

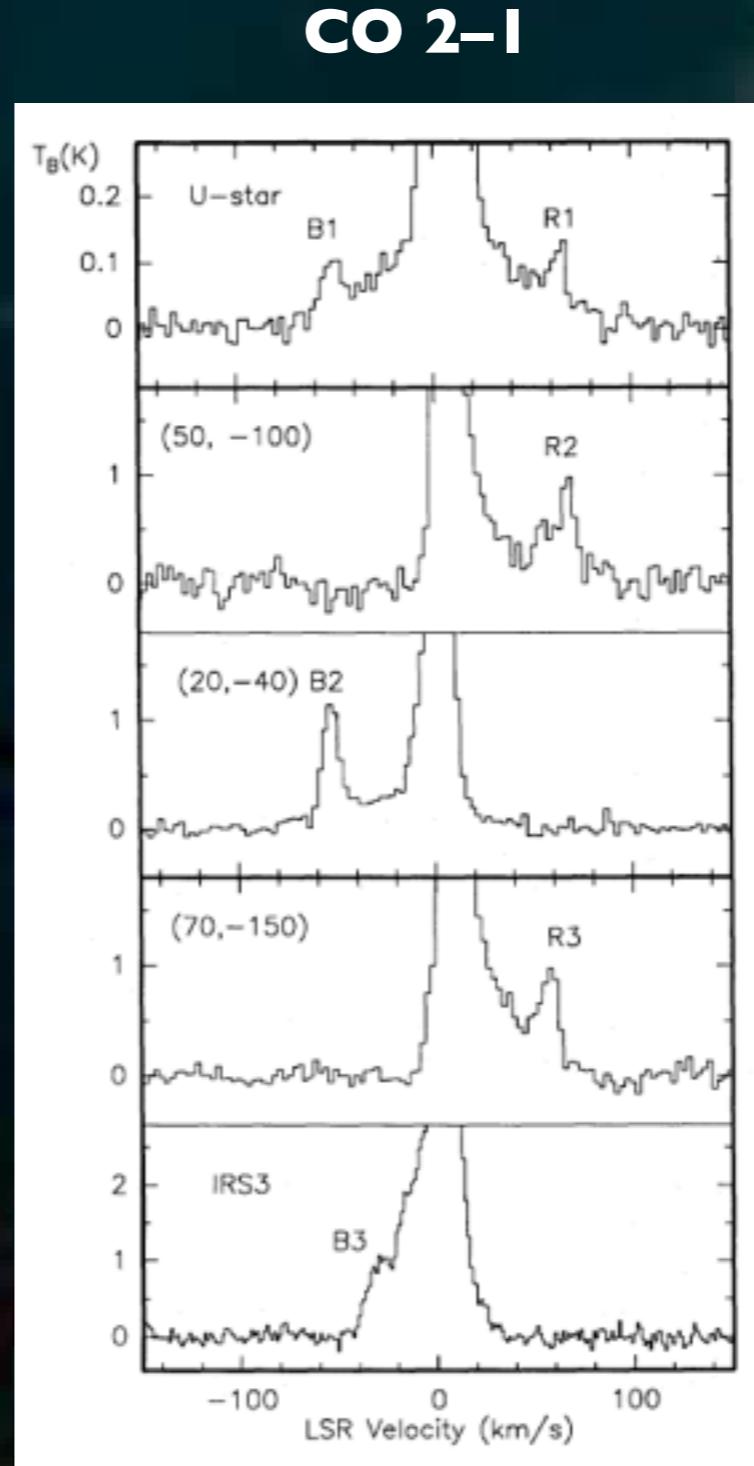
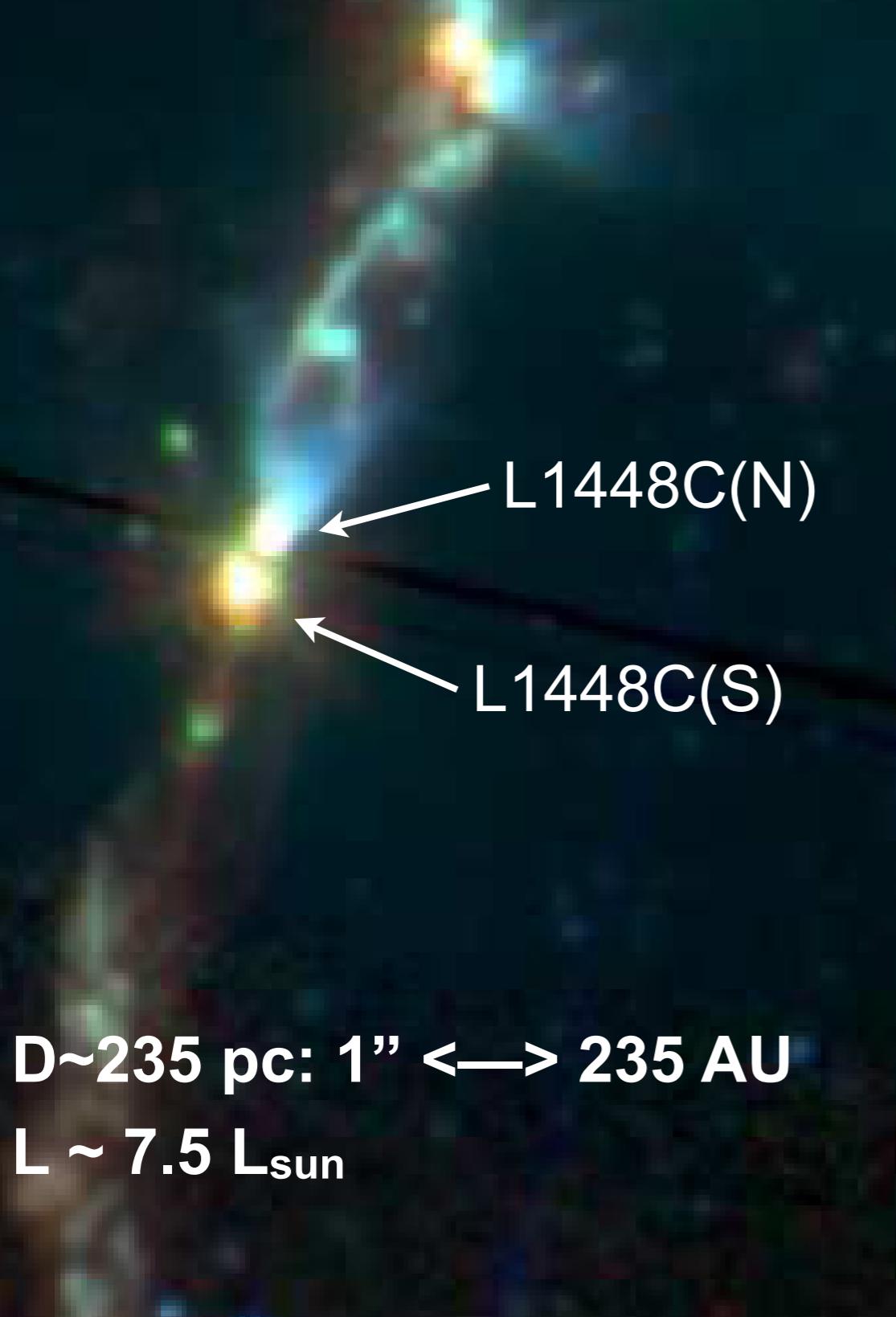
Resolving the central region of the L1448C(N) protostellar jet

— *High-resolution imaging with the SMA* —

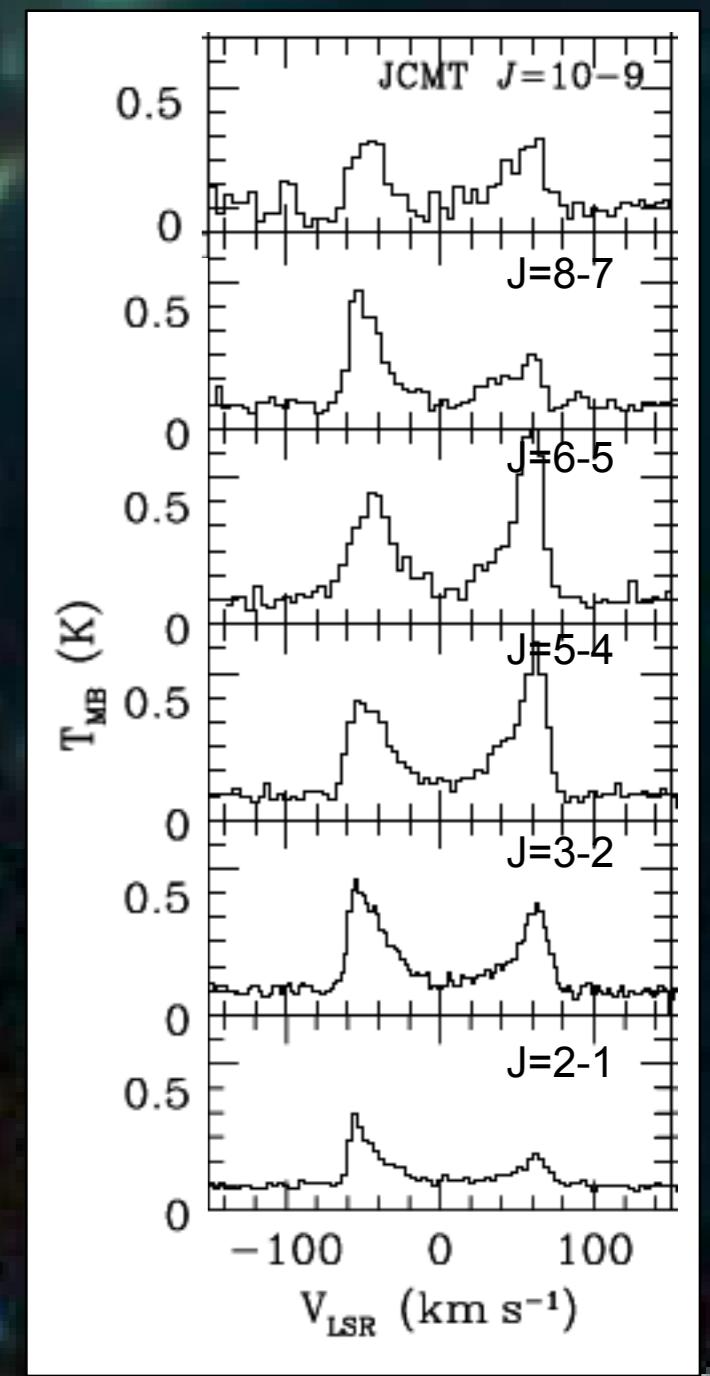
Naomi Hirano, Chin-Fei Lee, & Hsien Shang
(ASIAA, Taiwan)

2000 AU ~ 0.1

L1448C: an archetypal Outflow with an EHV component



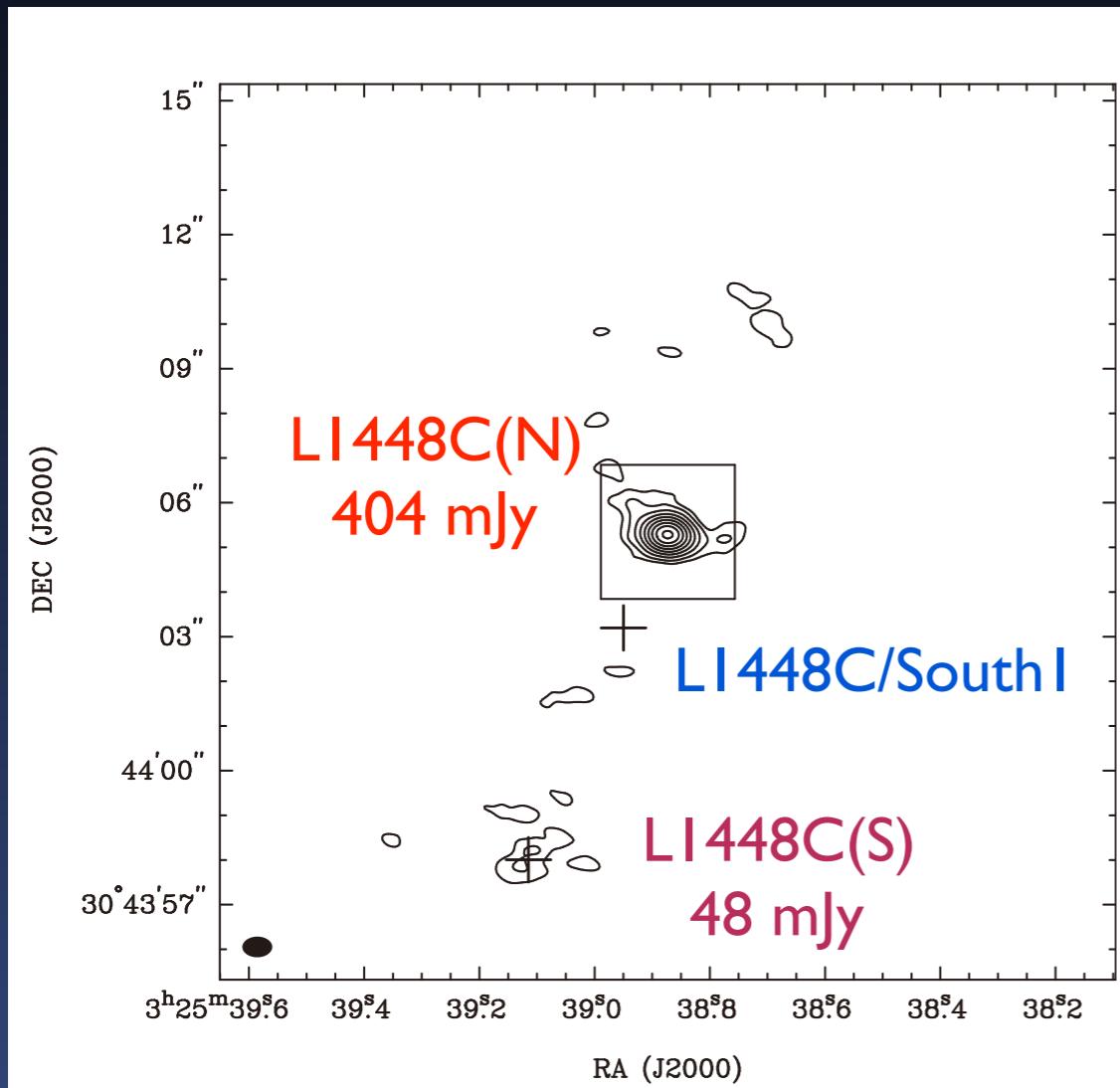
Bachiller et al. (1990)



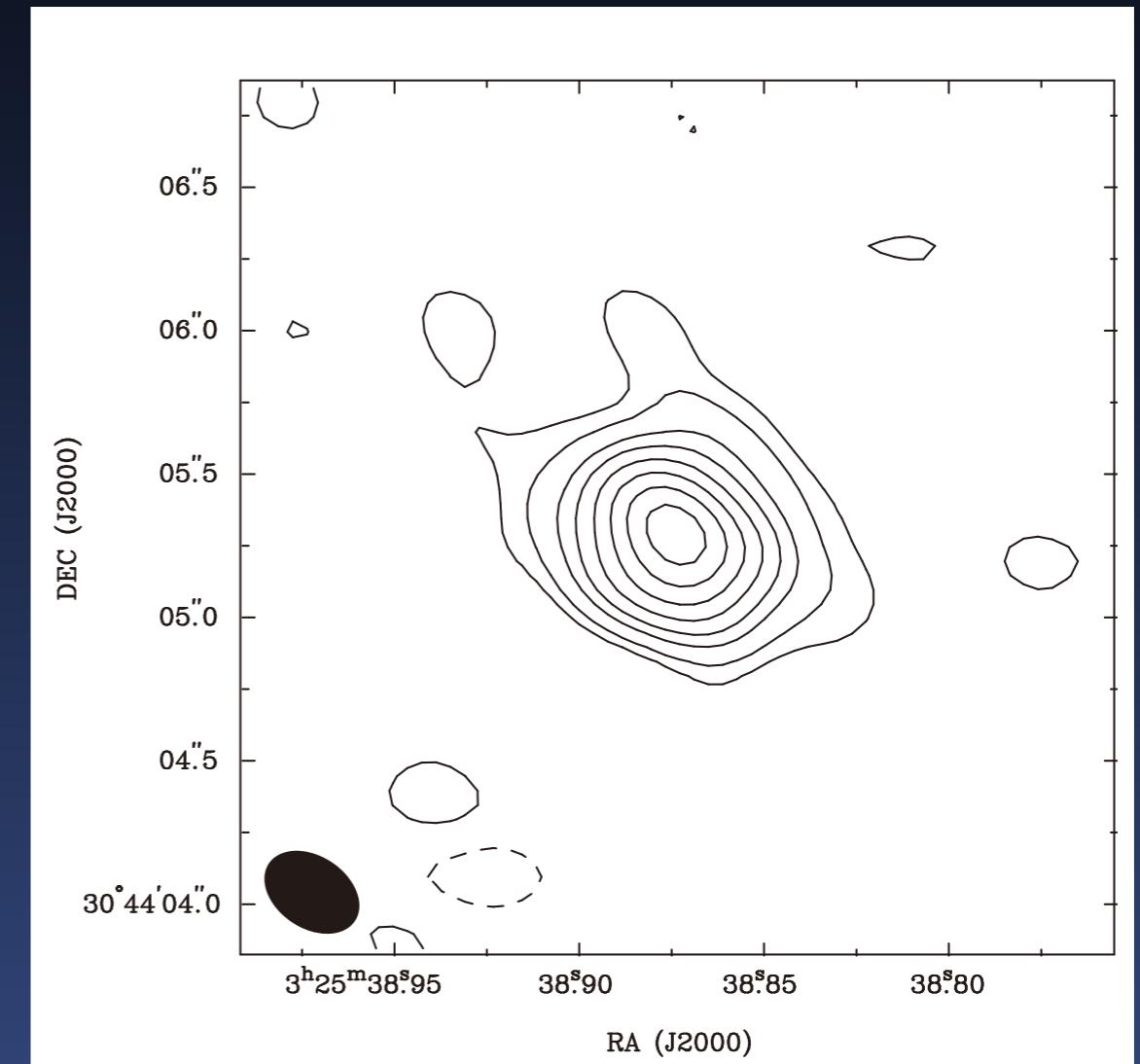
235 AU = 0.1

Submm (341 GHz) continuum emission

NA weight, $0.67'' \times 0.46''$ beam



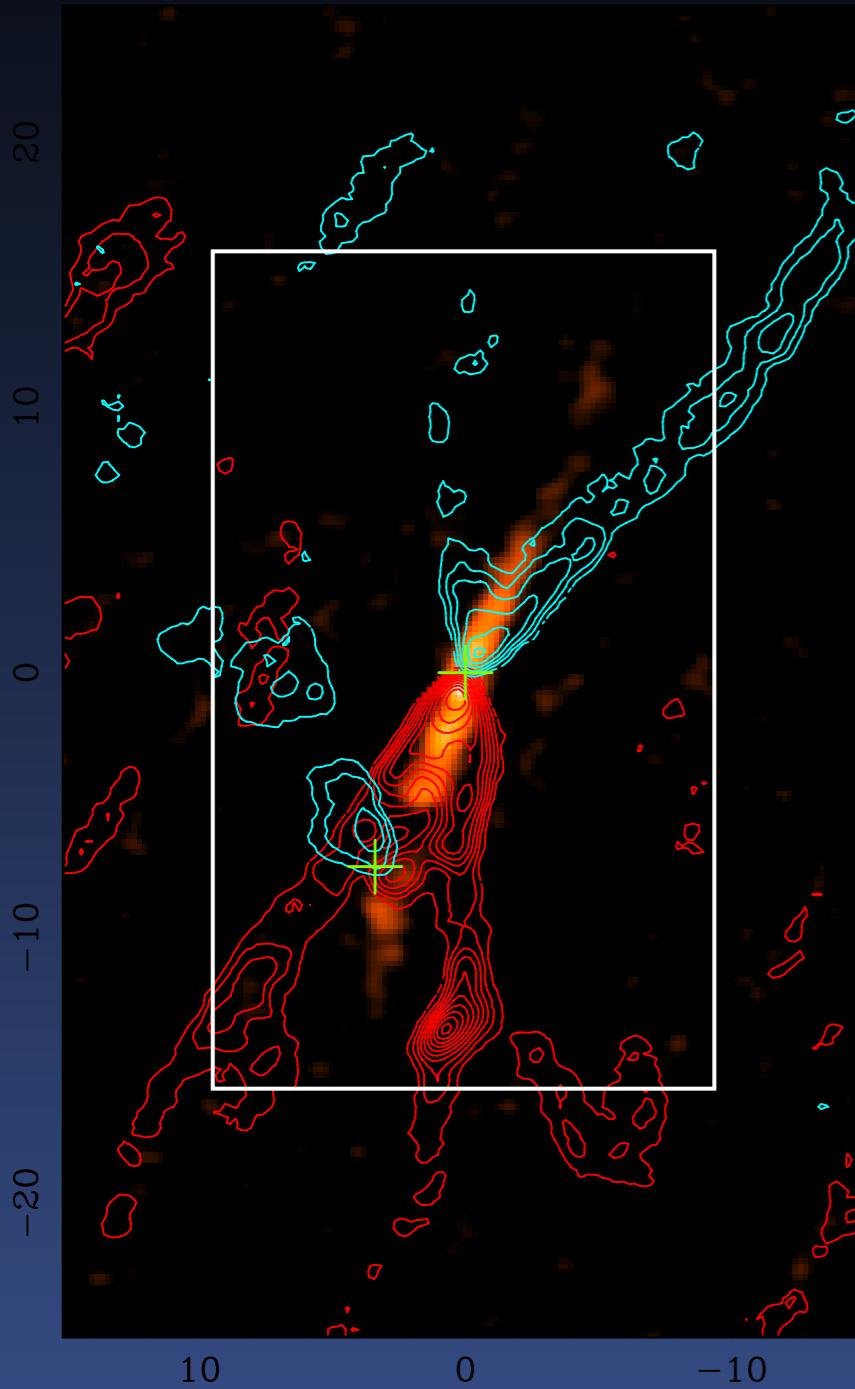
Super uniform weight, $0.36'' \times 0.25''$ beam



$0.34'' \times 0.29''$ (79 x 66 AU)
P.A. 33° (no significant elongation)

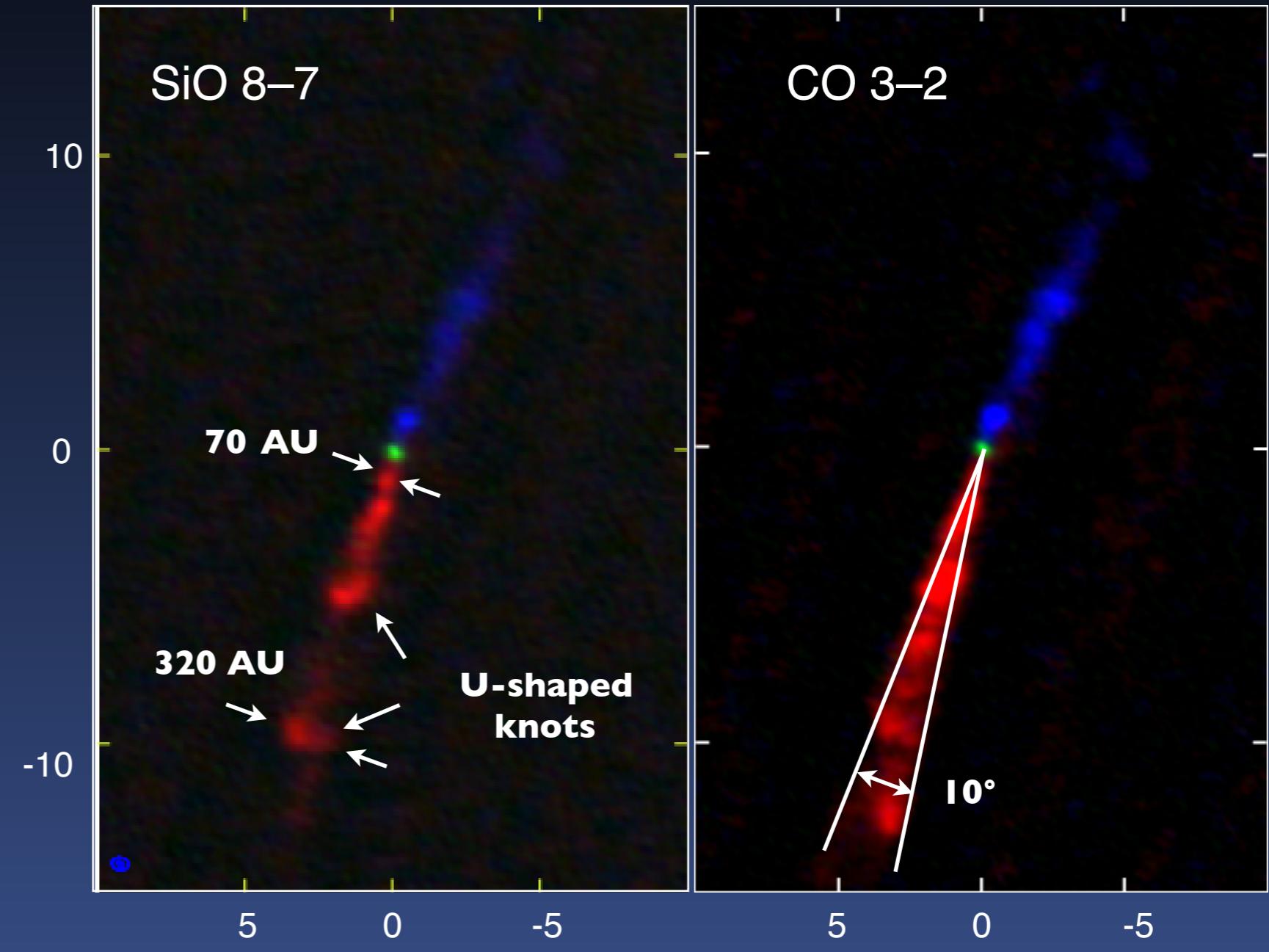
No sign of binary down to $\sim 0.3''$

*CO outflows from
LI448C(N) & LI448C(S)*



~0.5'' (125 AU) resolution

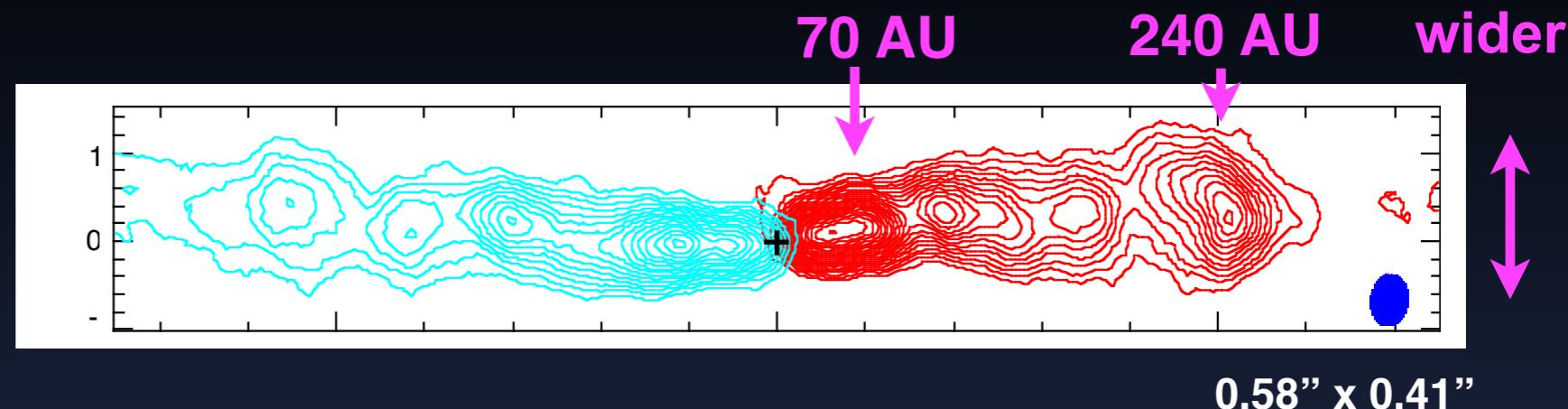
SiO & CO jets from LI448C(N)



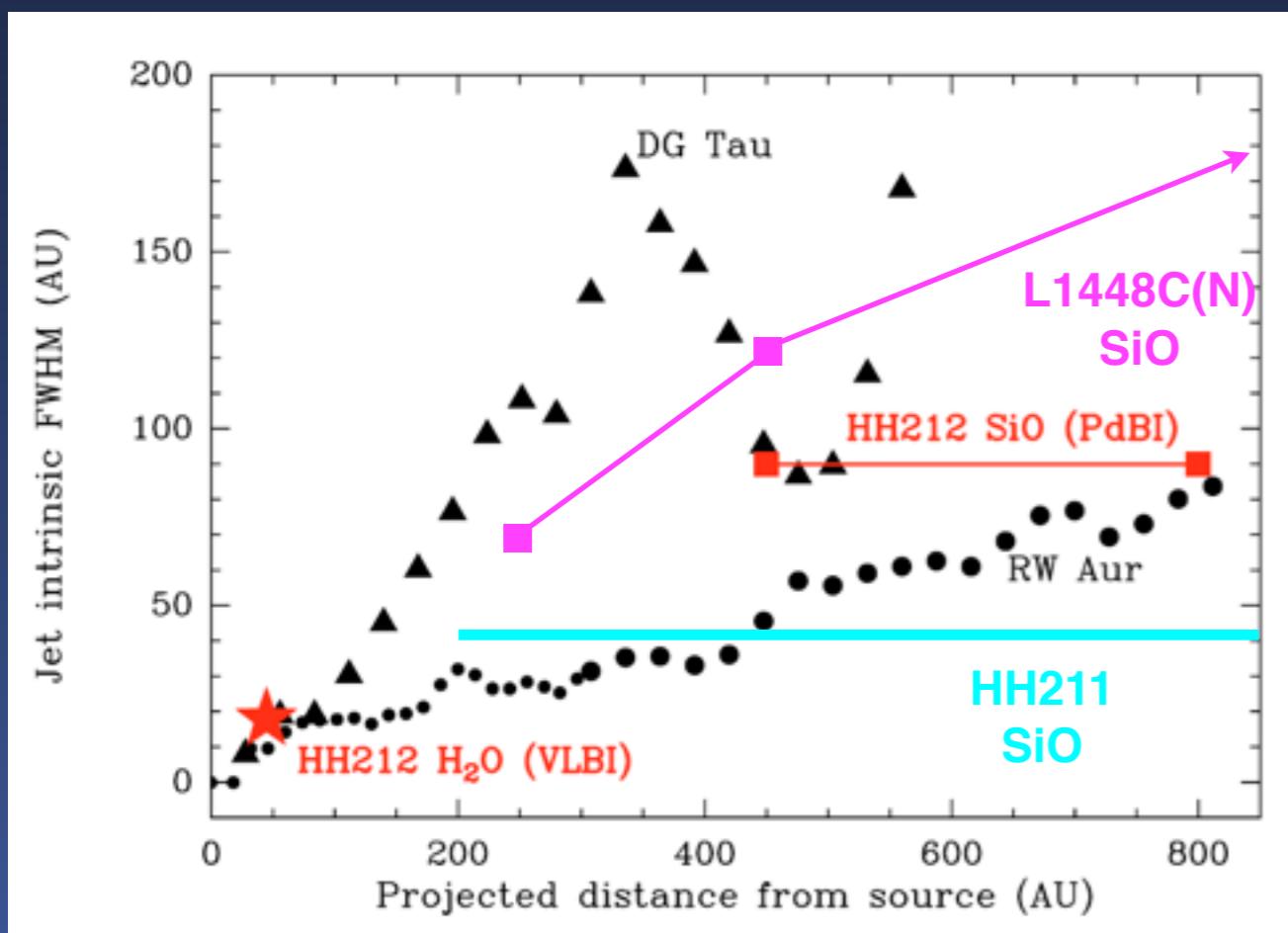
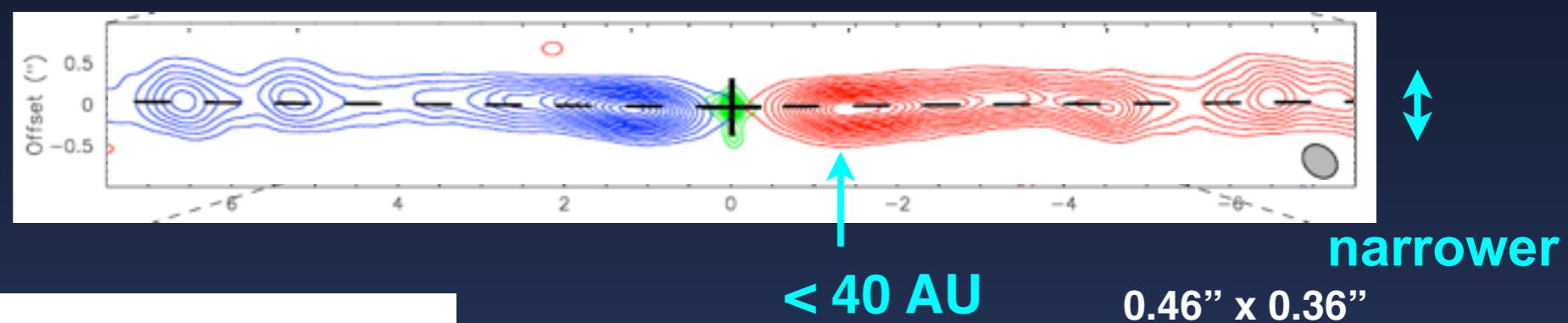
~0.5'' (125 AU) resolution

Widths of the jets

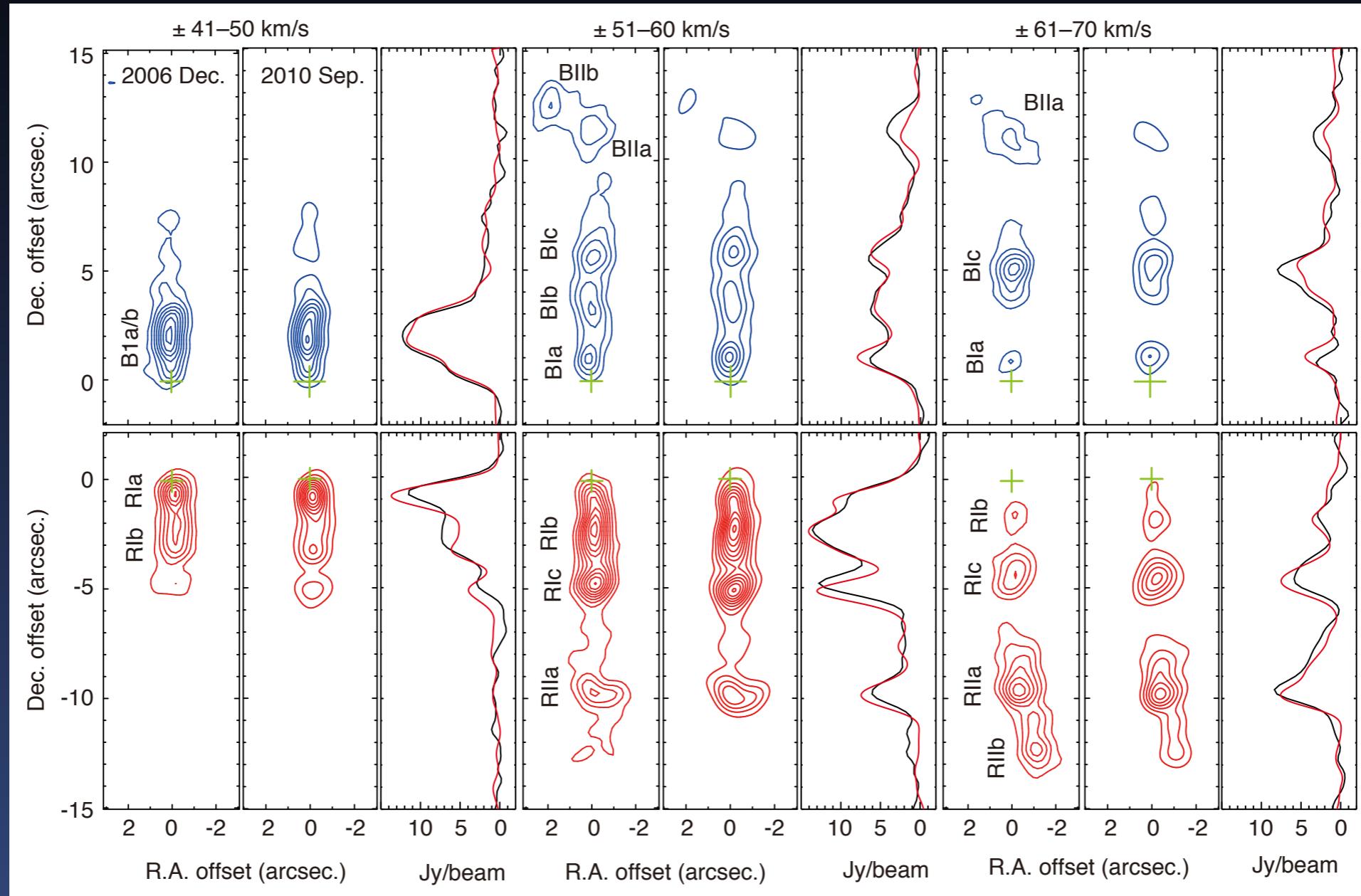
L1448C(N)



HH211



Proper motion



Blue: $0.1'' - 0.25'' / 3.75 \text{ yr}$

Red: $0.15'' - 0.35'' / 3.75 \text{ yr}$



$\sim 0.03'' - 0.08'' / \text{yr}$

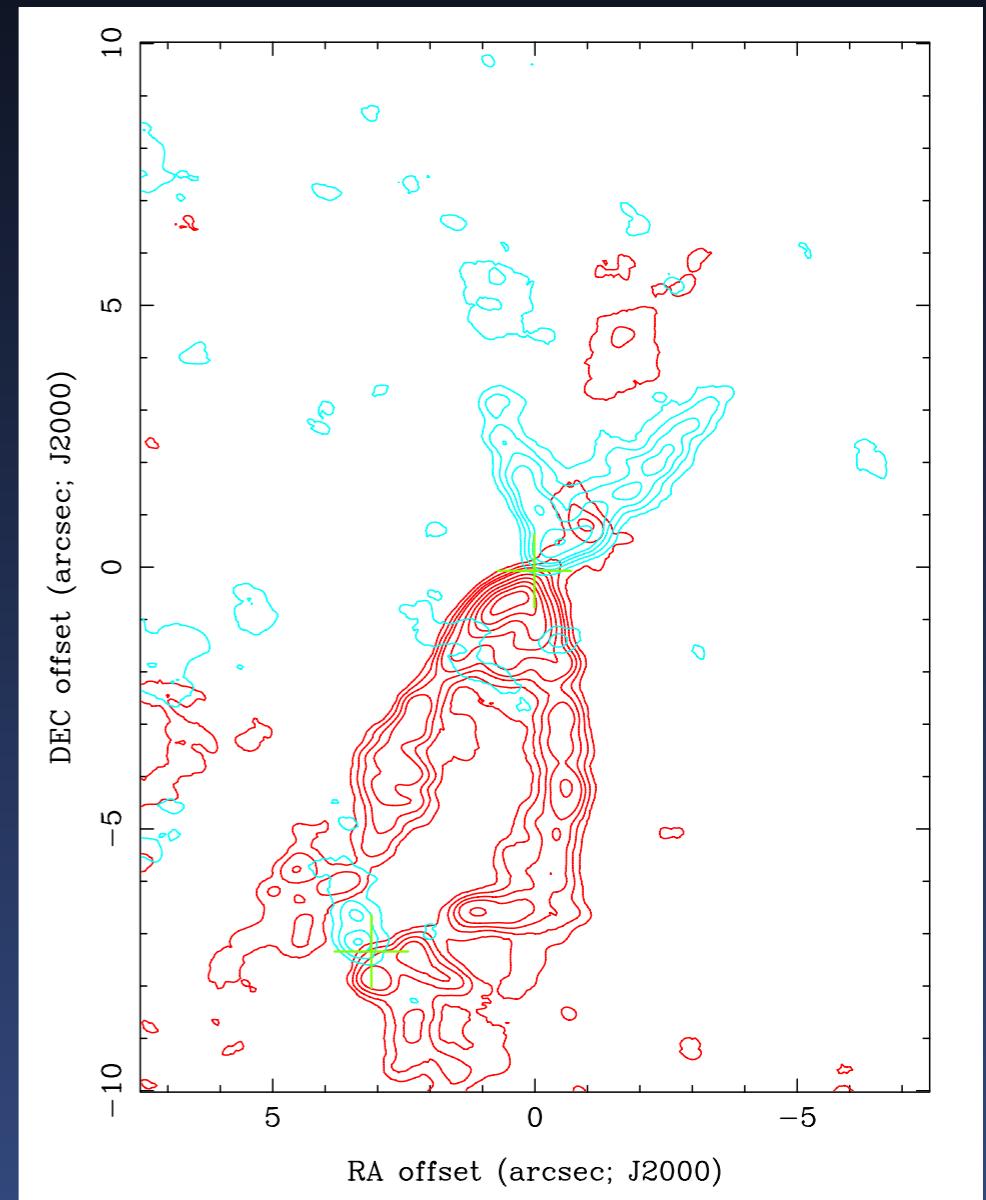
$< 0.12'' / \text{yr}$ @ RII knot

(Girart & Acord 2001)

Jet velocity & inclination

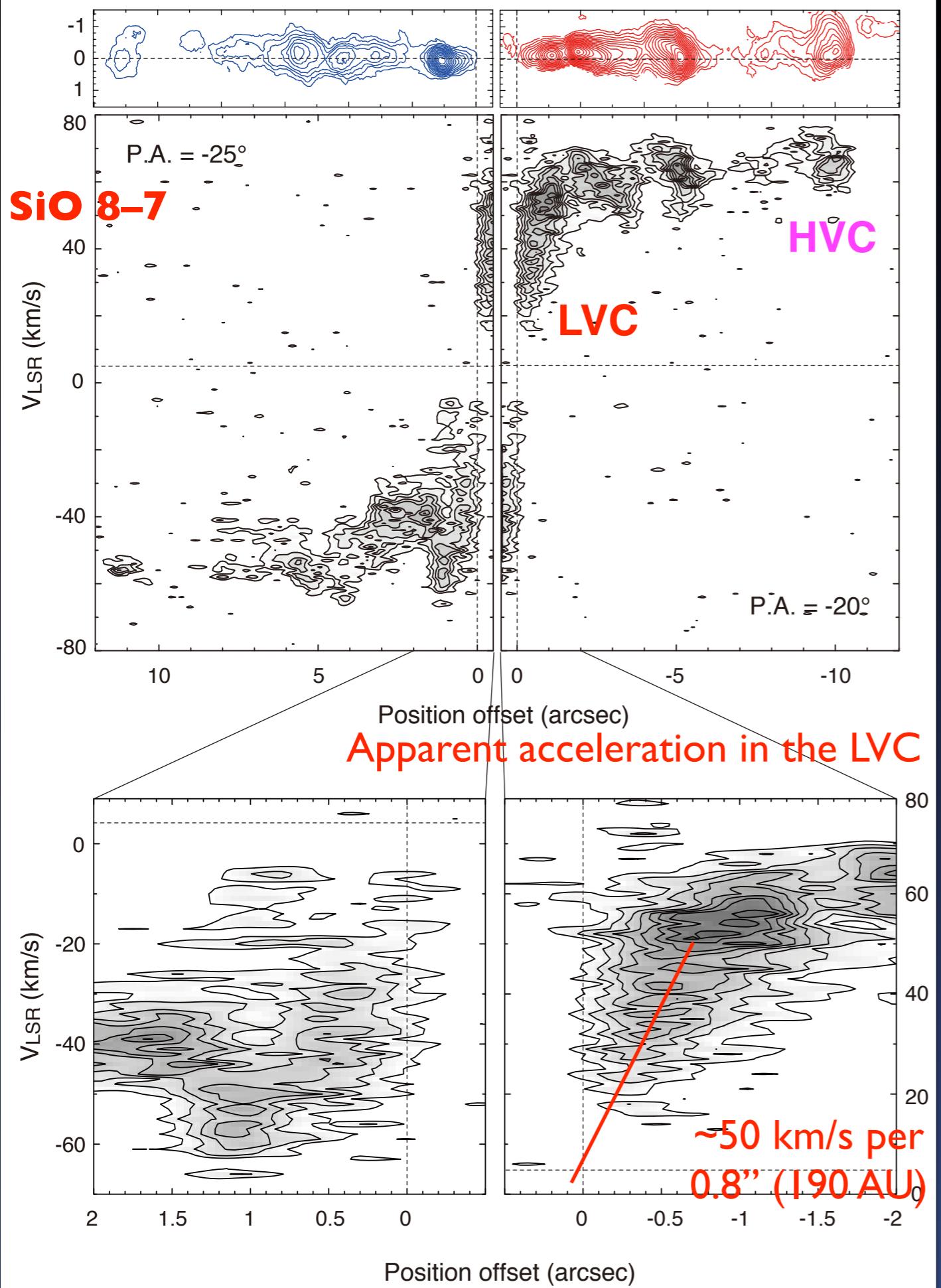
- proper motion: 0.03–0.08''/yr
- V_{trans} : 40–90 km/s
- V_{3D} : 70–110 km/s
- i (from POS): $\sim 45^\circ$
 - H_2O maser jet @ 60 mas, $i \sim 47^\circ$ (*Hirota et al. 2011*)
 - $R_{\text{II}} 0.12''/\text{yr}$ (*Girart & Acord 2001*) $\rightarrow V_{\text{trans}} = 134 \text{ km/s}$ @ 235 pc, $i \sim 28^\circ$

Evidence of large inclination



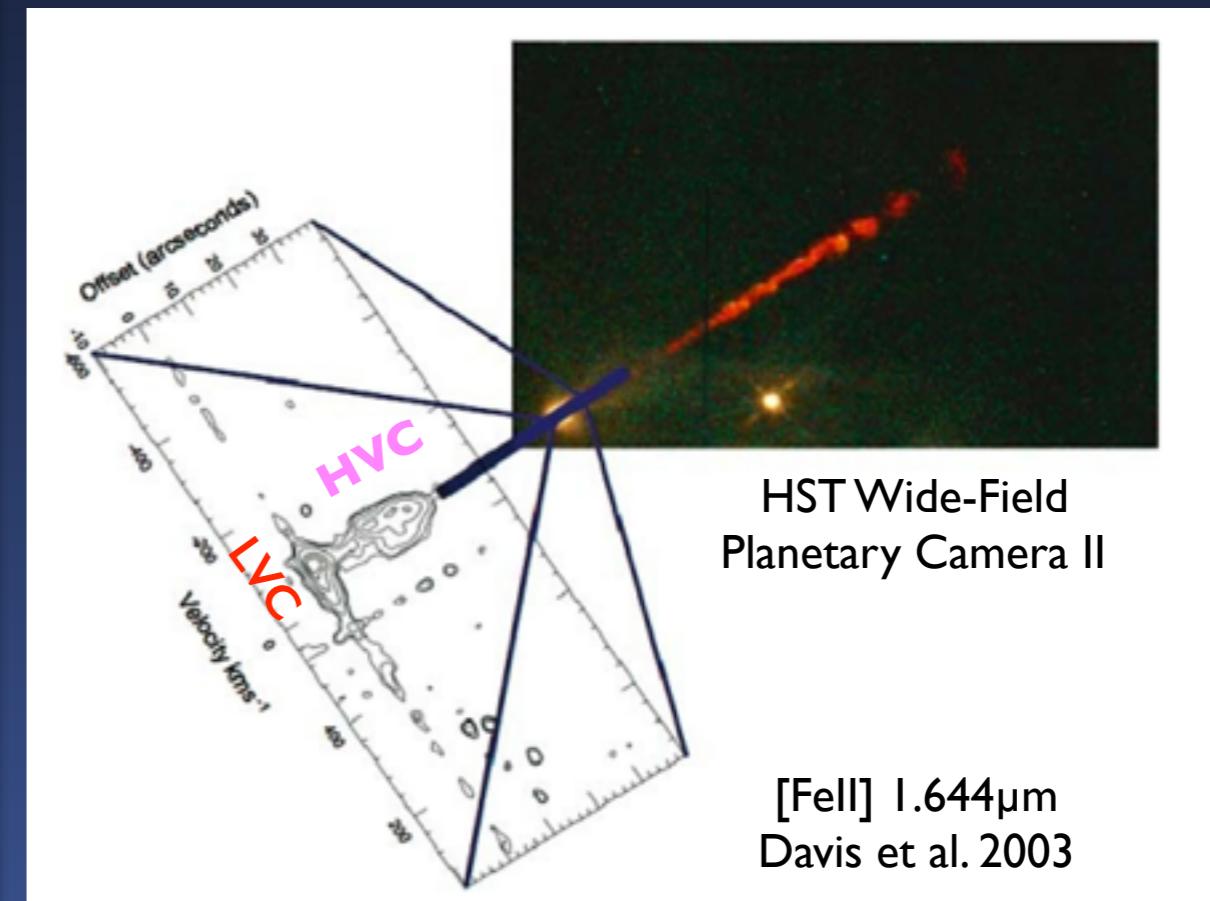
Larger inclination angle in the inner part of the jet

Kinematics

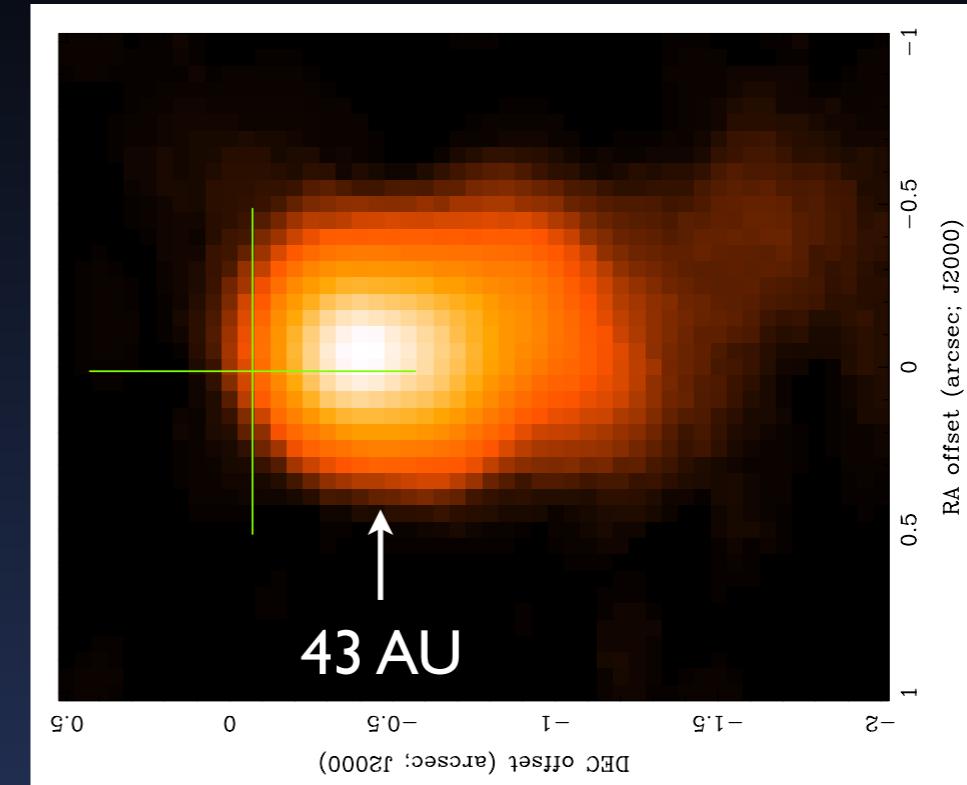
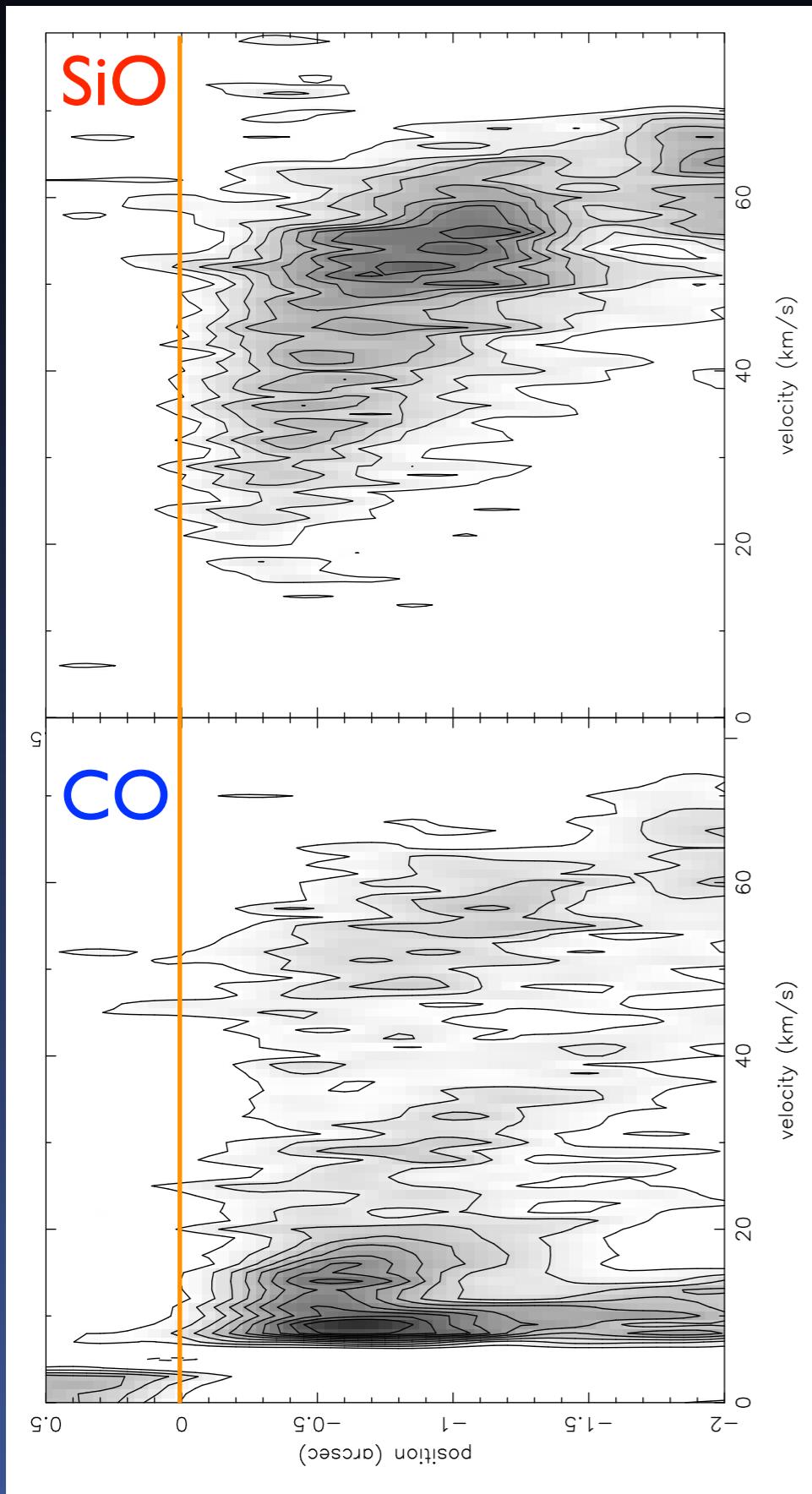


LVC: Low-velocity & broad component near the jet base
HVC: High-velocity component in the jet body

Class I jet HH34



LVC in SiO & CO

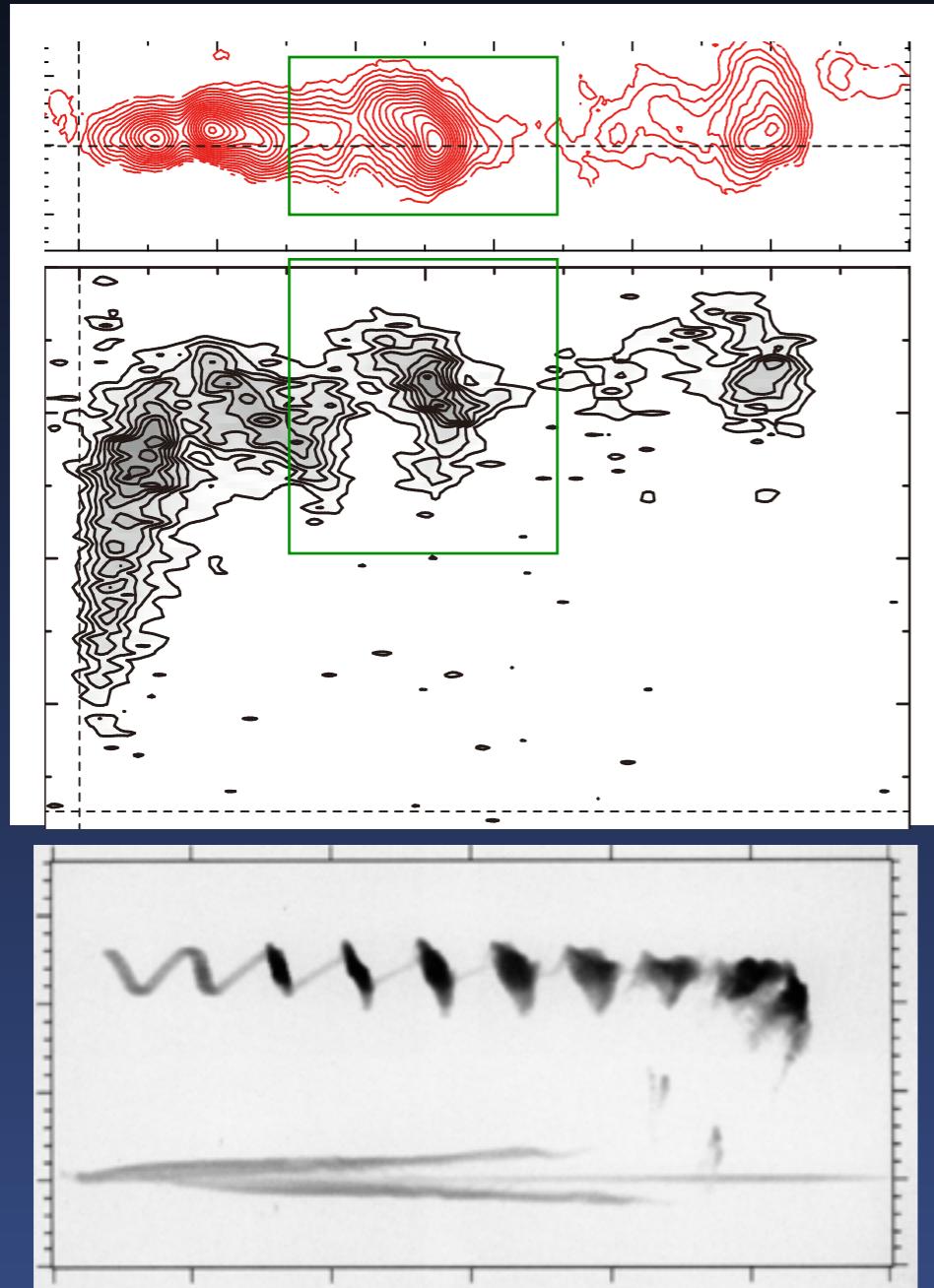


SiO LVC (+10–40 km/s)
deconvolved width: 43 AU @ 121 AU
opening angle at the base $\sim 40^\circ$

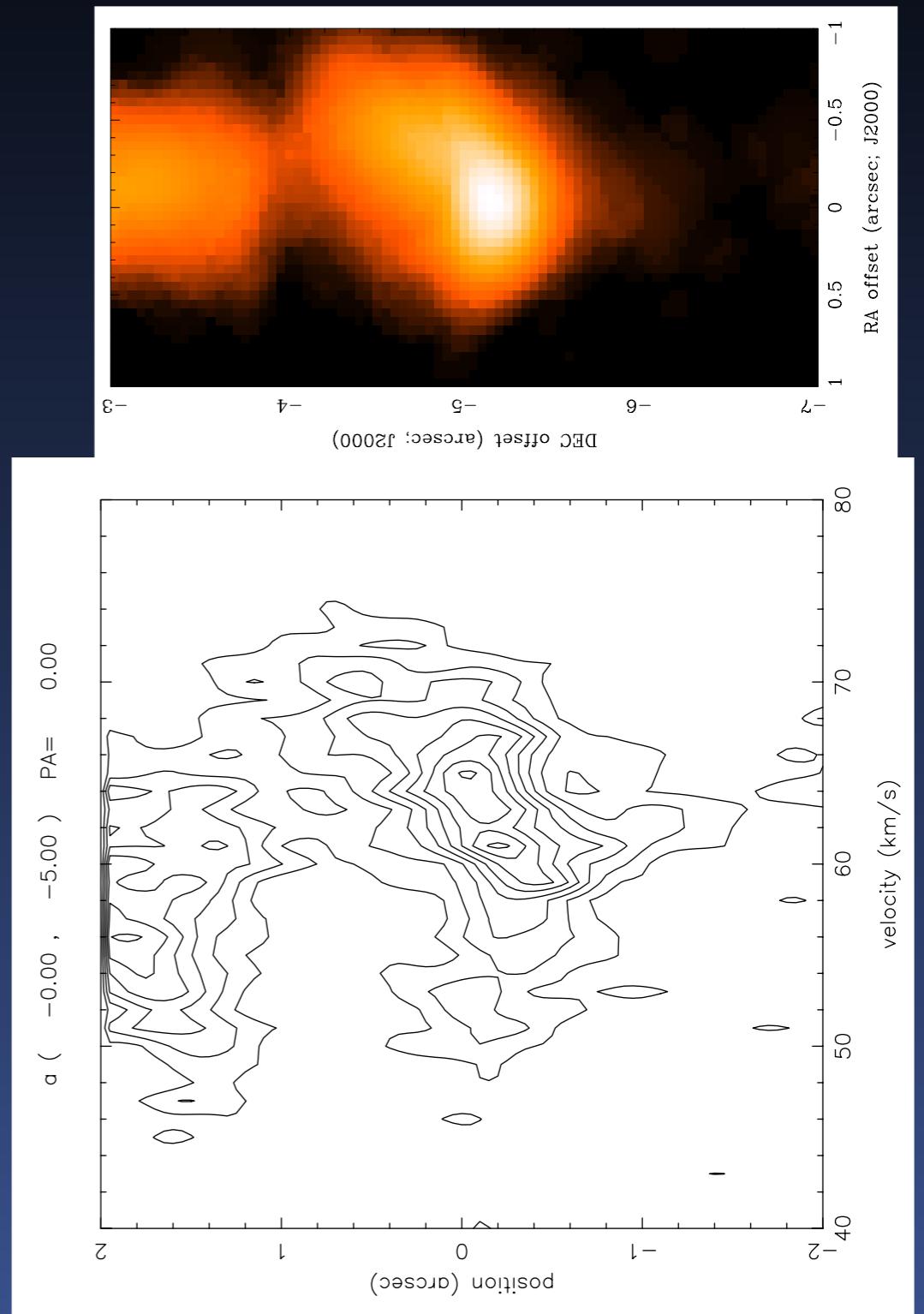
SiO better traces the LVC at the jet base
→ interaction between the jet and
surrounding material?

Velocity structure of the jet knots

Saw-tooth velocity pattern



Bow shock @ RI-c



Reproduced by the Pulsed jet model
(Stone & Norman 1993)

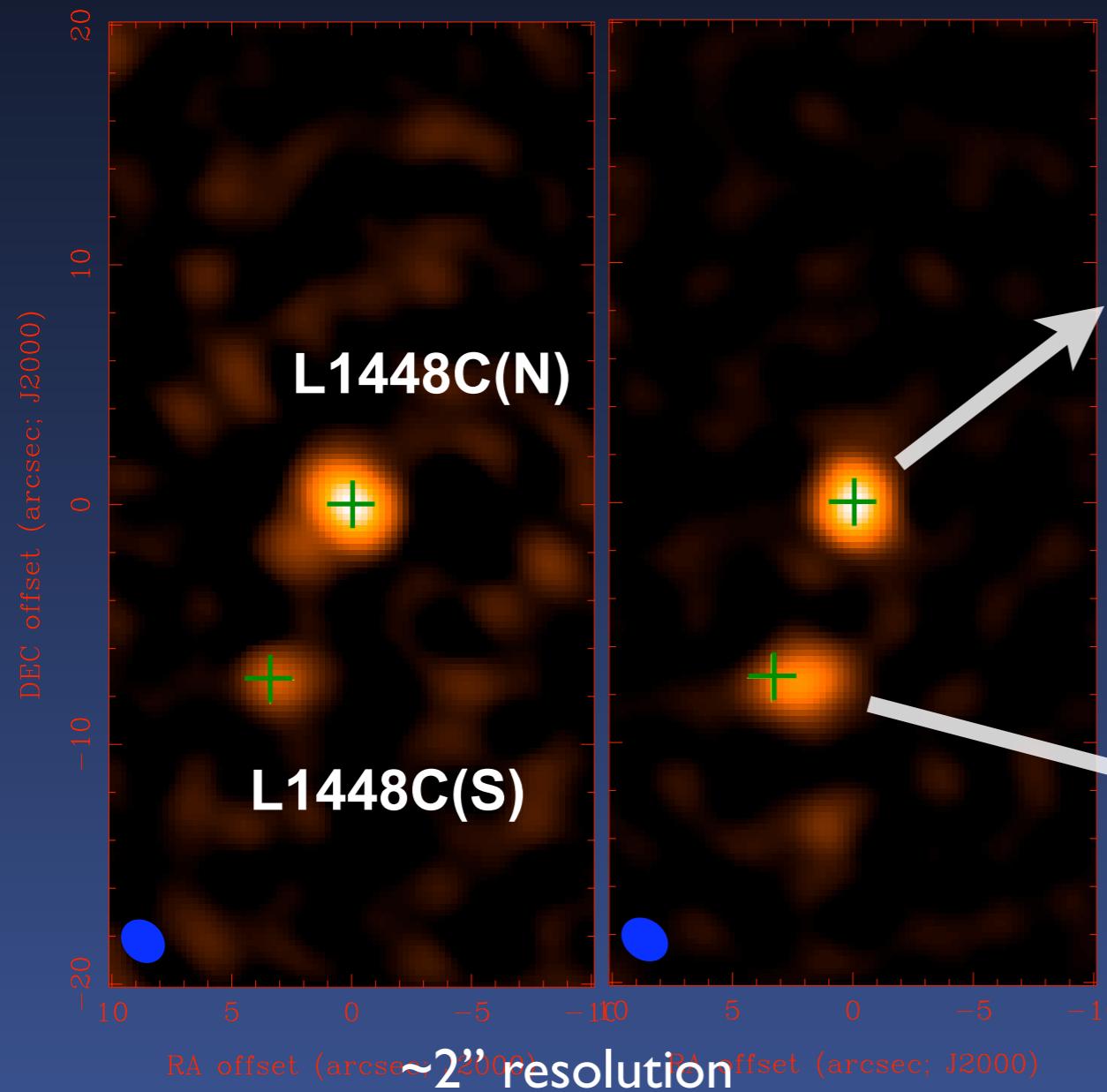
Jet -ambient gas interaction probed by HCN

HCN 4–3 @ L1448C(N)

(0, +1)

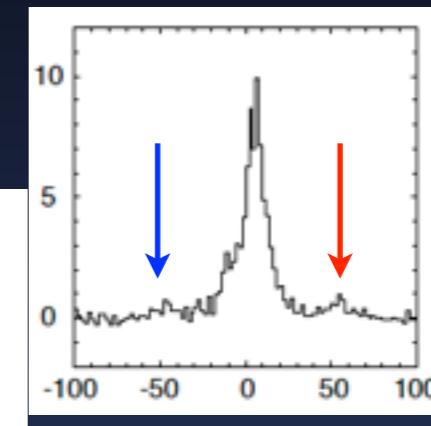
Continuum

HCN 4–3

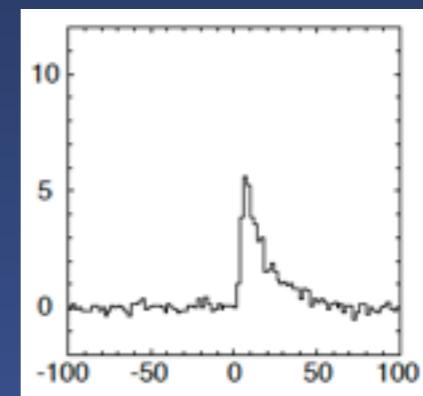


(0, -1)

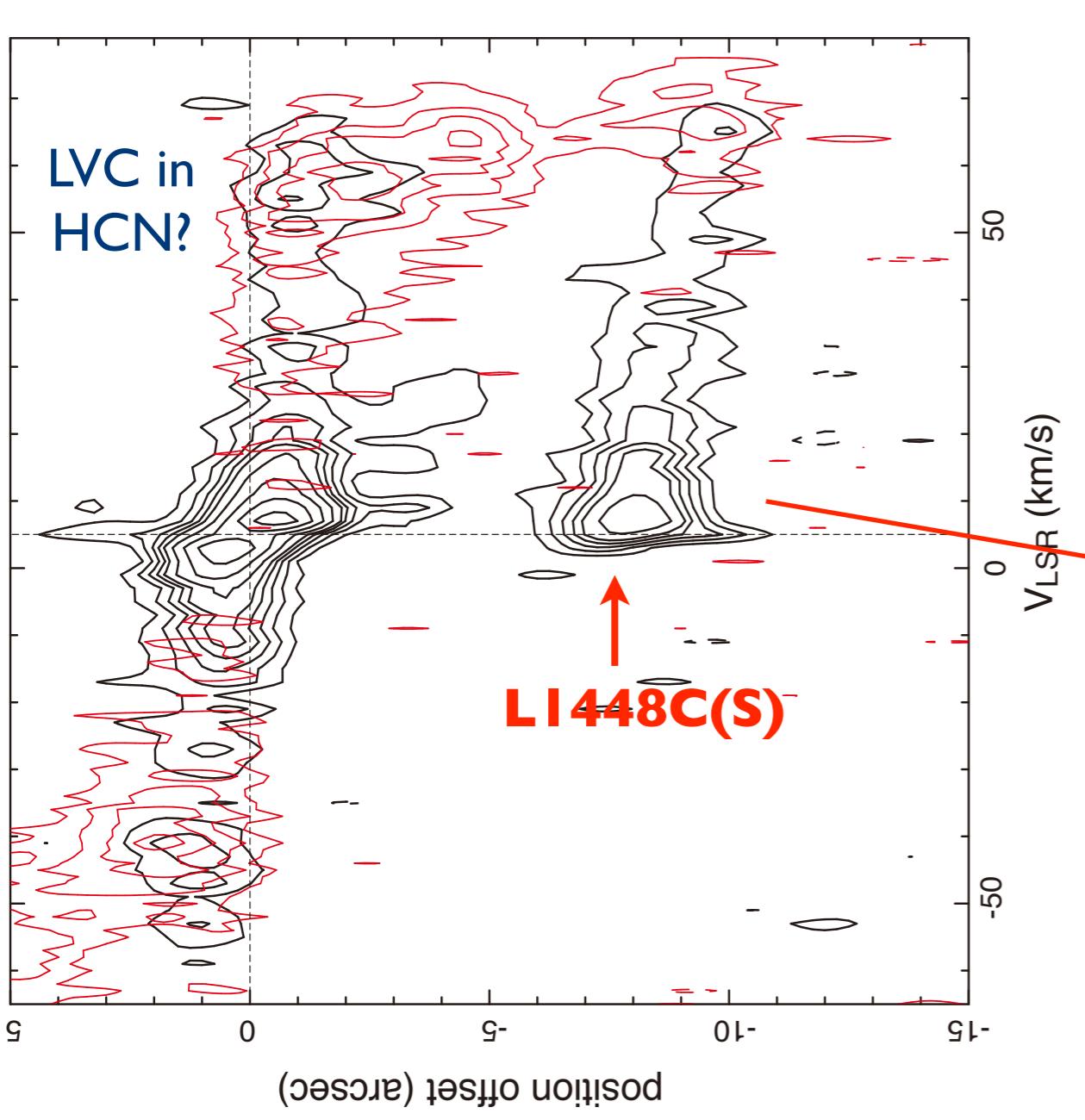
(0, 0)



HCN 4–3 @ L1448C(S)

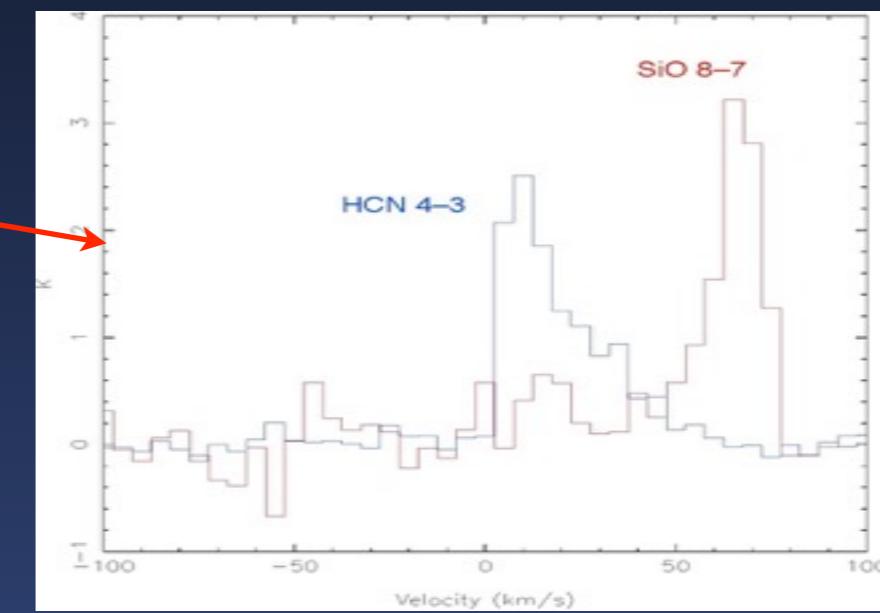


HCN v.s. SiO



HCN is significantly enhanced in the region of jet-ambient gas interaction

*HCN is not seen in the jet body
≠ SiO*



The jet from LI448C(N) is dynamically interacting with the LI448C(S) envelope

Summary

- ▶ LI448C(N) molecular jet has similar properties as the atomic jets in Class I/II sources
 - morphology – a chain of knots
 - collimation – 70 → 240 AU
 - kinematics – LVC @ jet base + HVC @ jet body
 - wide opening angle ($\sim 40^\circ$) @ ~ 100 AU from the star
- ▶ Proper motion in 3.75 yr
 - $v_{3D} \sim 70\text{--}110$ km/s
 - $i \sim 45^\circ$ (relatively large inclination angle in the inner part of the jet)
- ▶ Jet-ambient gas interaction is traced by HCN
 - dynamical interaction with the LI448C(N) jet and the LI448C(S) envelope