Nov. 15. 2001

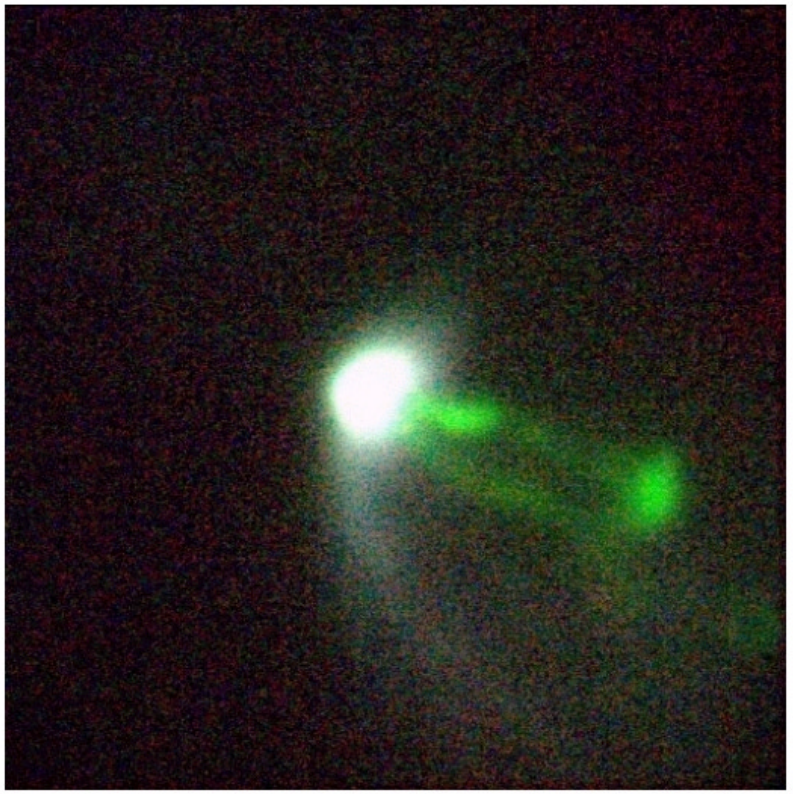
EAMAV@ ASIAA

Tae-Soo Pyo, Masahiko Hayashi, Naoto Kobayashi, Hiroshi Terada, Miwa Goto, Takuya Yamashita, Alan Tokunaga, and Yoichi Itoh

Subaru Telescope NIR Echelle Spectroscopy of the Northern Jet from the L1551 IRS 5: A Jet and A Disk Wind

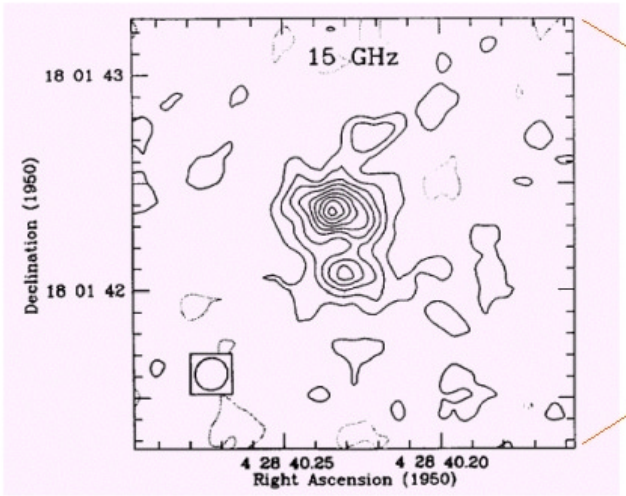
[Dec. 15. 2000]

H-cont : Blue
[Fe II] : Green
K-cont : Red

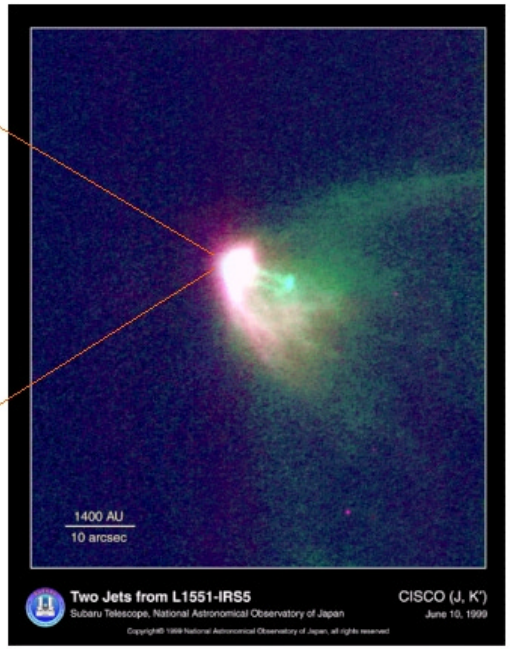


I. Introduction

- **Two Jets(?) and Circumbinary Disk**



Bieging & Cohen (1985)



II. Observations and Data Reduction

- Subaru Telescope + IRCS

	Narrow Band Imaging	Echelle Spectroscopy
Obs. Date	2000 Dec. 15	2000 Dec. 16
Seeing	~ 0.6 arcsec	~ 0.3 arcsec
Pixel Scale	0.058 X 0.058 arcsec^2	0.075 X 0.075 arcsec^2
Wavelnegth Range	[Fe II] λ1.644 $\pm$ 0.013 μm H–cont λ1.573 $\pm$ 0.010 μm	H band (1.49 – 1.83 μm)
Wavelength Resolution	$R_{[Fe\ II]}$ ~ 63 (4745 km/s) $R_{H\text{-}cont}$ ~ 78 (3822 km/s)	R ~ 5000 (59 km/s) with 0".6 slit
Exposure Time	660 sec ([Fe II]), 1380 sec (H-cont)	720 sec

- **Reduction by using IRAF Packages**

Dark Subtraction

Flat Fielding by APNORMALIZE Task

Removing Bad Pixels and Cosmic Ray Events

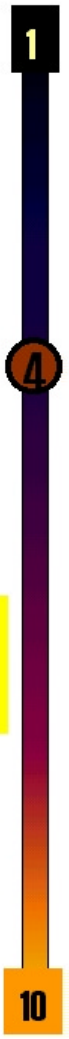
Extract Each Order of the Spectra by APALL Task

Wavelength Calibration and Distorted Line Image Correction by IDENTIFY, REIDENTIFY, FITCOORDS, and TRANSFORM

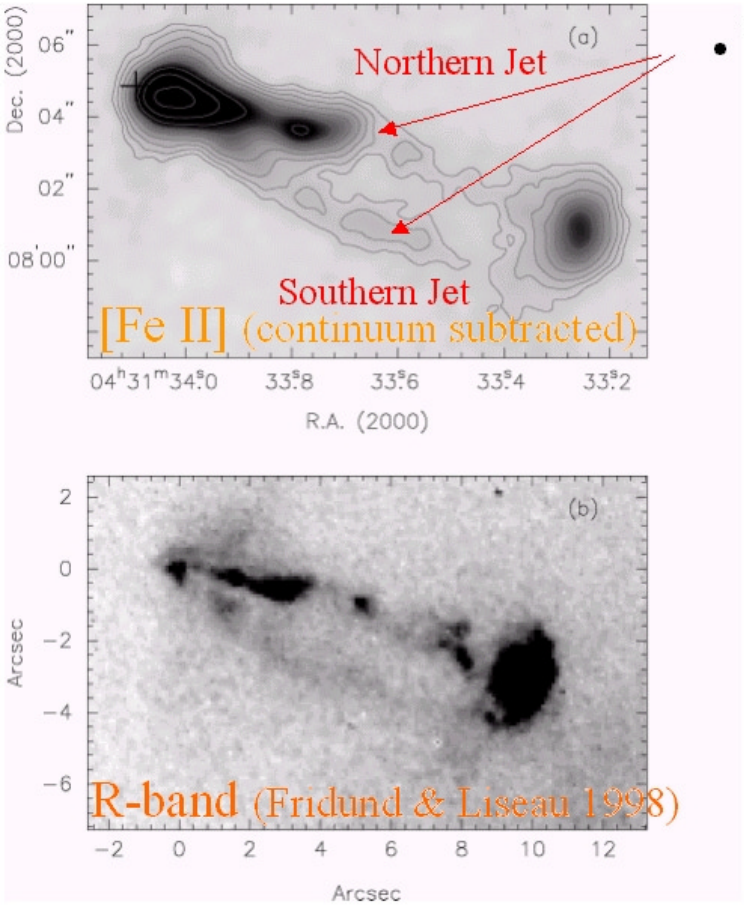
Sky Subtraction

Wavelength Sensitivity and Atm. Transmission Correction

Flux Calibration



III. Results Spatial Distribution of [Fe II] λ 1.644 μm



- Well Separated Two Jets

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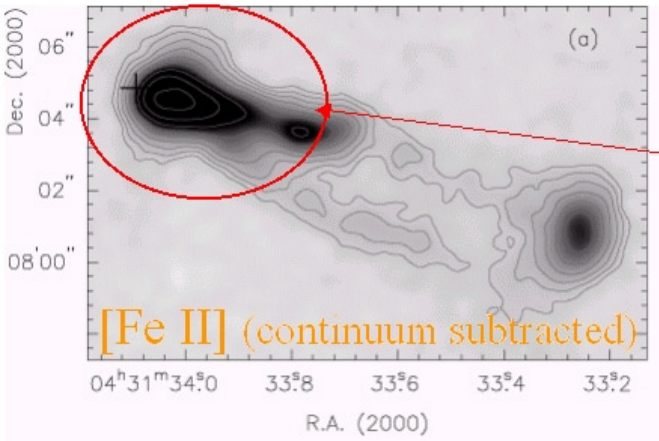
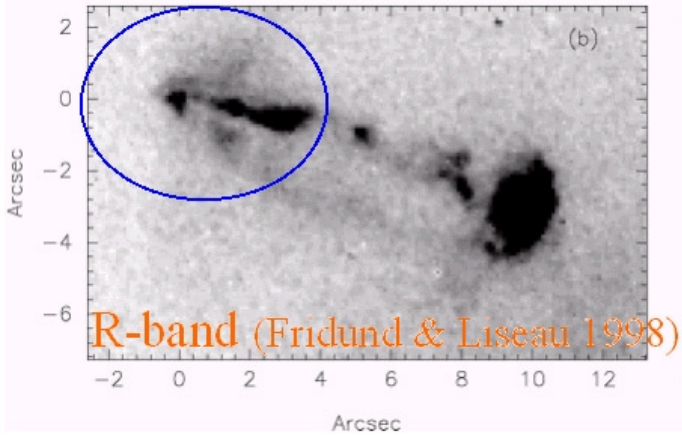
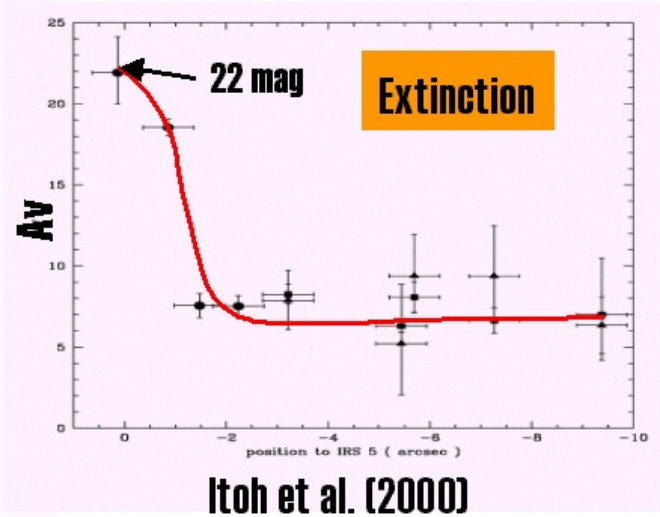




- Well Separated Two Jets
- Strong and wide [Fe II] Emission



Itoh et al. (2000)

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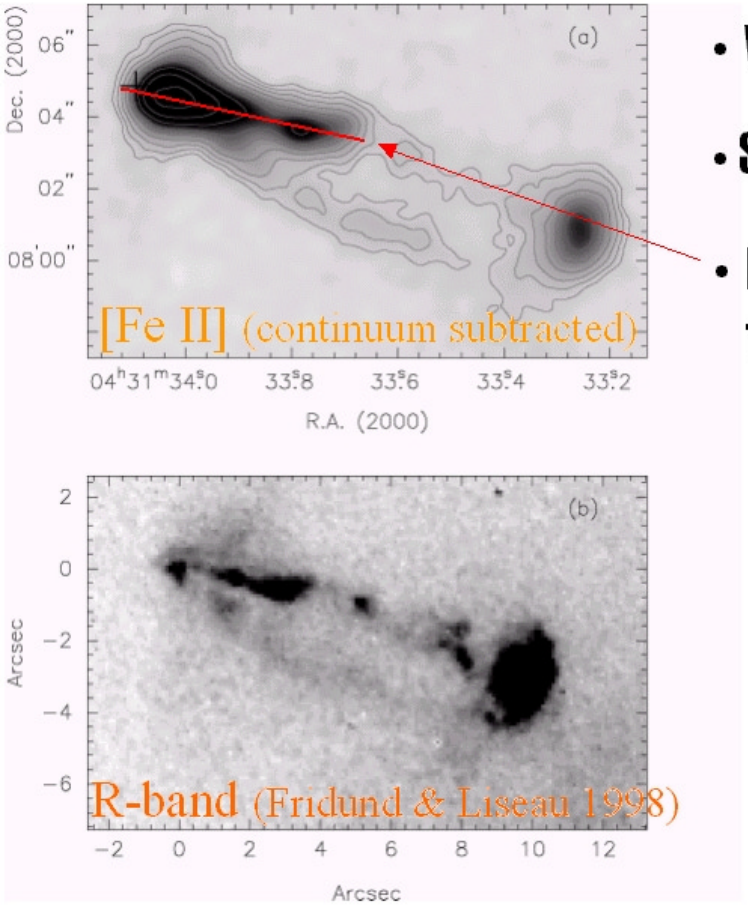

- Well Separated Two Jets
- Strong and wide [Fe II] Emission
- Elongated Feature along the Northern Jet

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5
10

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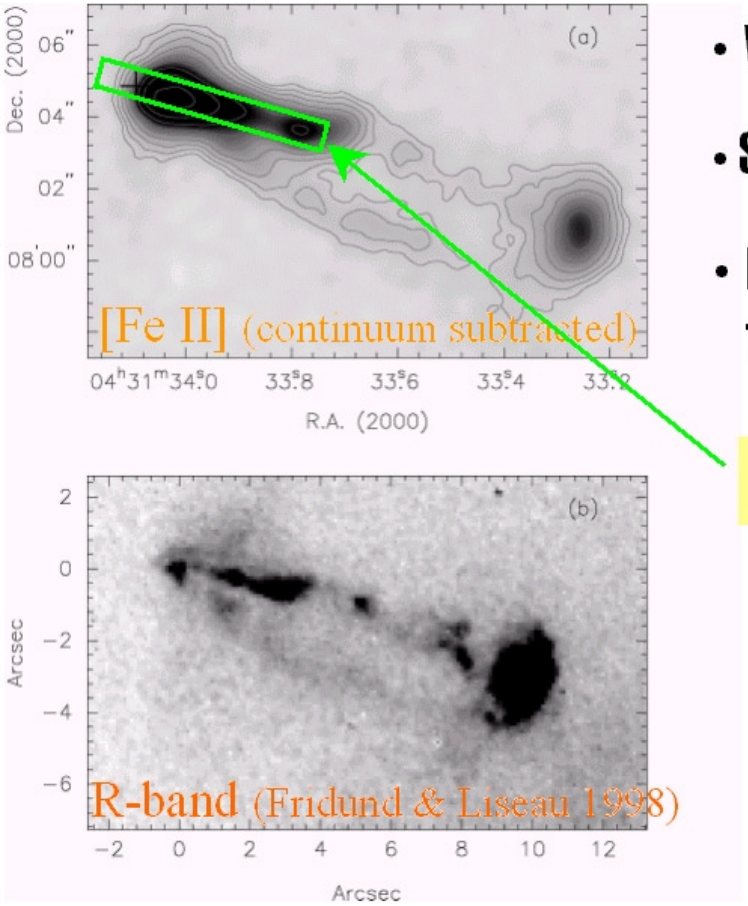
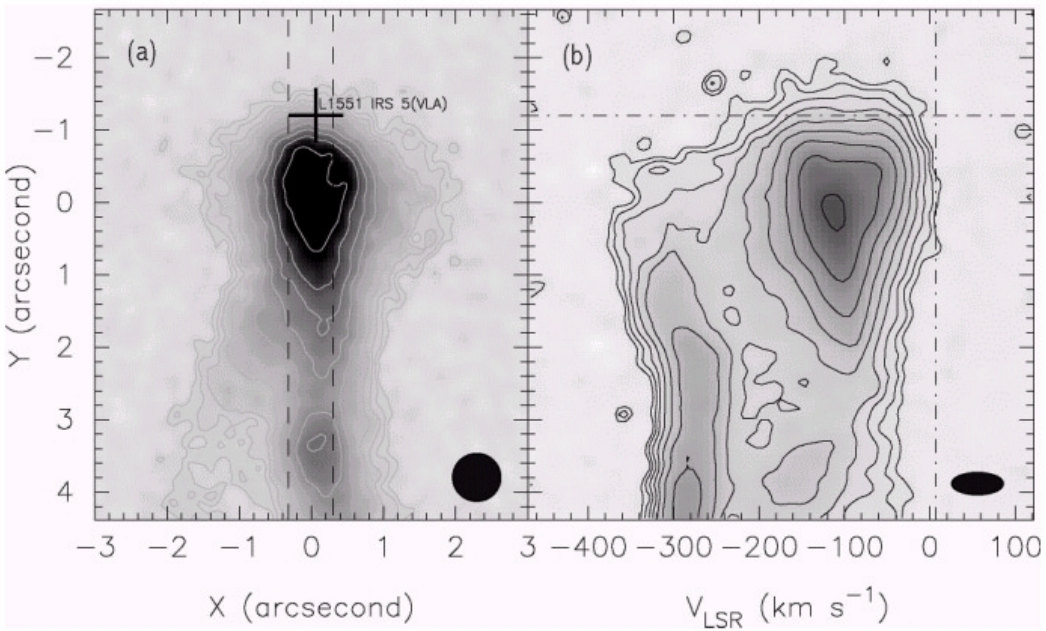


- Well Separated Two Jets
- Strong and wide [Fe II] Emission
- Elongated Feature along the Northern Jet

Slit Position

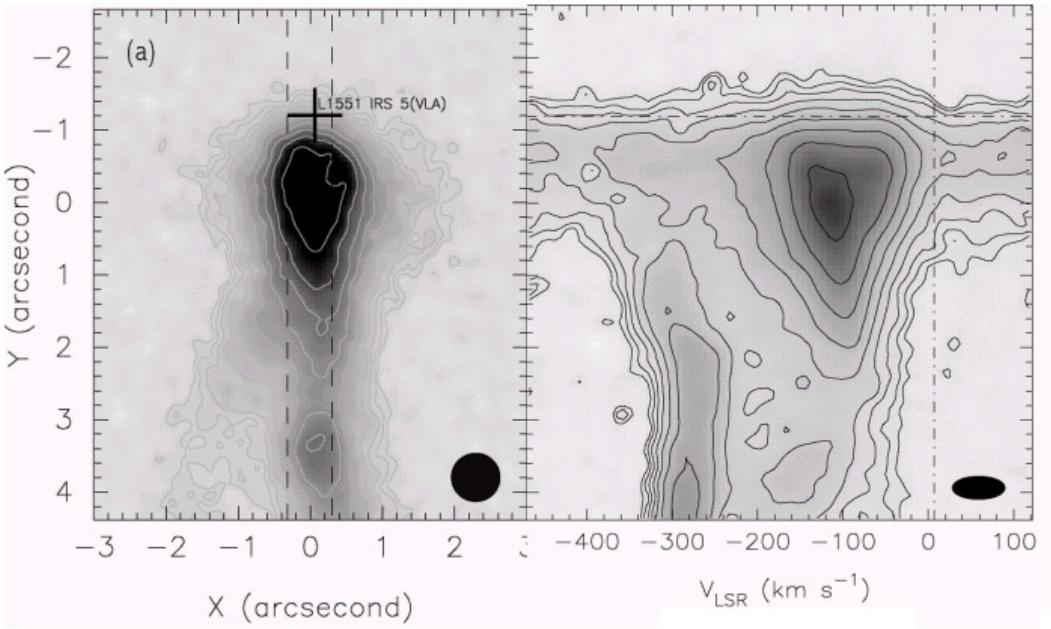
1 5 10

III. Results Velocity Structure of the Northern Jet



Pure [Fe II] : Intensity and Position-Velocity Map

III. Results Velocity Structure of the Northern Jet



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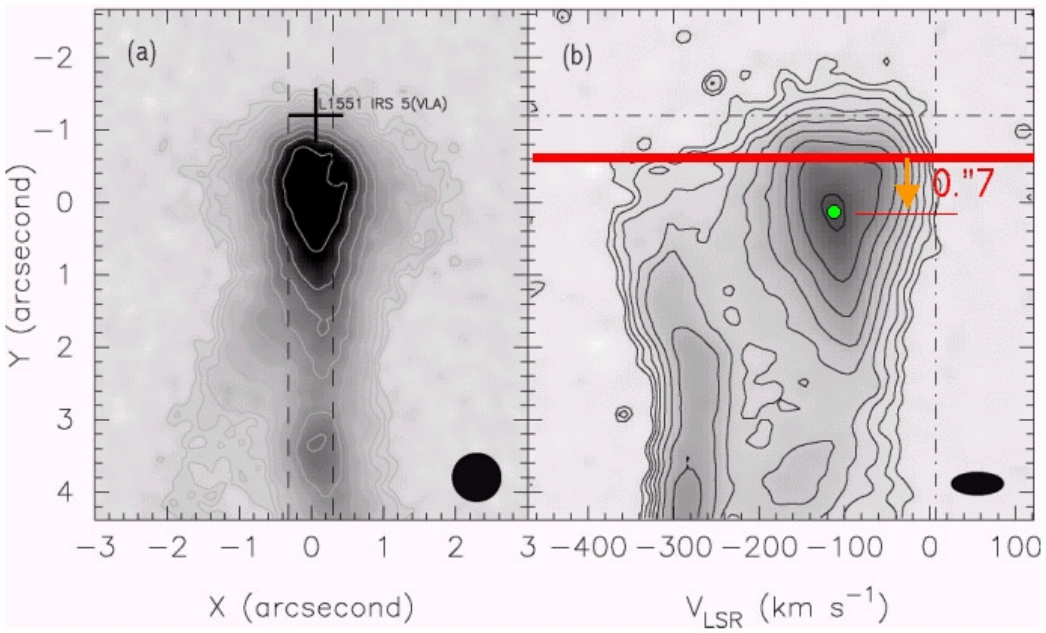

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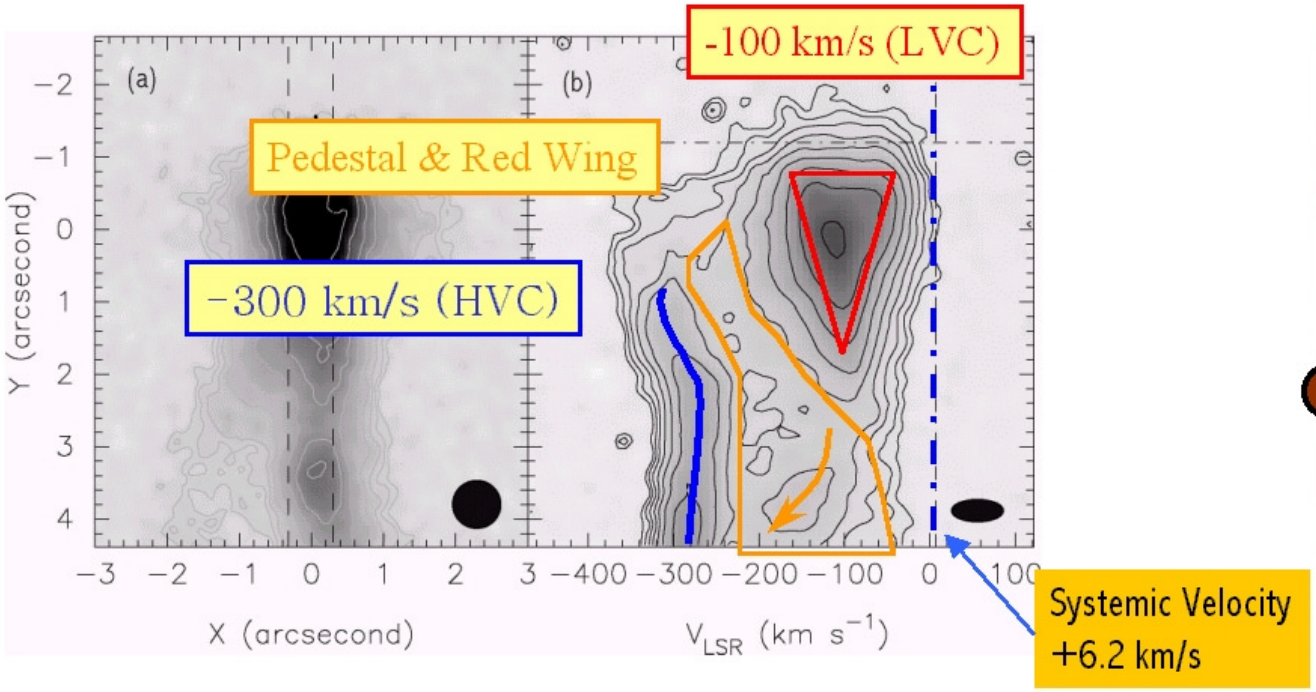


Pure [Fe II] : Intensity and Position-Velocity Map

IV. Discussion Analogy to T Tauri Outflows

1. Two blue-shifted velocity components.
2. HVC located farther away from the origin and is spatially more extended than the LVC.
3. HVC shows narrow line width and LVC has broad line width.

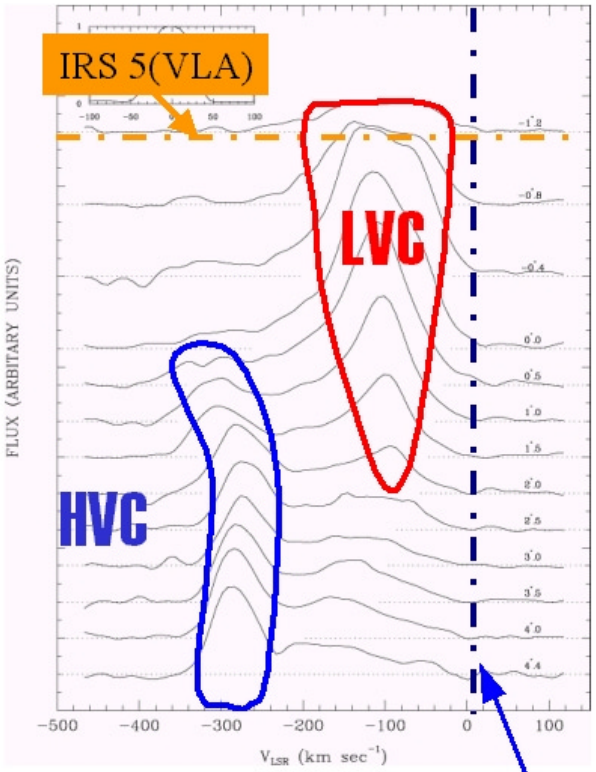
Similar to forbidden lines from CTTSs
: Two components differ in spatial, kinematical, and physical properties.

IV. Discussion — Analogy to T Tauri Outflows

1. Two blue-shifted velocity components.
2. HVC located farther away from the origin and is spatially more extended than the LVC.
3. HVC shows narrow line width and LVC has broad line width.

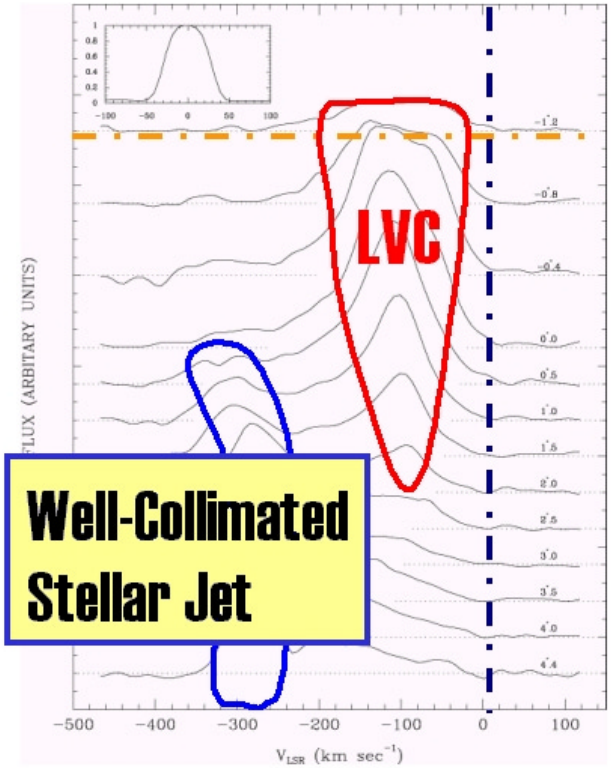
Kwan & Tademaru (1988,1995)
Two Different Outflows:
A Jet and A Disk Wind

IV. Discussion Collimation of the Two Outflows



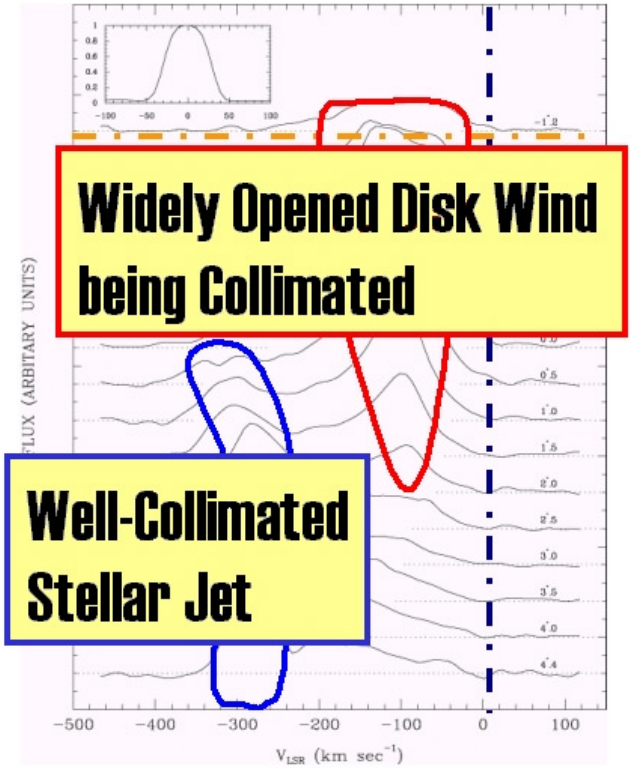
Systemic Velocity +6.2 km/s

IV. Discussion — Collimation of the Two Outflows



HVC (Jet)
High Velocity, Narrow Width

IV. Discussion — Collimation of the Two Outflows



Widely Opened Disk Wind being Collimated

Well-Collimated Stellar Jet

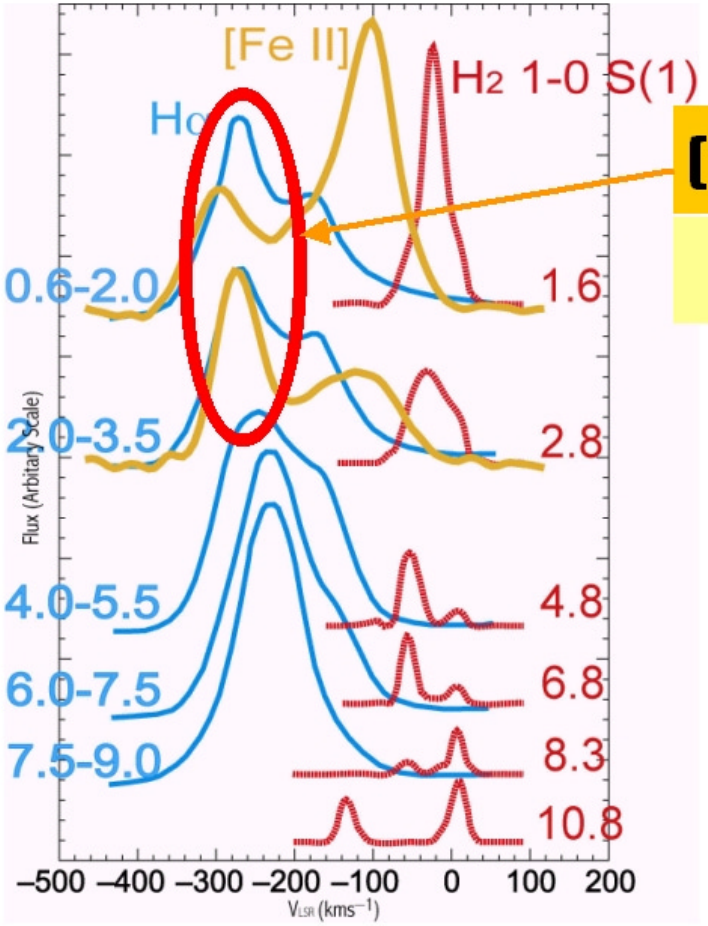
HVC (Jet)
High Velocity, Narrow Width

LVC (Disk wind)
Broad Line Width at base
Not include the systemic Velocity
→ ~~Disk Rotation~~
→ Wide Opening Angle(~95 deg.)

Decrease the Line Width
→ Collimation Process

1
8
10

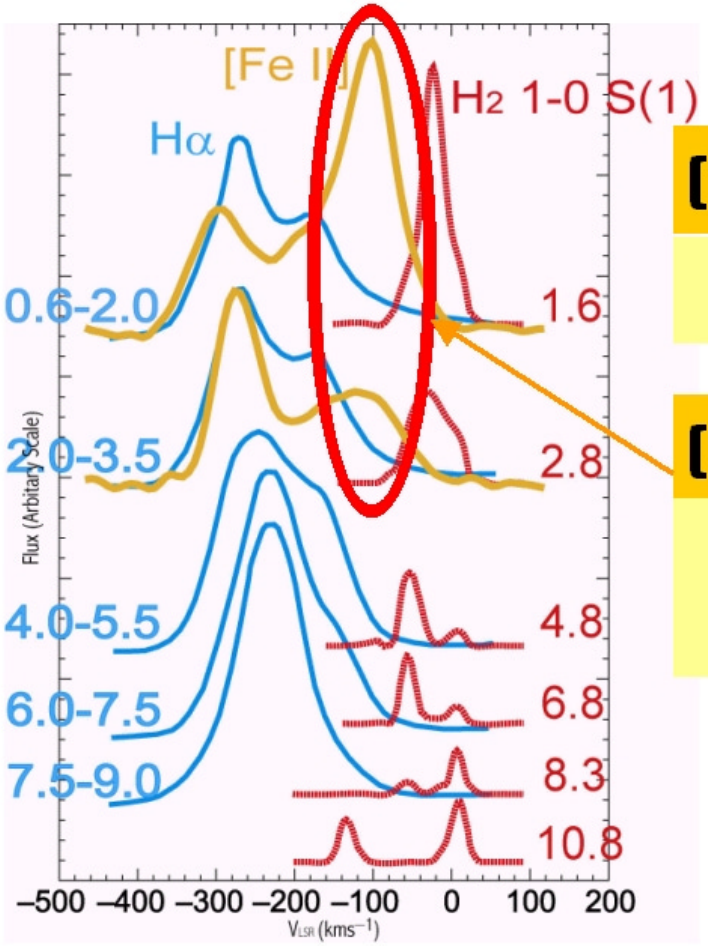
IV. Discussion — Hα, [Fe II], and H_2 emission lines



(1) HVC ⟷ Hα

Ionized Jet from Star

IV. Discussion Hα, [Fe II], and H_2 emission lines



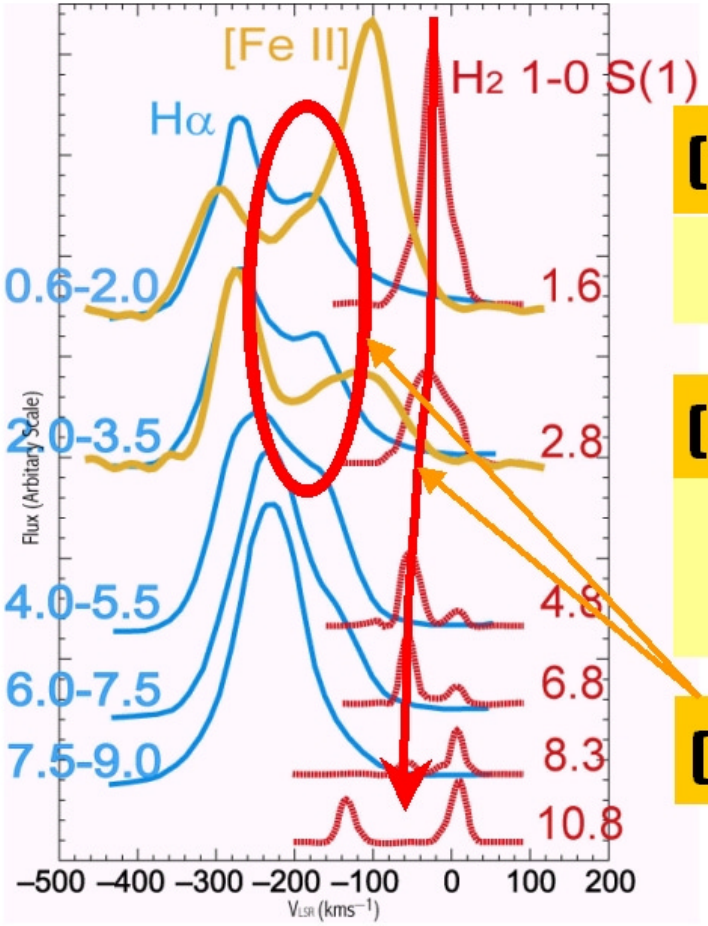
(1) HVC ⟷ Hα

Ionized Jet from Star

(2) LVC ⟷ Hα

Partially Ionized Wind from Disk

IV. Discussion — Hα, [Fe II], and H_2 emission lines



(1) HVC ⟷ Hα

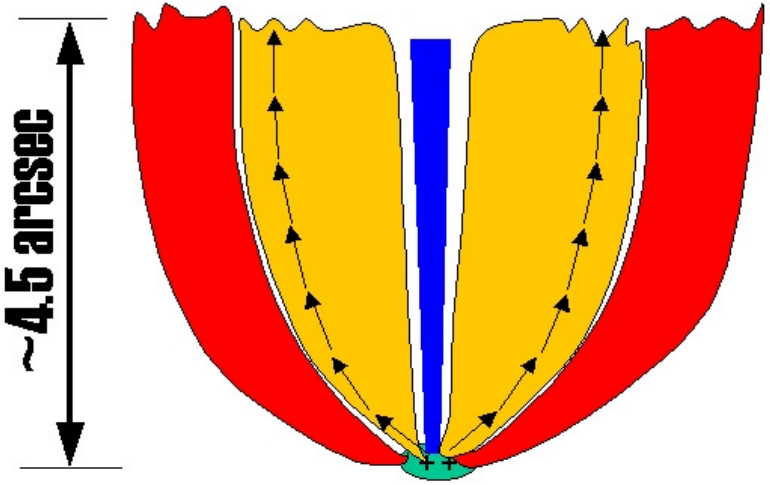
Ionized Jet from Star

(2) LVC ⟷ Hα

Partially Ionized Wind from Disk

(3) Entrained Gases

V. Summary



HVC: Well-Collimated Ionized Stellar Jet

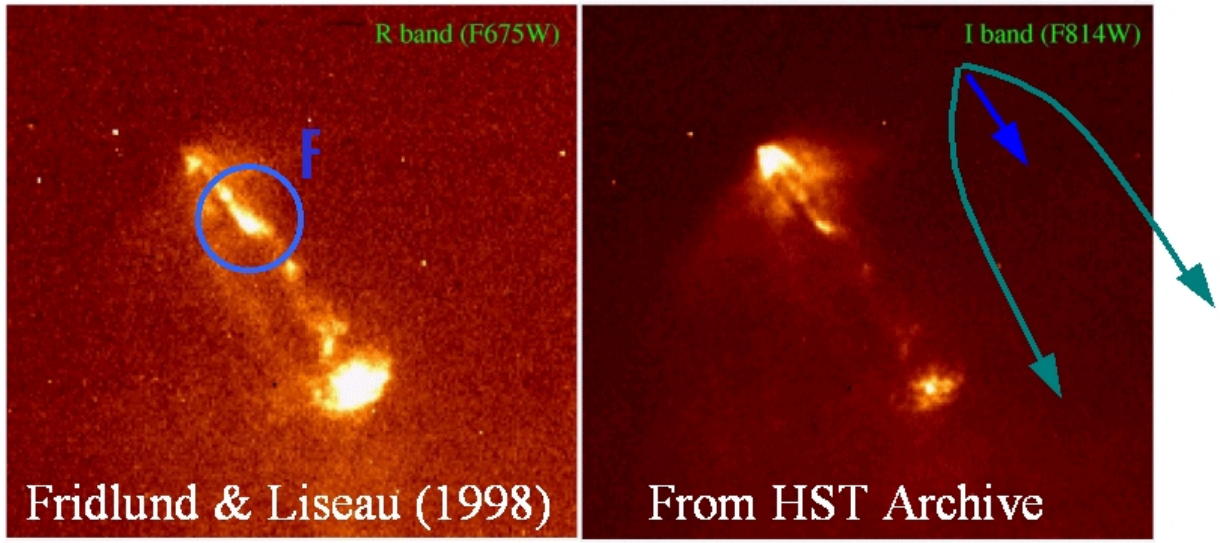
LVC: Widely Opened Partially Ionized Disk wind under Collimation Process

Entrained Wind Gas:
Pedestal and Part of Red Wing

Entrained Neutral Wind
CO, OH, HI, H_2, ...

And .....

Is it really 'Two Jets'?



F knot was observed on Oct. 1985 for the first time.
(Proper motion: $\mu = 0.17 \pm 0.04$ ″/yr)

? A Jet and Cavity Edges of Disk Wind !?

Thank you. **To Be Continued...**