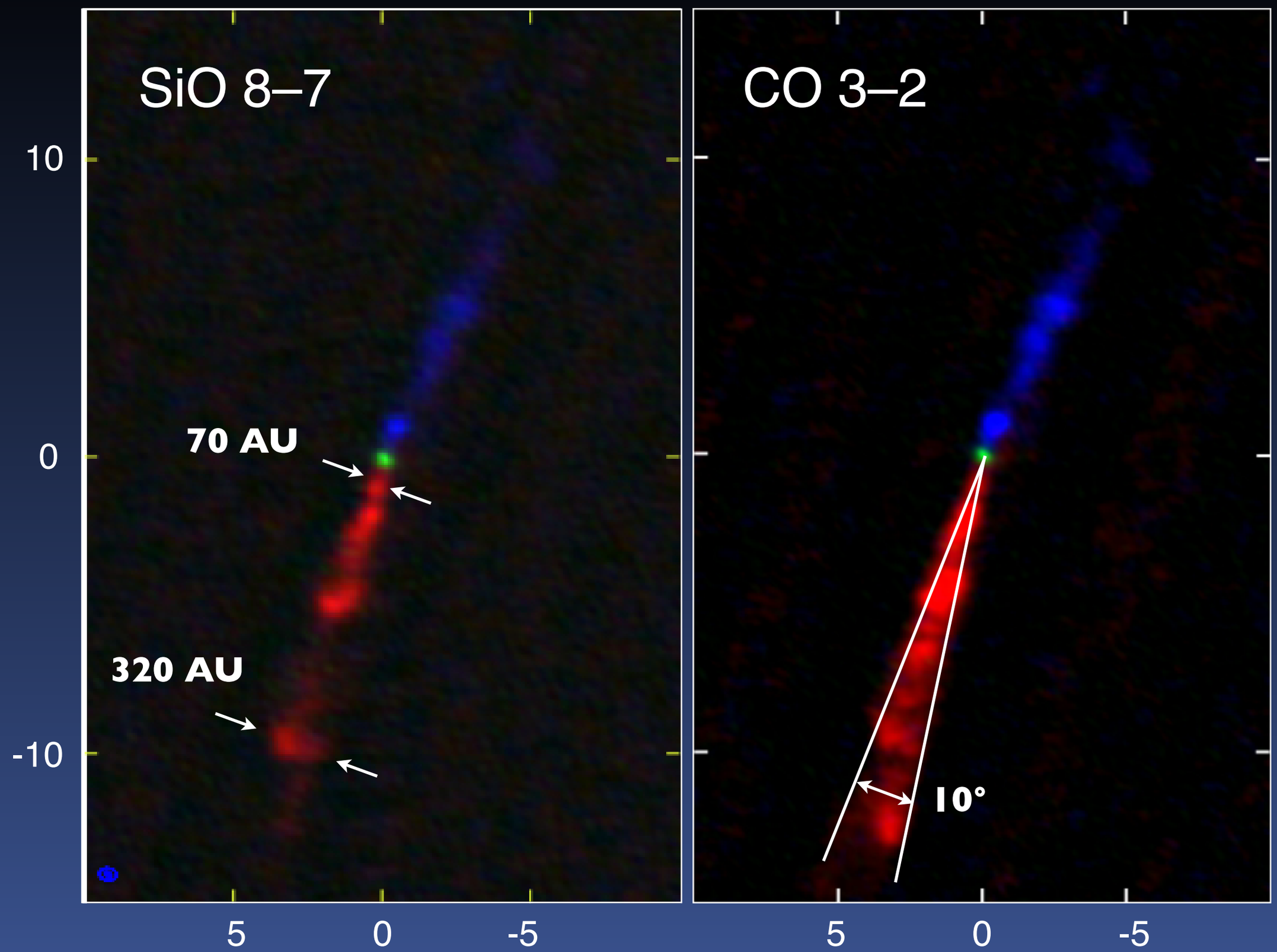
The jet consists of a chain of emission knots
inter knots spacing ~ 2" (500 AU)

Zooming up the EHV jet with the SMA @ VEX configuration

Longest baseline : 509 m

angular resolution: ~0.3” @ 345 GHz

The EHV molecular jet from L1448C(N)

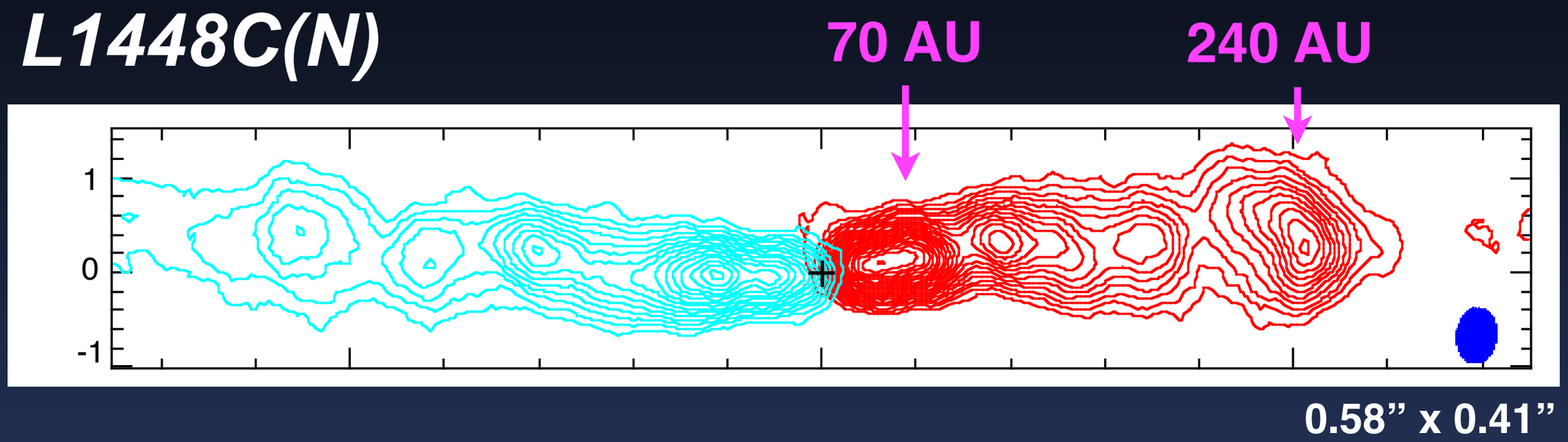


~0.5” (125 AU) resolution

beam: 0.58” x 0.41”

Collimation of the jet

L1448C(N)

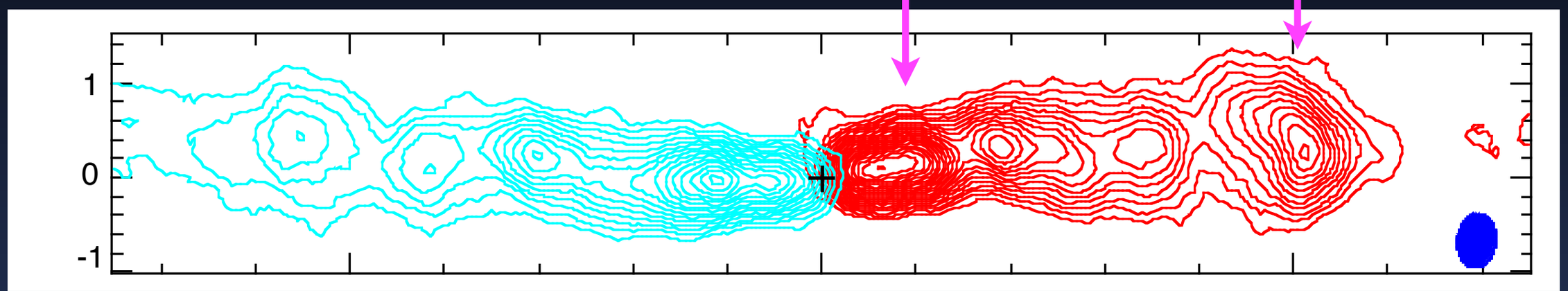


Collimation of the jet

L1448C(N)

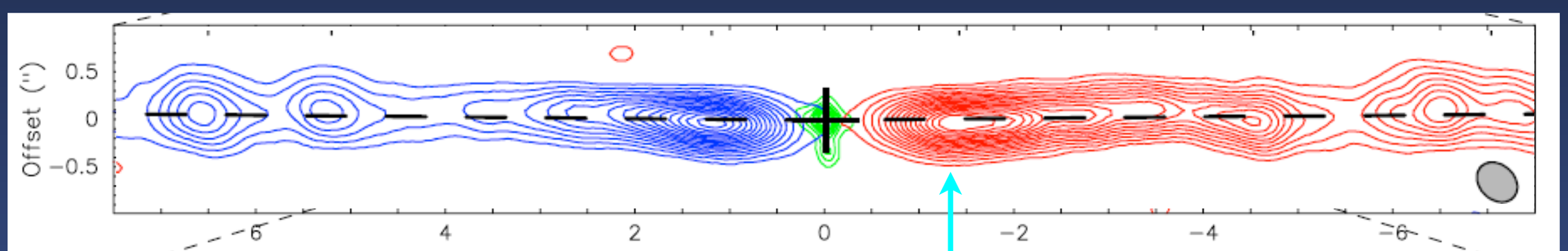
70 AU

240 AU



0.58” x 0.41”

HH211



< 40 AU

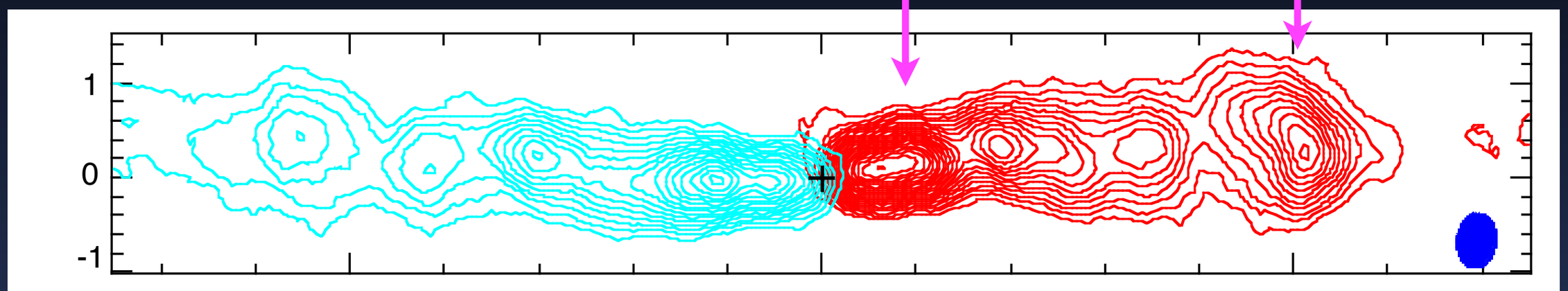
0.46” x 0.36”

Collimation of the jet

L1448C(N)

70 AU

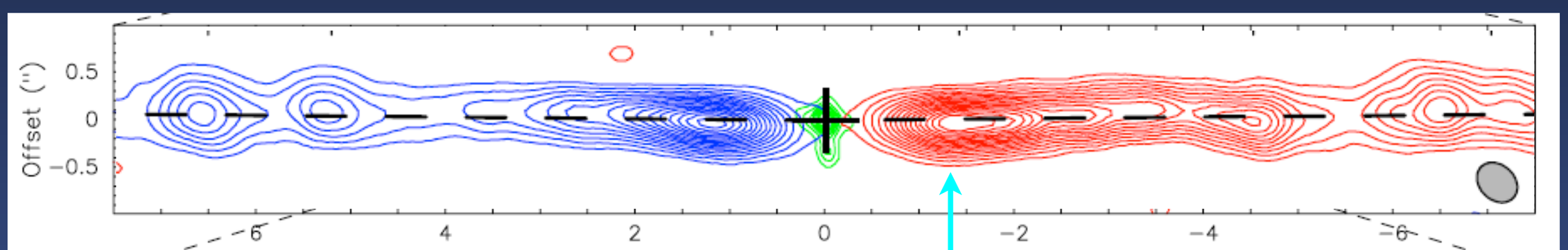
240 AU



0.58” x 0.41”

HH211

narrower



< 40 AU

0.46” x 0.36”

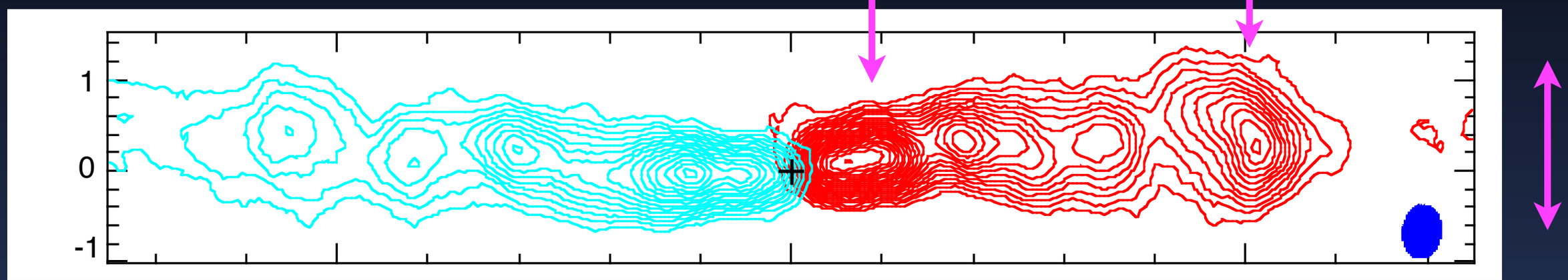
Collimation of the jet

L1448C(N)

70 AU

240 AU

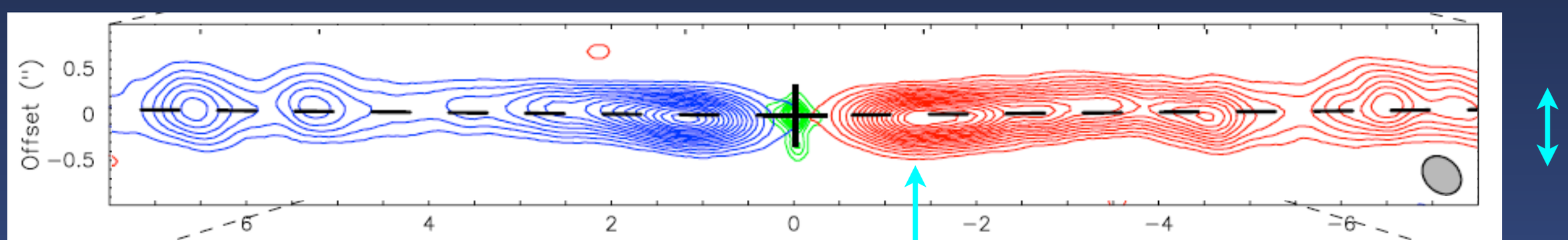
wider



0.58” x 0.41”

HH211

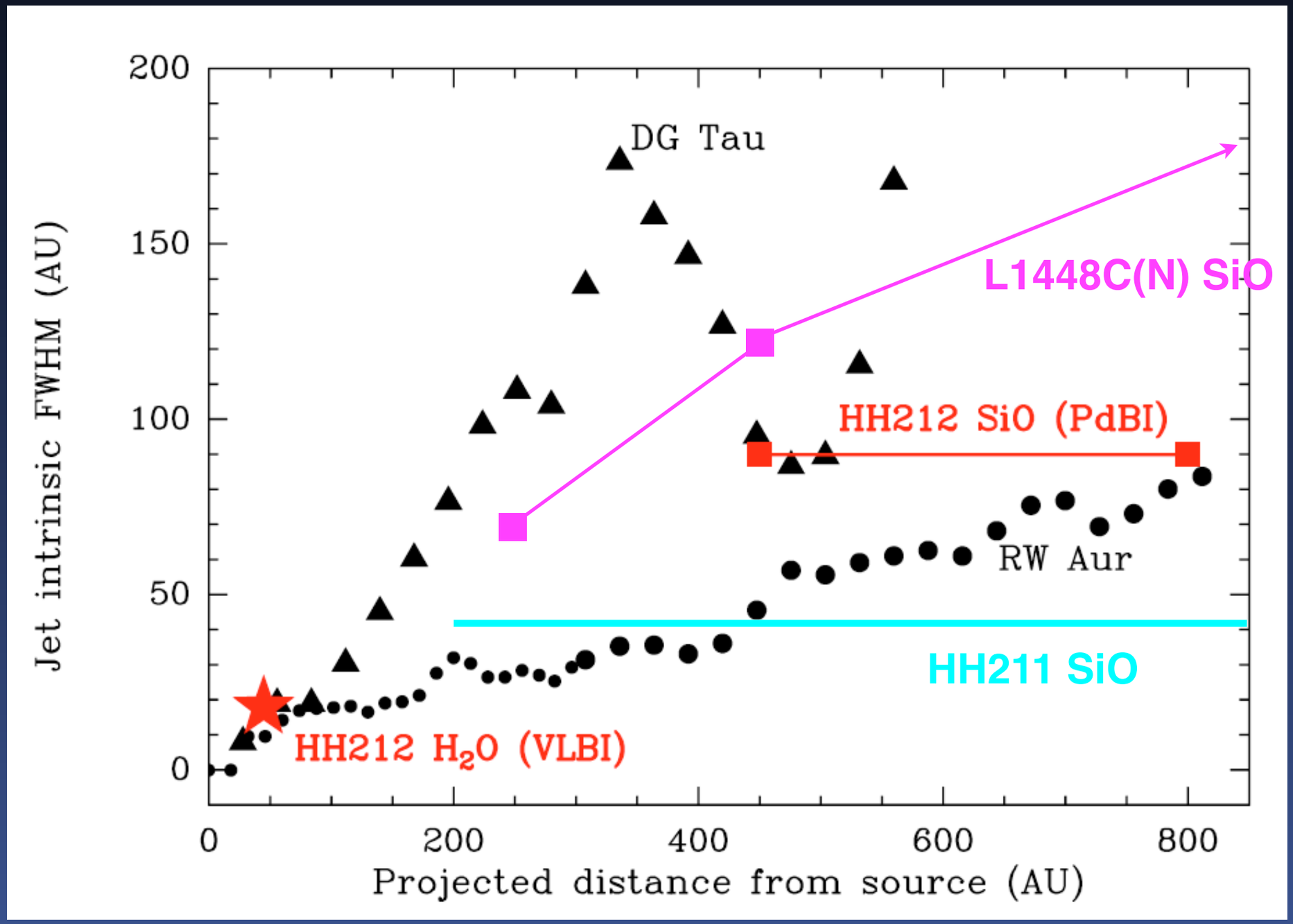
narrower



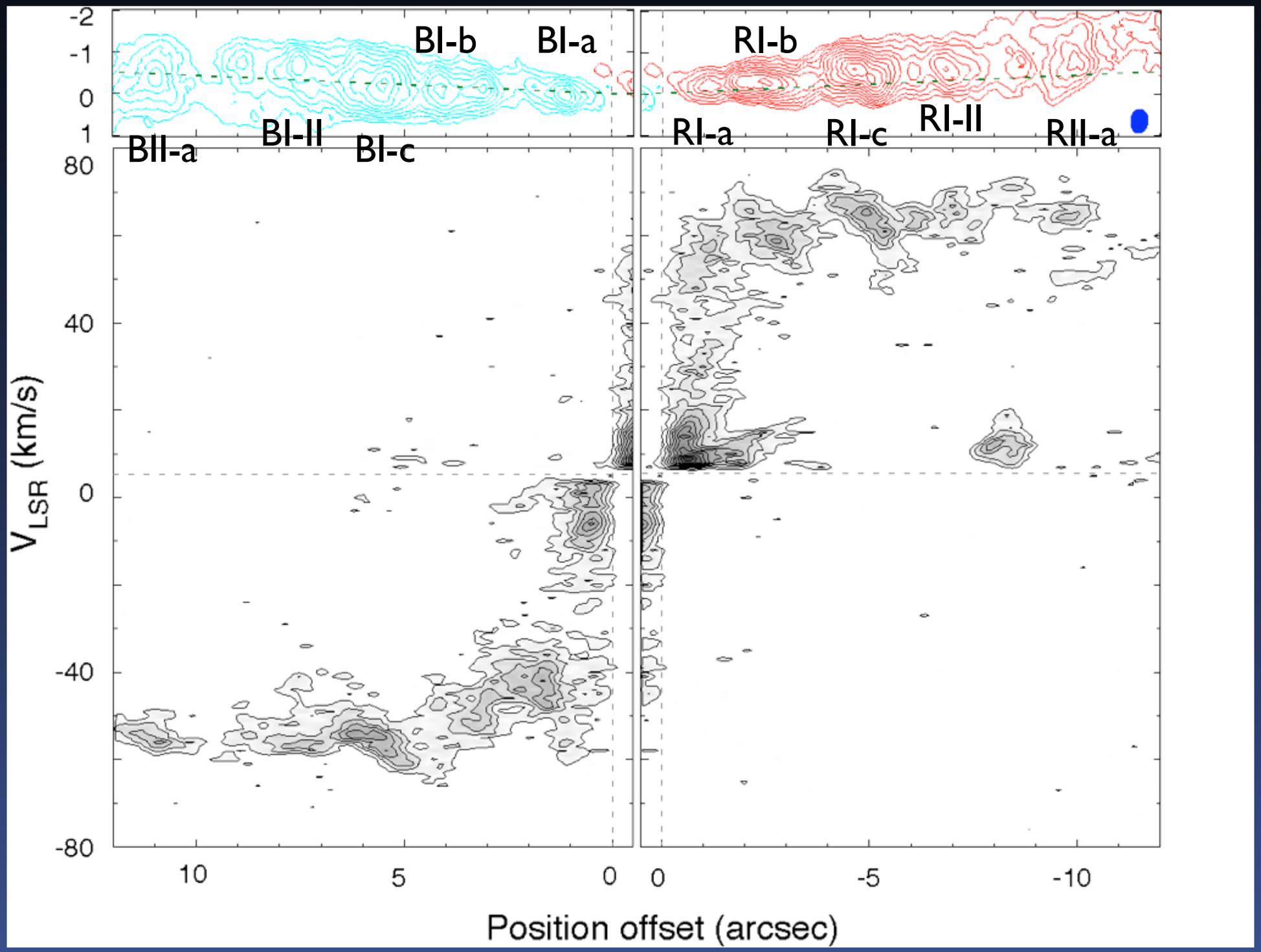
< 40 AU

0.46” x 0.36”

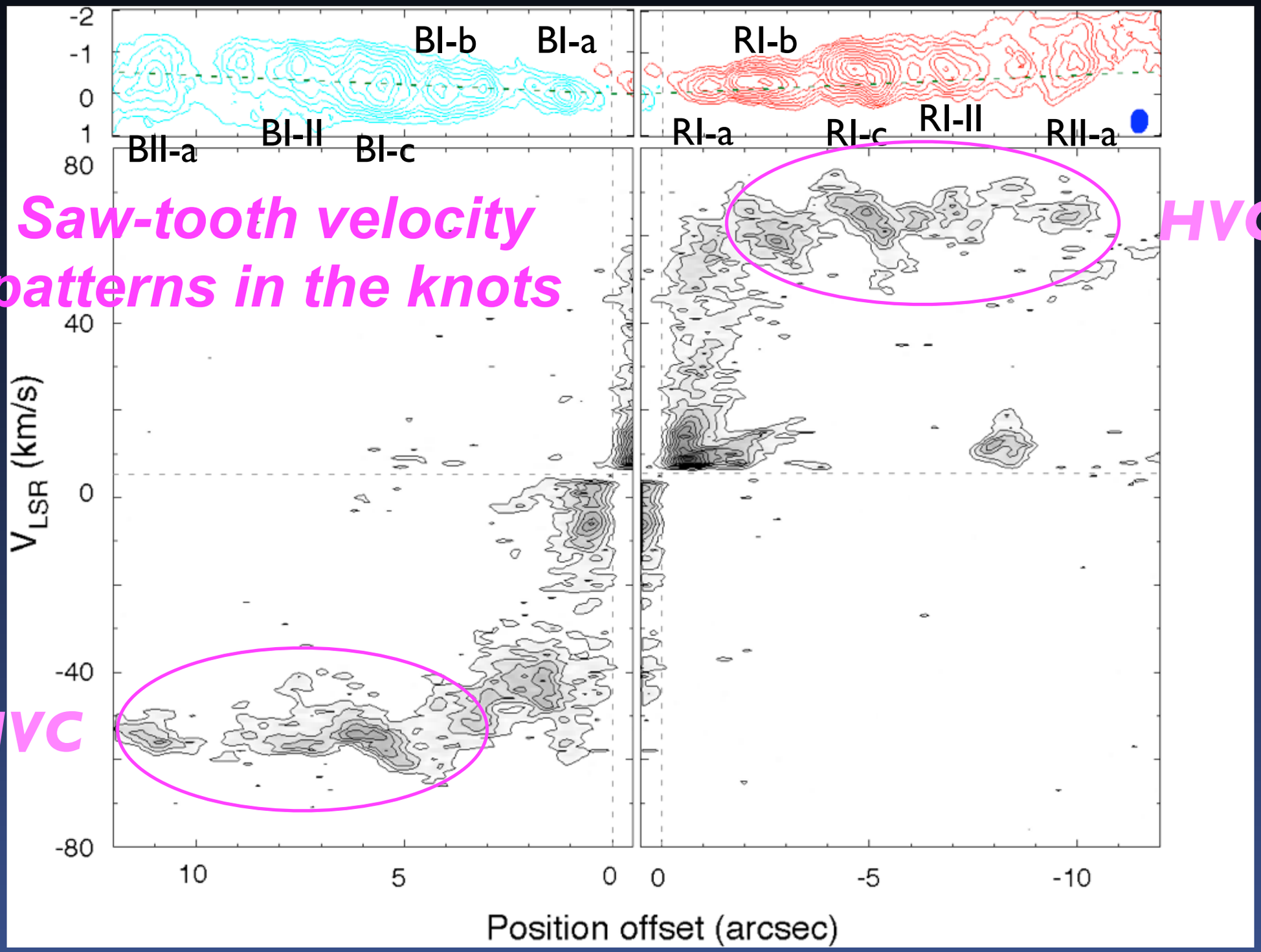
Intrinsic widths of the jets



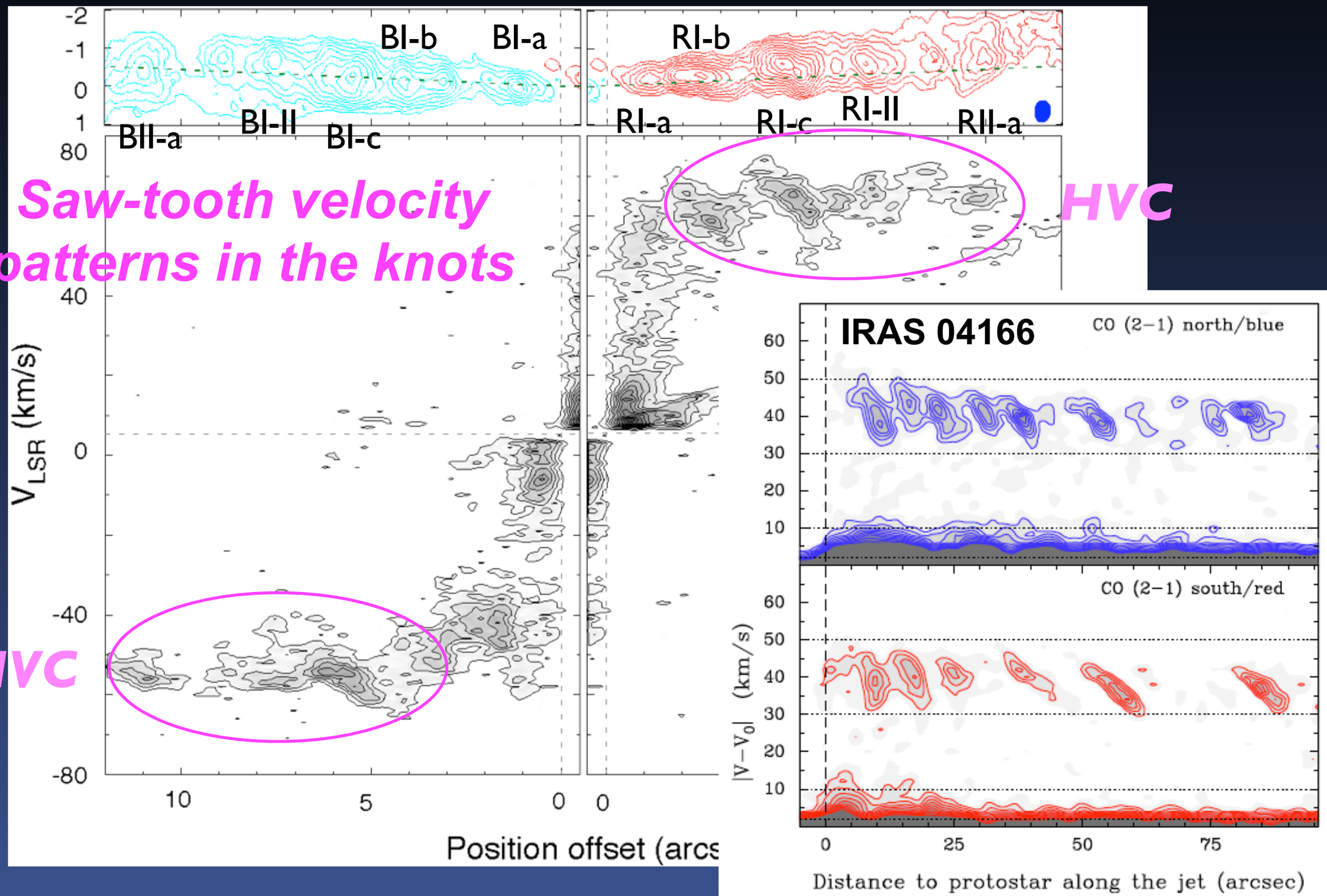
CO 3–2


BI-b
BI-a
BII-a
BI-II
BI-c
RI-b
RI-a
RI-c
RI-II
RII-a
-2
-1
0
1
80
40
0
-40
-80
V_{LSR} (km/s)
10
5
0
0
-5
-10
Position offset (arcsec)

CO 3–2

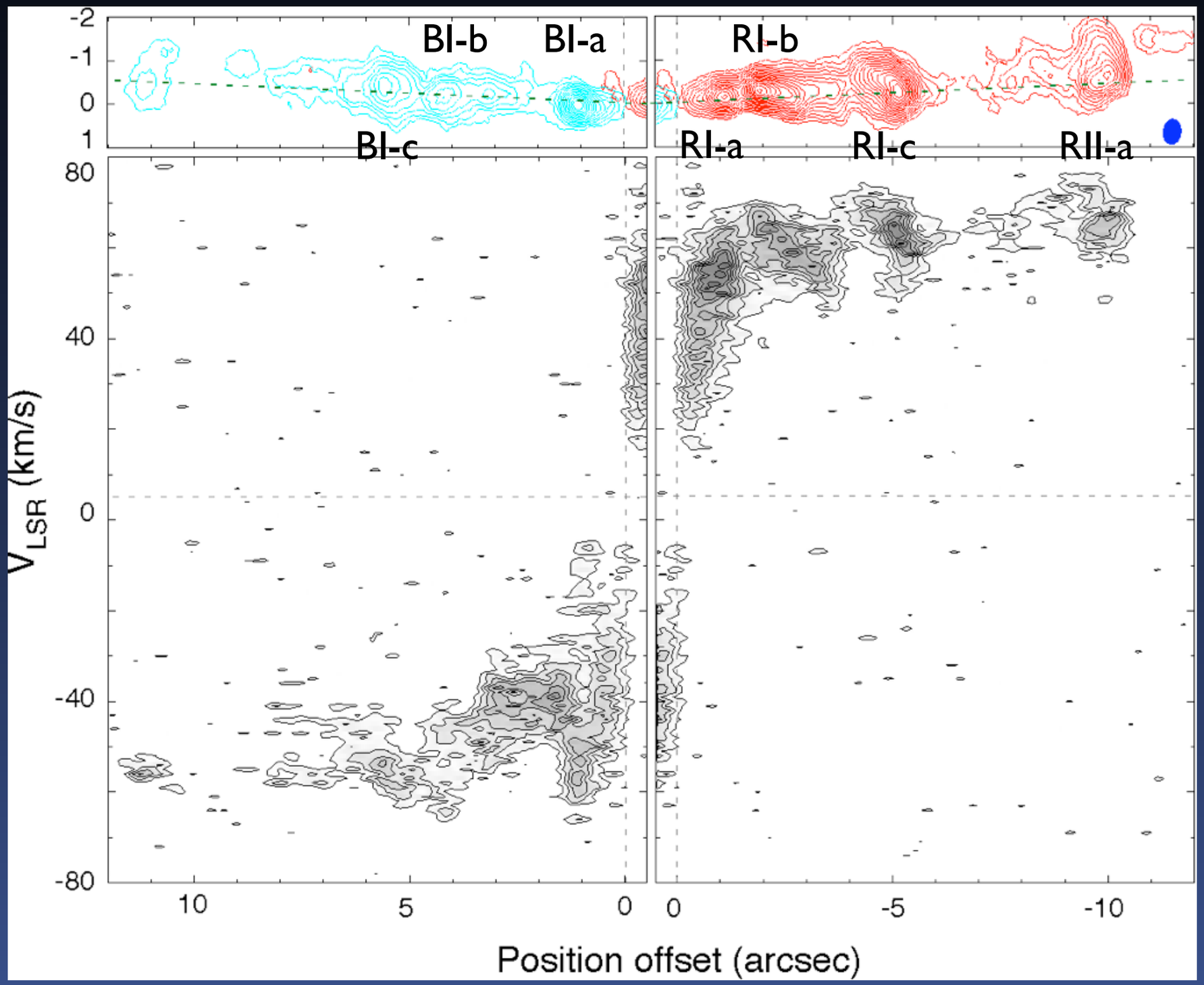

BI-b
BI-a
BII-a
BI-II
BI-c
RI-b
RI-a
RI-c
RI-II
RII-a
Saw-tooth velocity patterns in the knots
HVC
HVC
V_{LSR} (km/s)
Position offset (arcsec)

CO 3–2

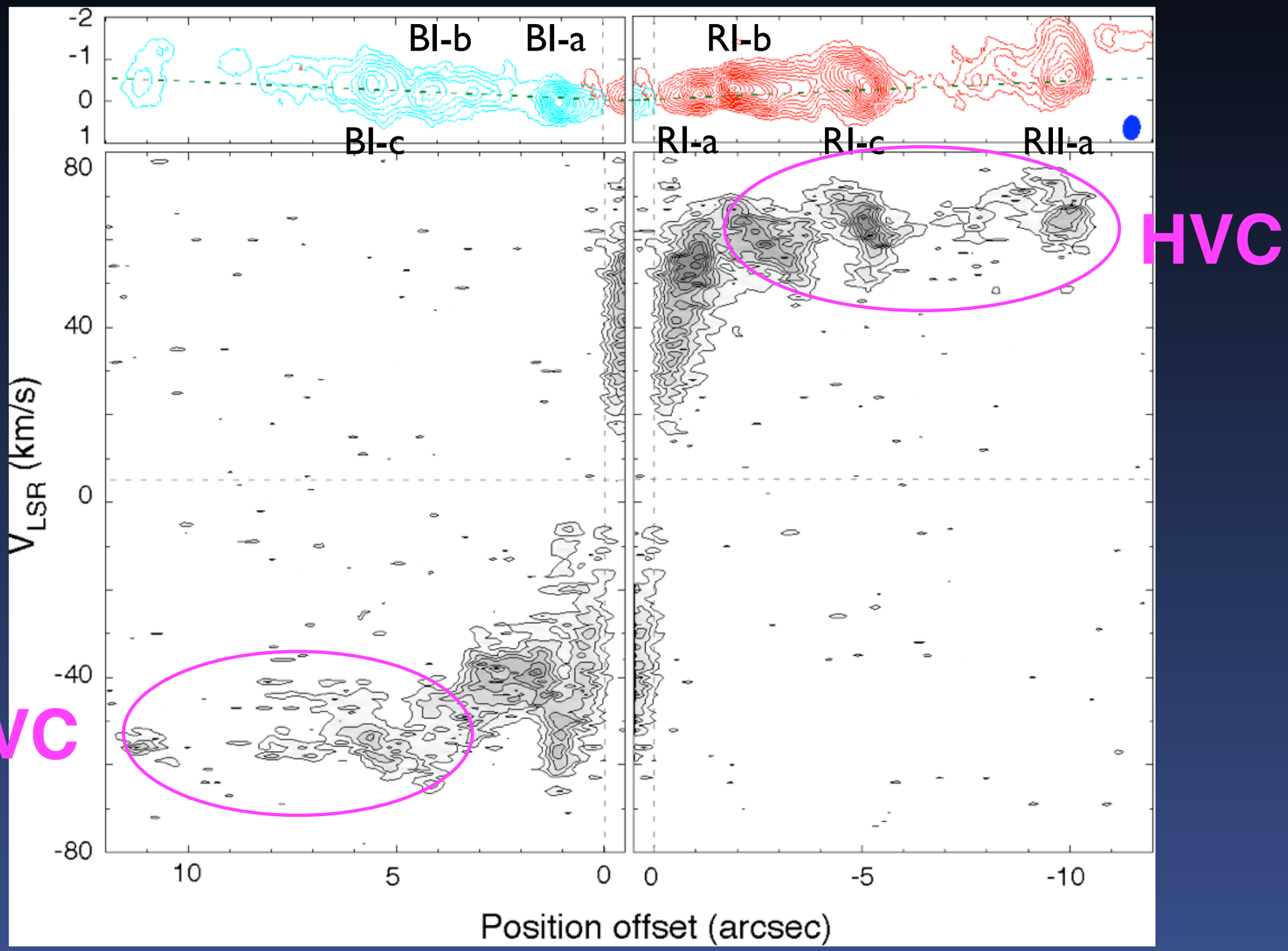


Santiago-Garcia et al. (2009)

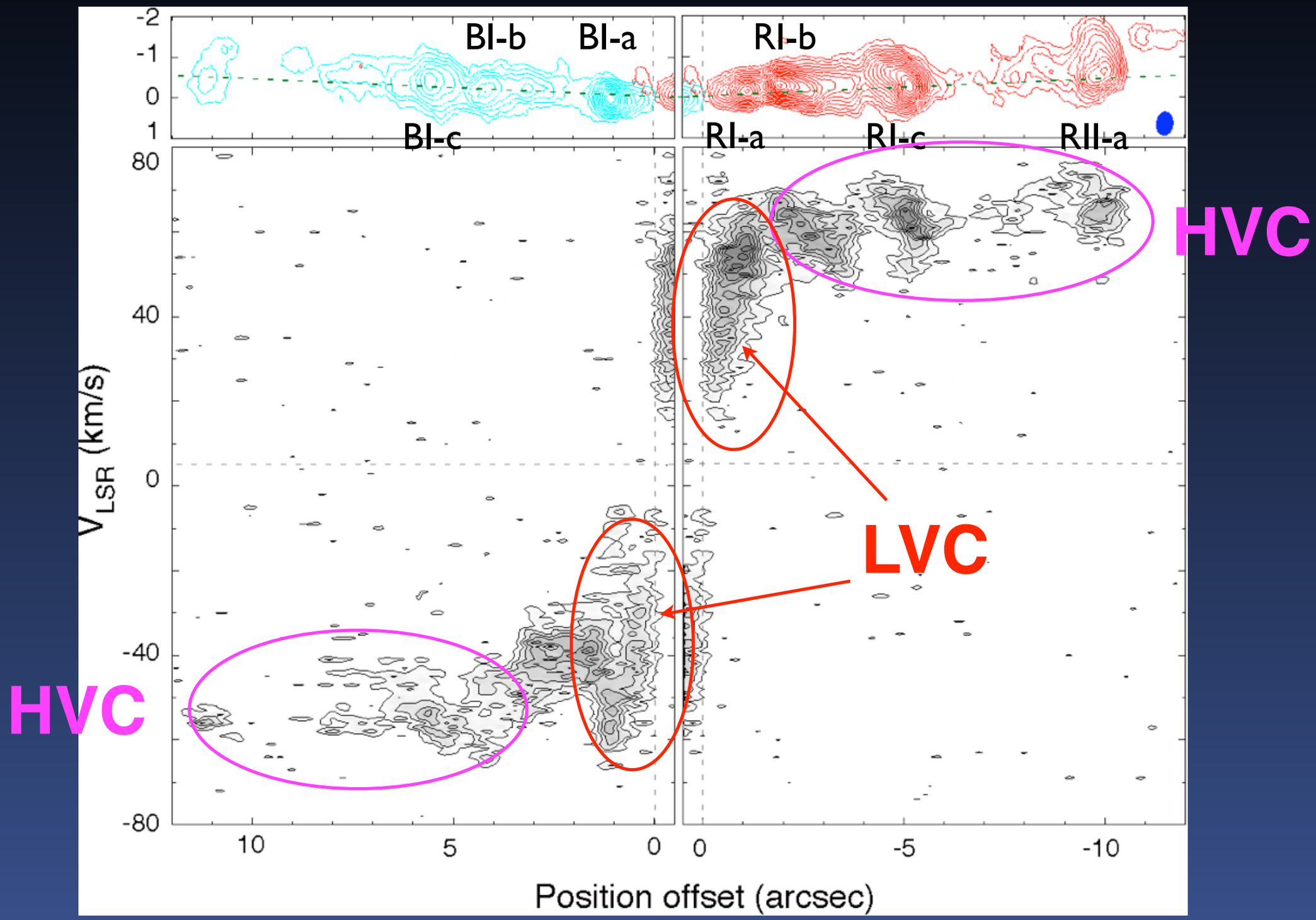
SiO 8–7


BI-b
BI-a
BI-c
RI-b
RI-a
RI-c
RII-a
-2
-1
0
1
80
40
0
-40
-80
V_{LSR} (km/s)
10
5
0
0
-5
-10
Position offset (arcsec)

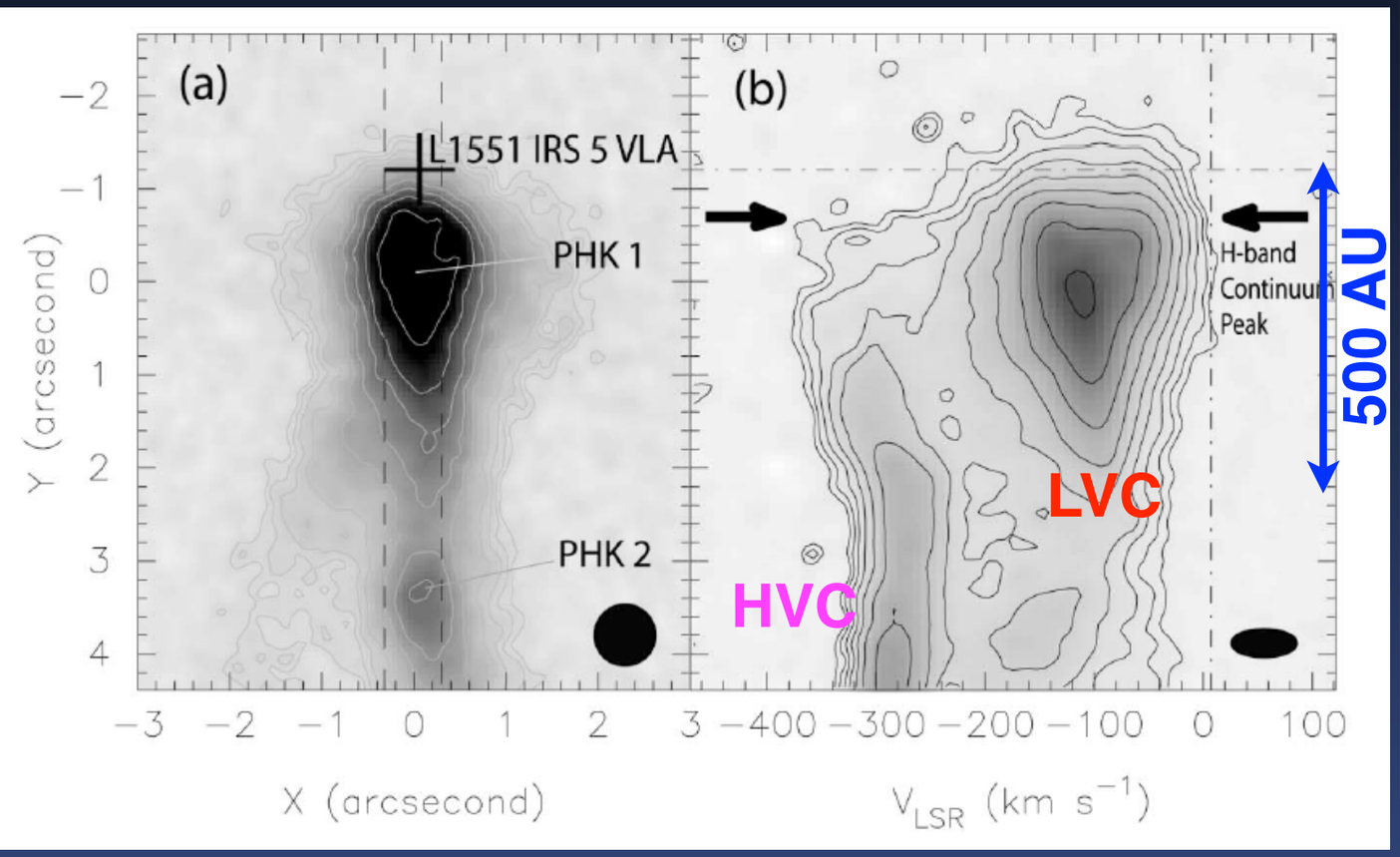
SiO 8–7


BI-b
BI-a
BI-c
RI-b
RI-a
RI-c
RII-a
HVC
HVC
V_{LSR} (km/s)
Position offset (arcsec)
-2
-1
0
1
80
40
0
-40
-80
10
5
0
0
-5
-10

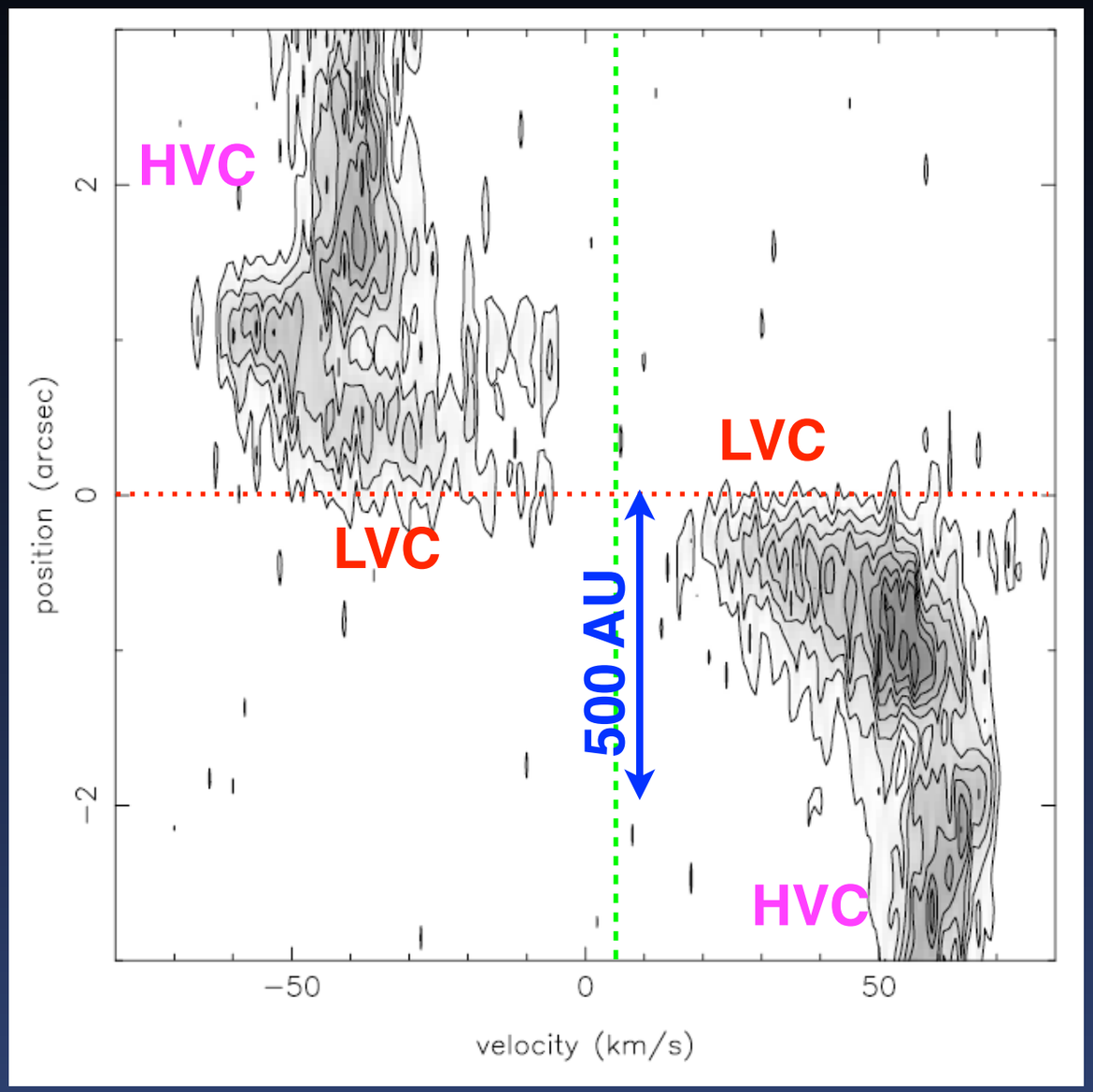
SiO 8–7


BI-b
BI-a
BI-c
RI-b
RI-a
RI-c
RII-a
HVC
LVC
HVC
V_{LSR} (km/s)
Position offset (arcsec)
-2
-1
0
1
80
40
0
-40
-80
10
5
0
0
-5
-10

L1551 IRS5
[FeII] 1.644μm

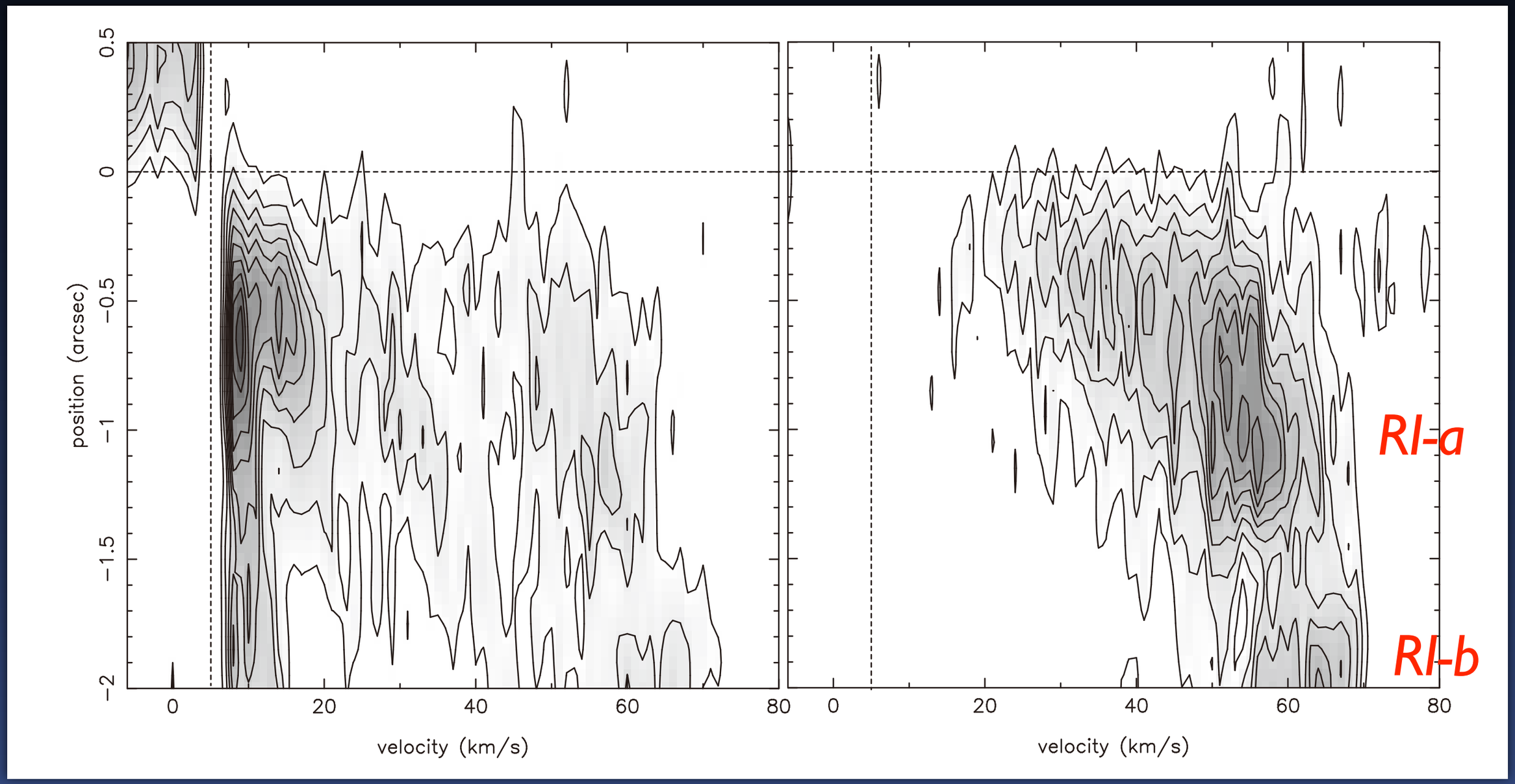


L1448C(N) SiO

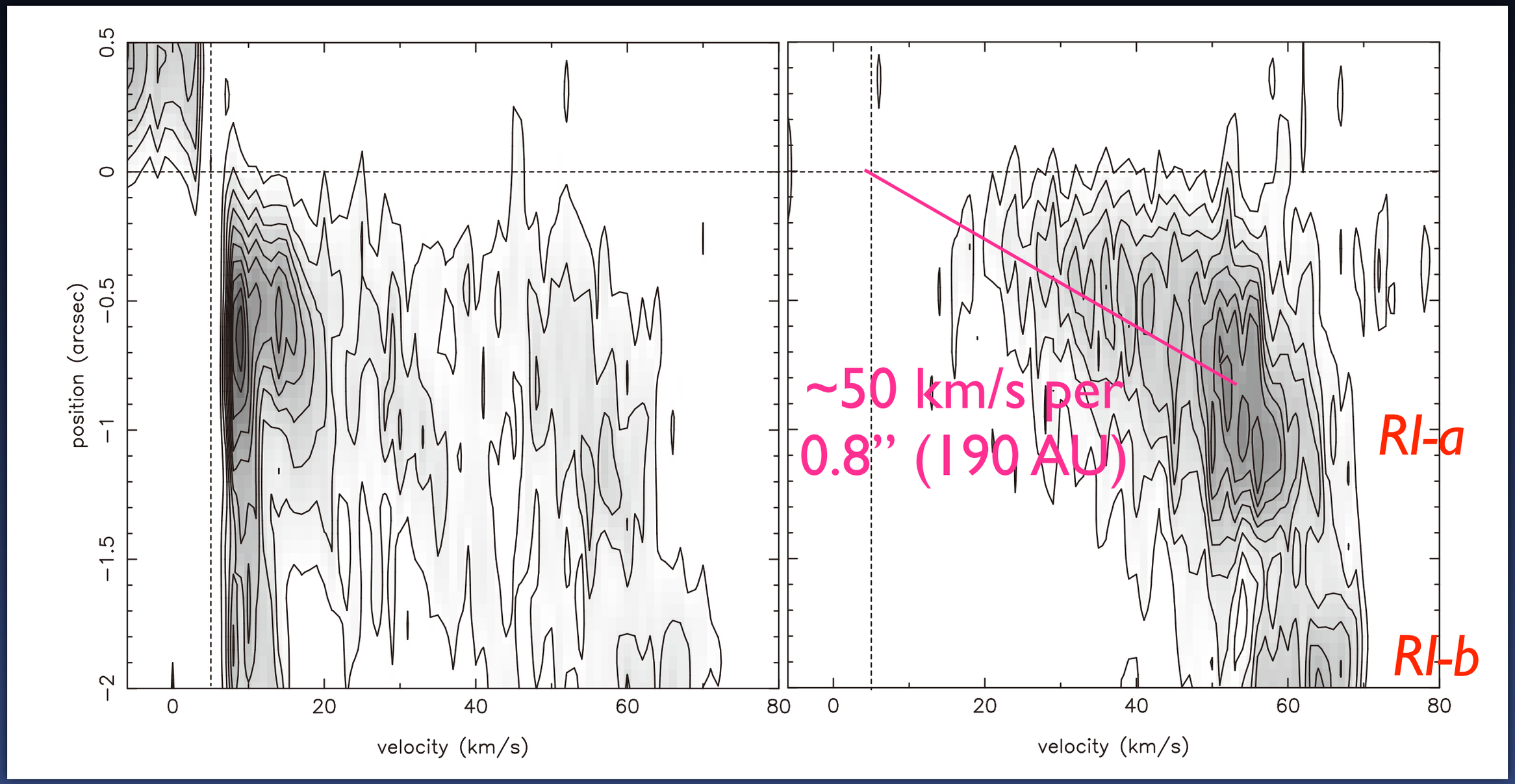


Pyo et al. (2002)

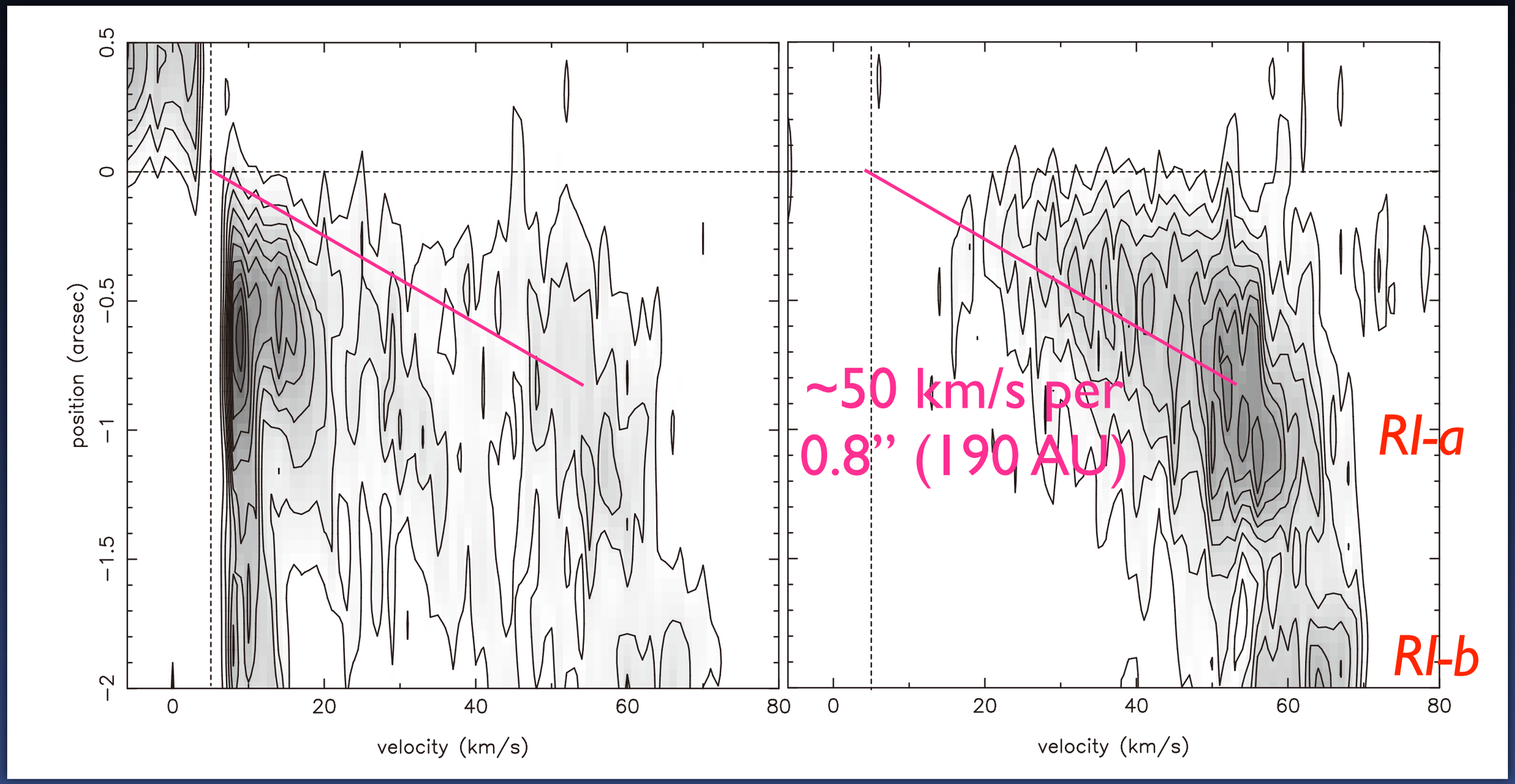
Apparent acceleration of the LVC



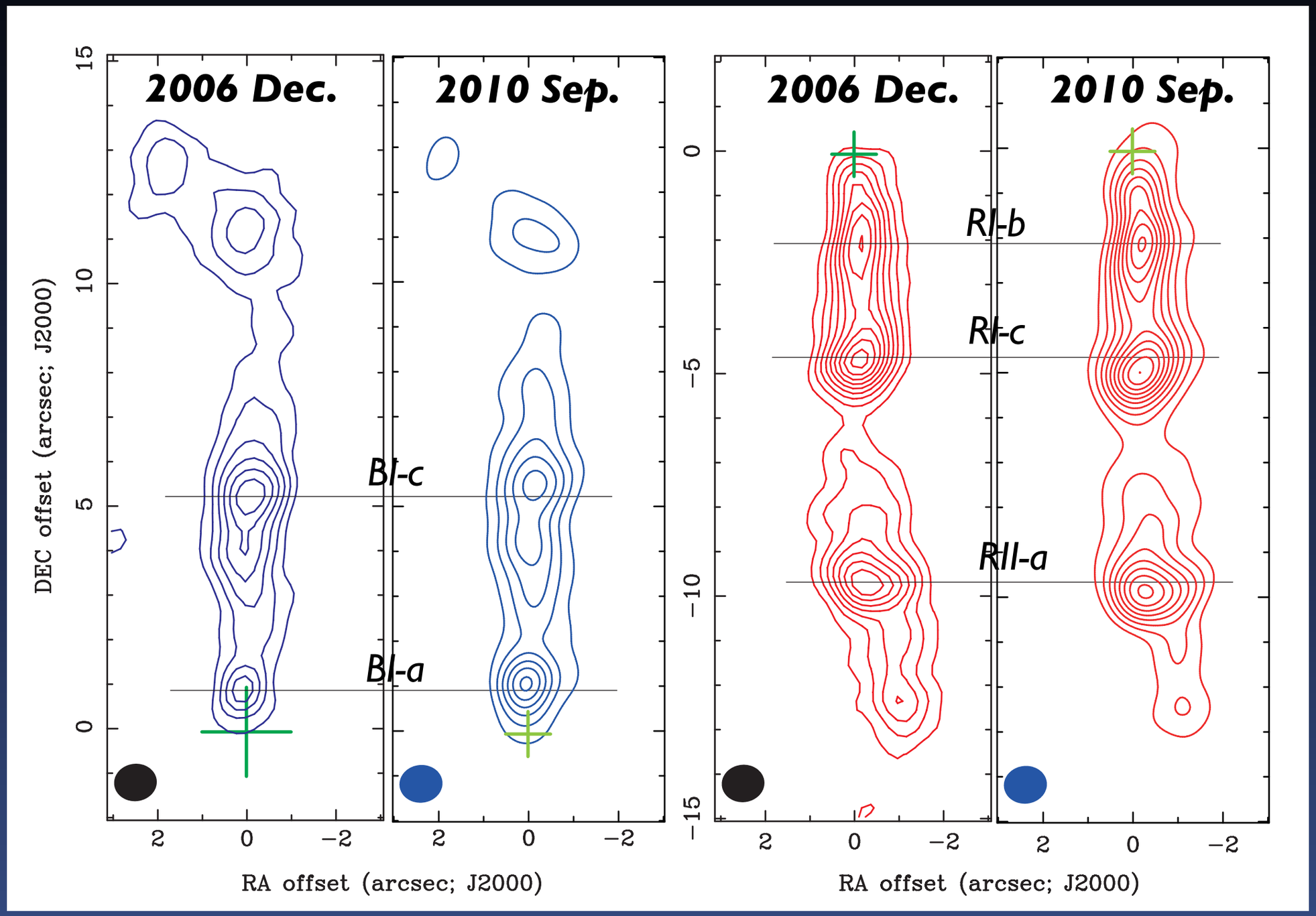
Apparent acceleration of the LVC



Apparent acceleration of the LVC



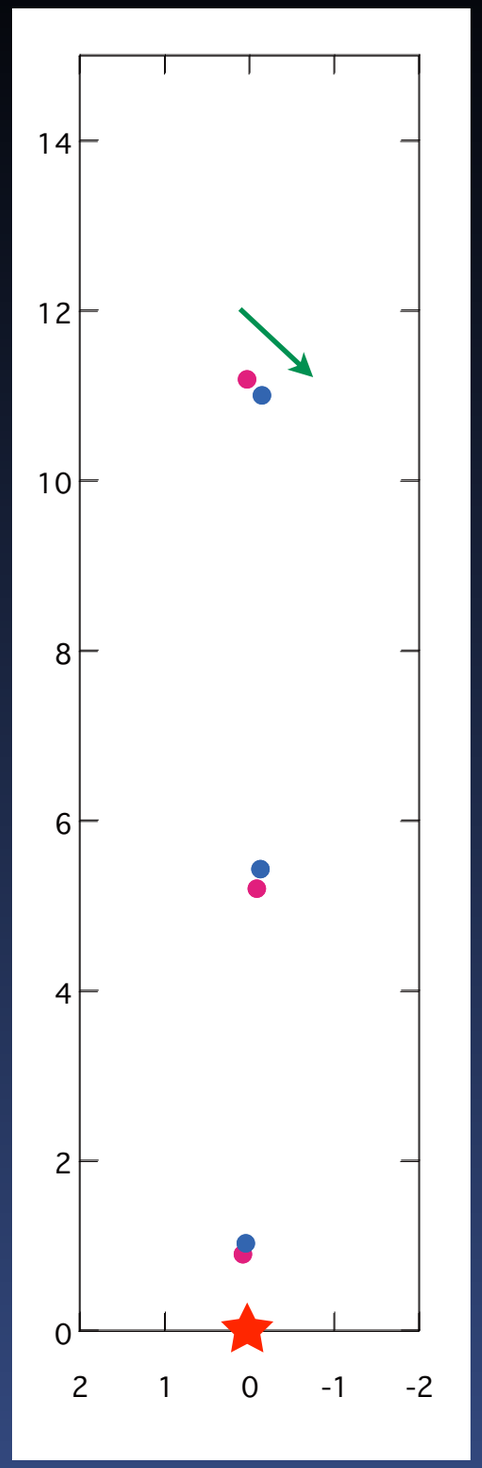
Proper motion of the knots



0.15” – 0.3” / 3.75 yrs

< 0.12”/yr for RII from SiO 2–1 obs. (Girart & Acord 2001)

Blue (P.A. -25°)

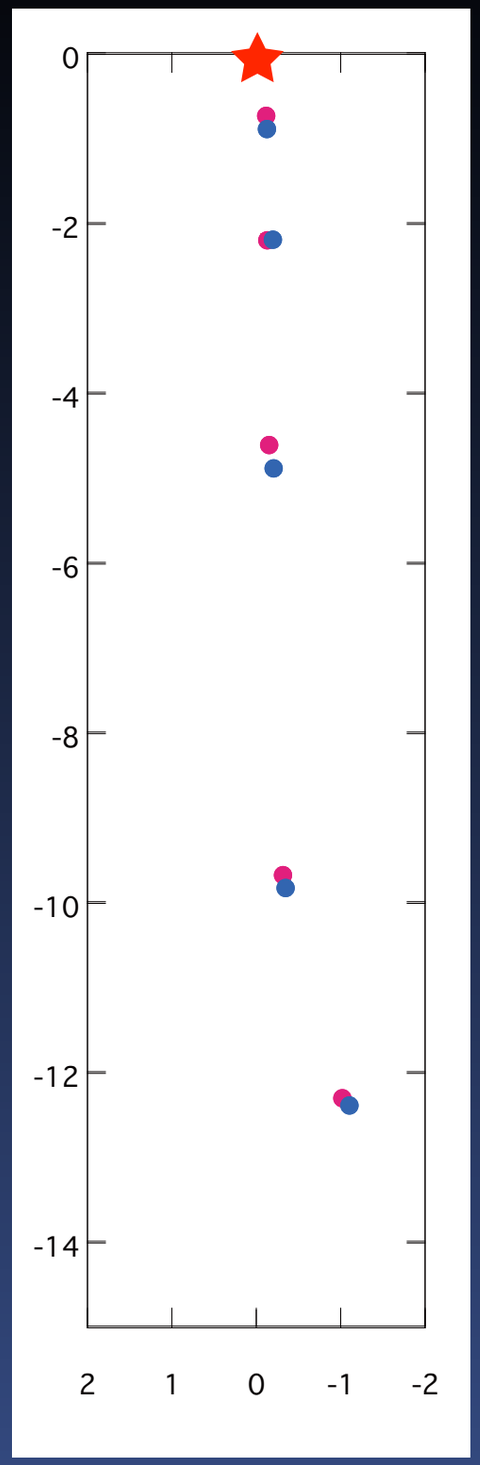


BII-a
v_{trans} ~ -77 km/s ?
i ~ 38°
v_{3D} ~ -97 km/s ?

BI-c
v_{trans} ~ 75 km/s
i ~ 39°
v_{3D} ~ 96 km/s

BI-a
v_{trans} ~ 45 km/s
i ~ 53°
v_{3D} ~ 75 km/s

Red (P.A. -20°)



RI-a
v_{trans} ~ 45 km/s
i ~ 53°
v_{3D} ~ 76 km/s

RI-b
stationary?

RI-c
v_{trans} ~ 90 km/s
i ~ 34°
v_{3D} ~ 108 km/s

RII-a
v_{trans} ~ 52 km/s
i ~ 49°
v_{3D} ~ 79 km/s

RII-b
v_{trans} ~ 41 km/s
i ~ 56°
v_{3D} ~ 73 km/s

- *RII 0.12”/yr (Girart & Acord 2001) –> v_{trans} = 134 km/s @ 235pc, i~ 28°*
- *H_2O maser jet @ 60 mas, i ~ 47° (Hirota et al. 2011)*

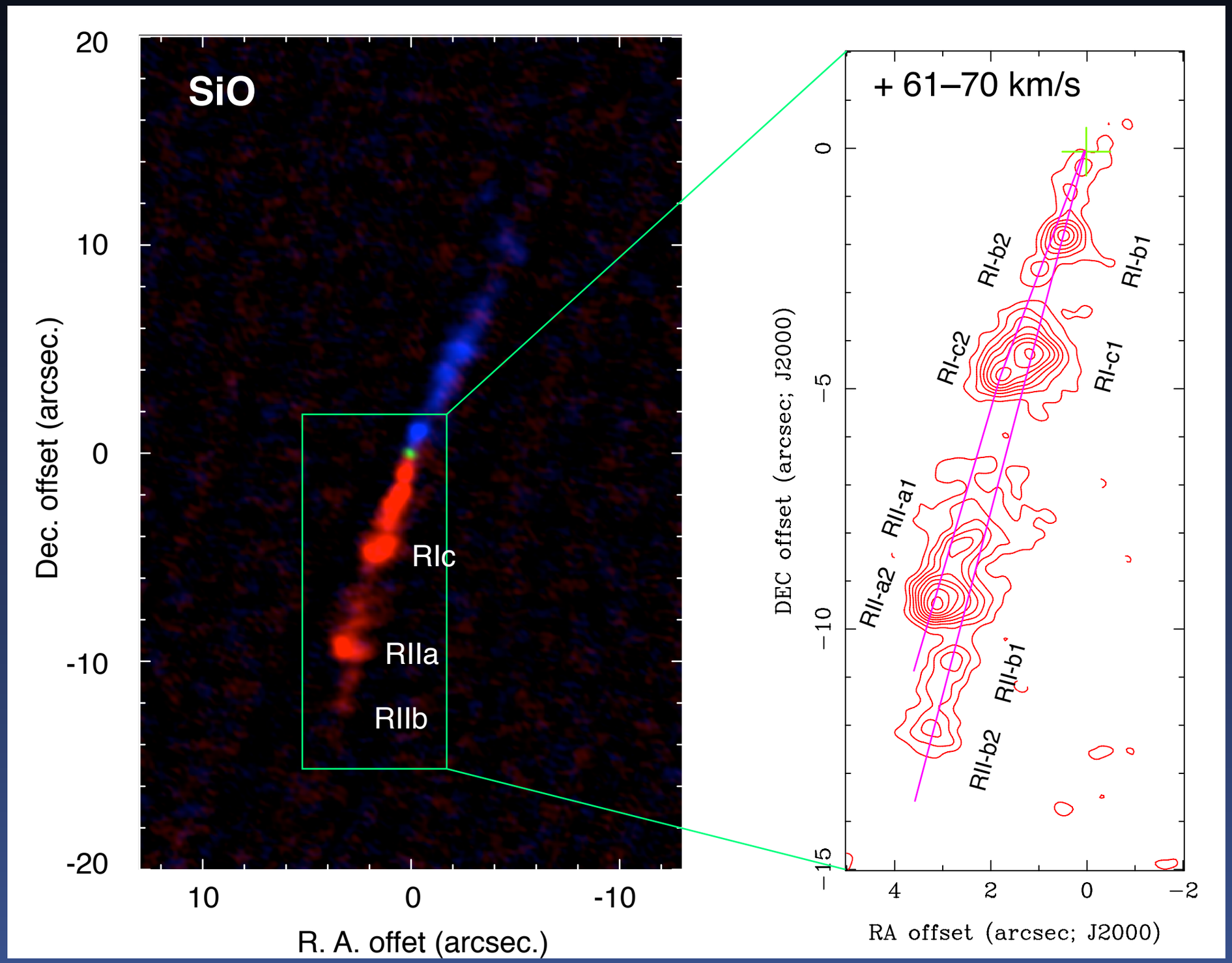
Summary – I

- *Morphology — A chain of knots*
- *Collimation — width < 100 AU @ ~300 AU from the star*
- *Kinematics — 2 components, HVC + LVC*
  - *HVC – jet body, narrow line width*
    - *V_{jet} in L1448C(N) < V_{jet} in Class I & II obj.*
  - *LVC – at the jet base, from V_{sys} to V_{jet}*
    - *L1448C(N) – 200 AU v.s. L1551 IRS 5 – 500 AU*
    - *Apparent linear acceleration (~50 km/s per 190 AU)*

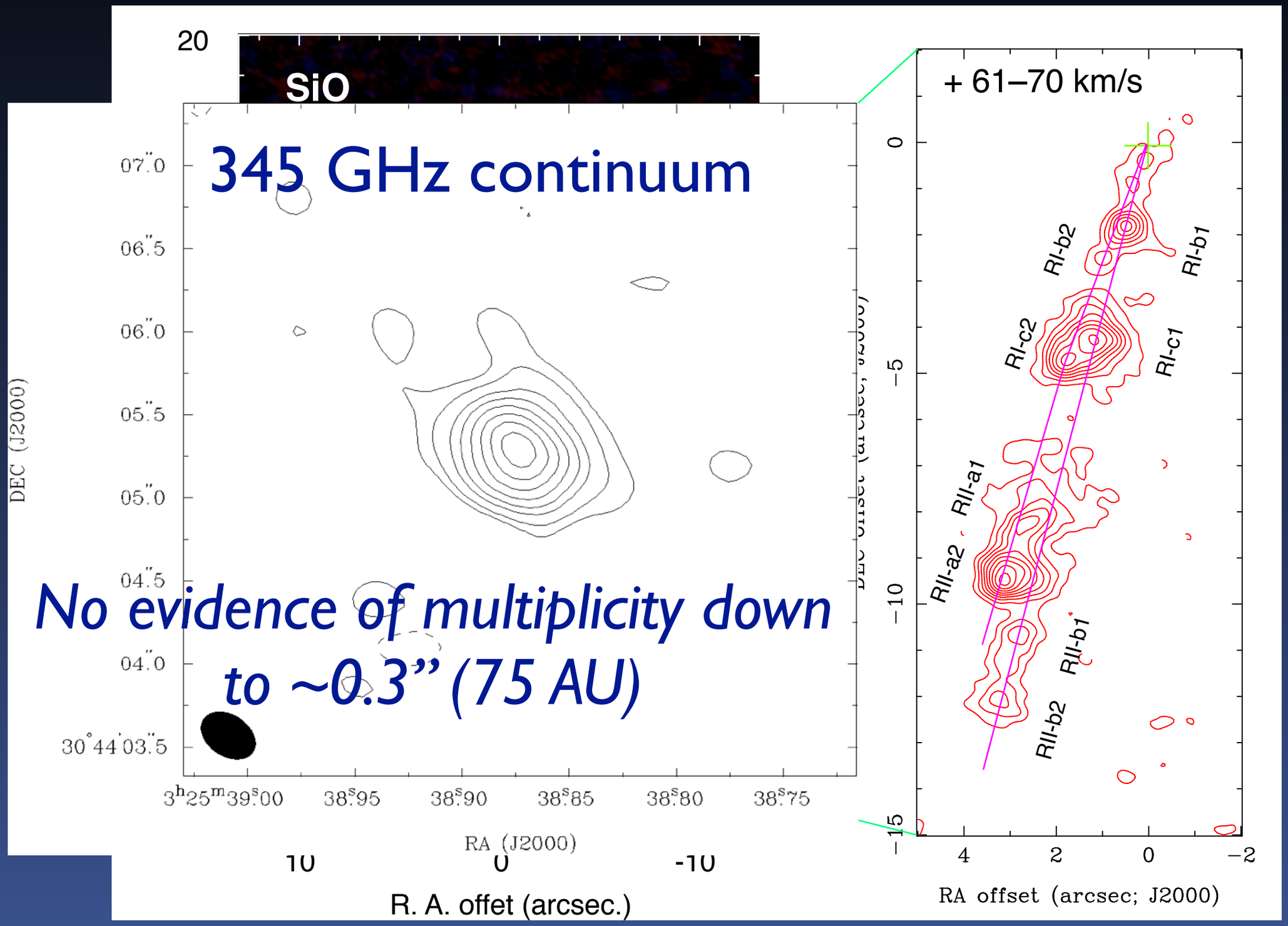
Summary – II

- *Proper motion of the knots*
  - *0.15–0.3" / 3.5 yrs*
    - *V_{trans} ~45–90 km/s < 134 km/s in RII (Girart & Acord 2001)*
    - *i ~ 53 deg. at the innermost knot pair, ~ 47 deg. @ 60 mas (Hirota et al. 2011)*
    - *V_{3D} ~ 75 km/s @ BI-a & RI-a, ~ 100 km/s @ BI-c & RI-c, ~75 km/s @ RII-a & RII-b*
    - *Variabilities in the ejection direction and velocity?*

A twin jets from binary protostars???



A twin jets from binary protostars???



No evidence of multiplicity down to ~0.3" (75 AU)