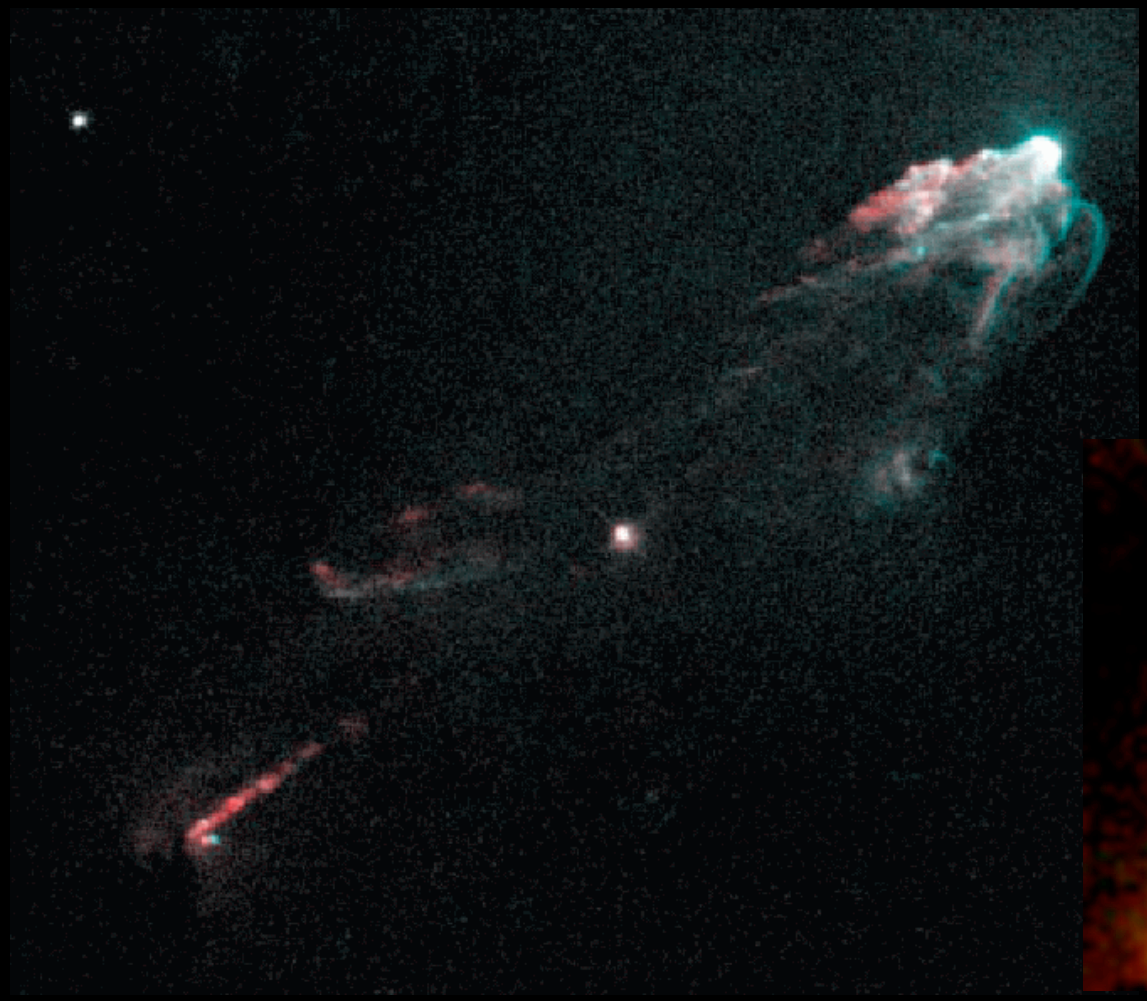
Observations and Theory

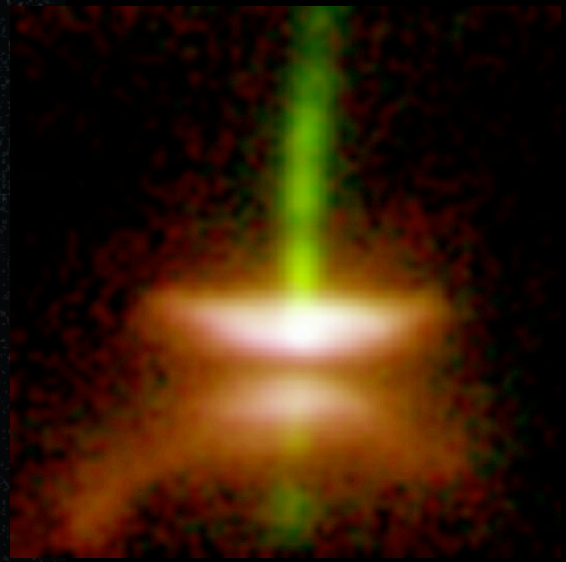
P. Hartigan for S. Matt

PPPL, Jan 20, 2010

Jets From YSO's



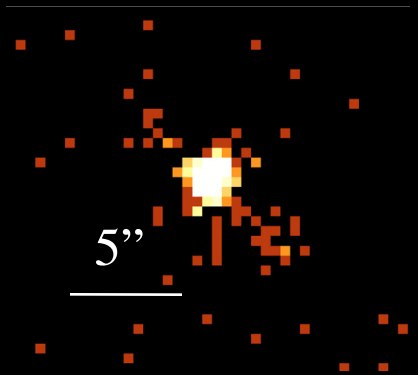
HH 1, optical; Reipurth & Bally (2001)

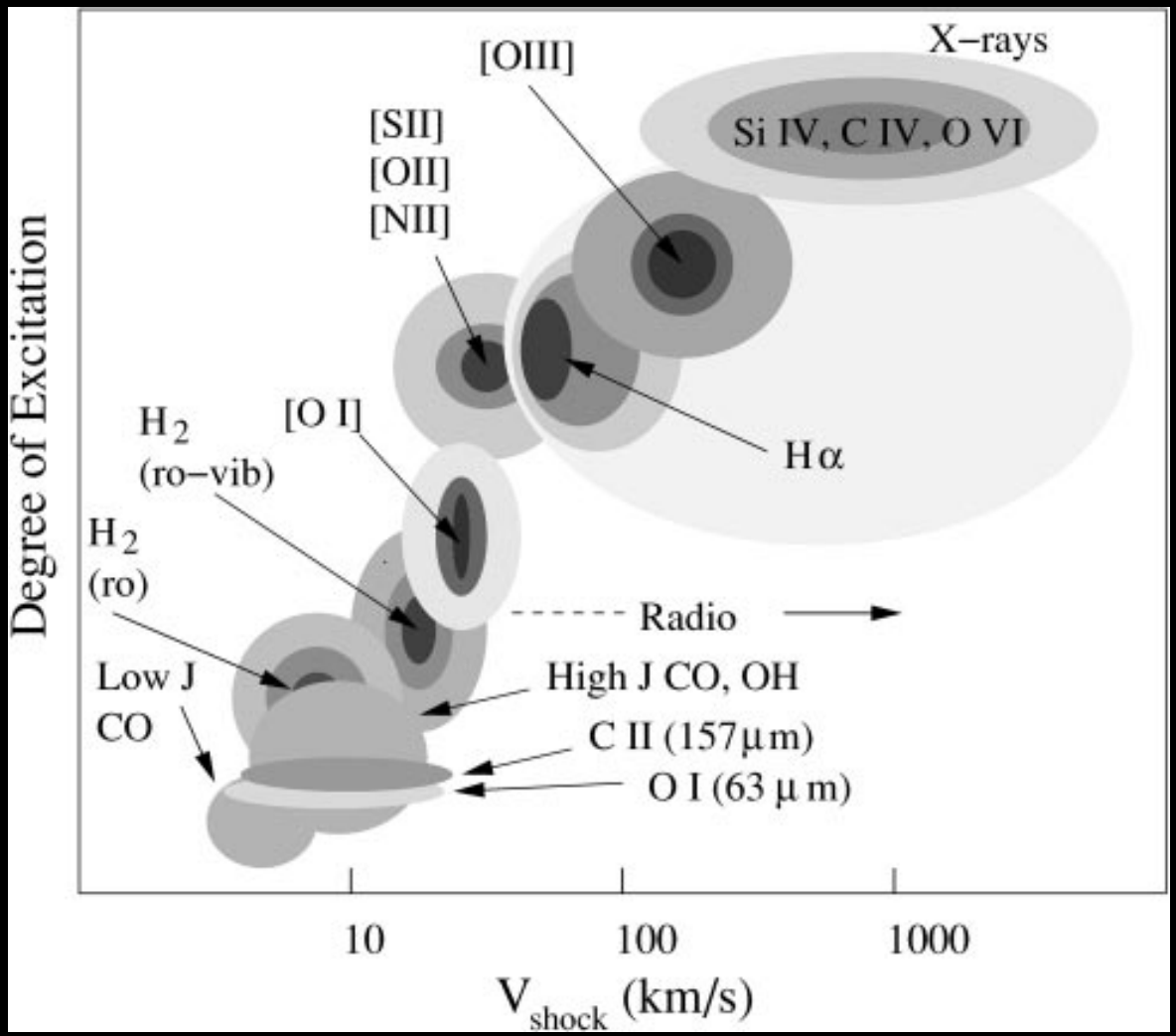


HH 30, optical; Burrows et al. (1996)

Jets From YSO's

Common jet/outflow diagnostics as a function of shock velocity.





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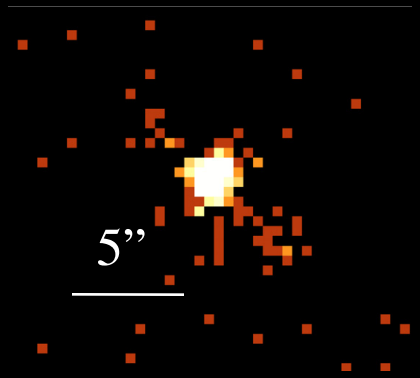
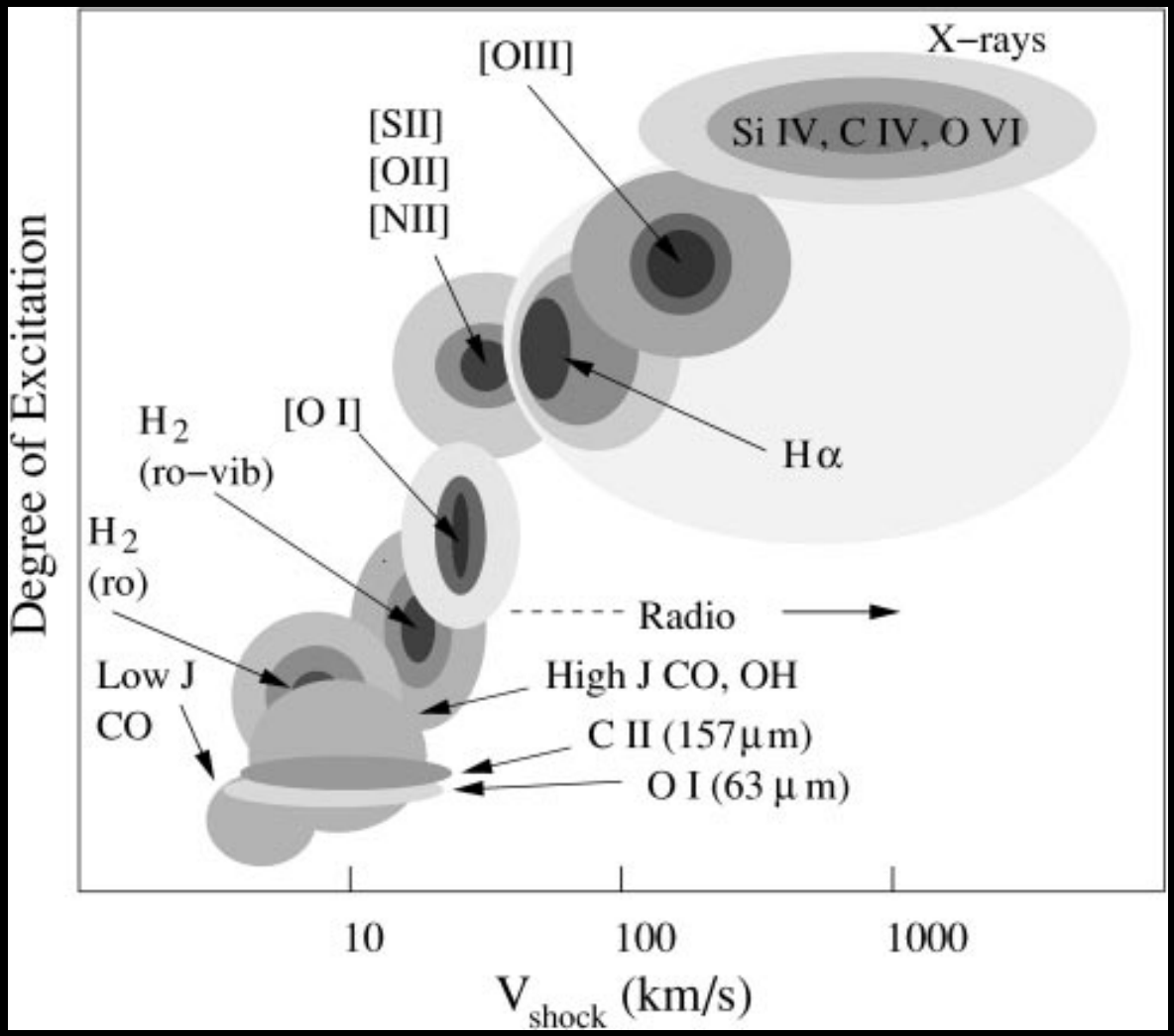


DG Tau in X-rays. Guedel et al. (2008)

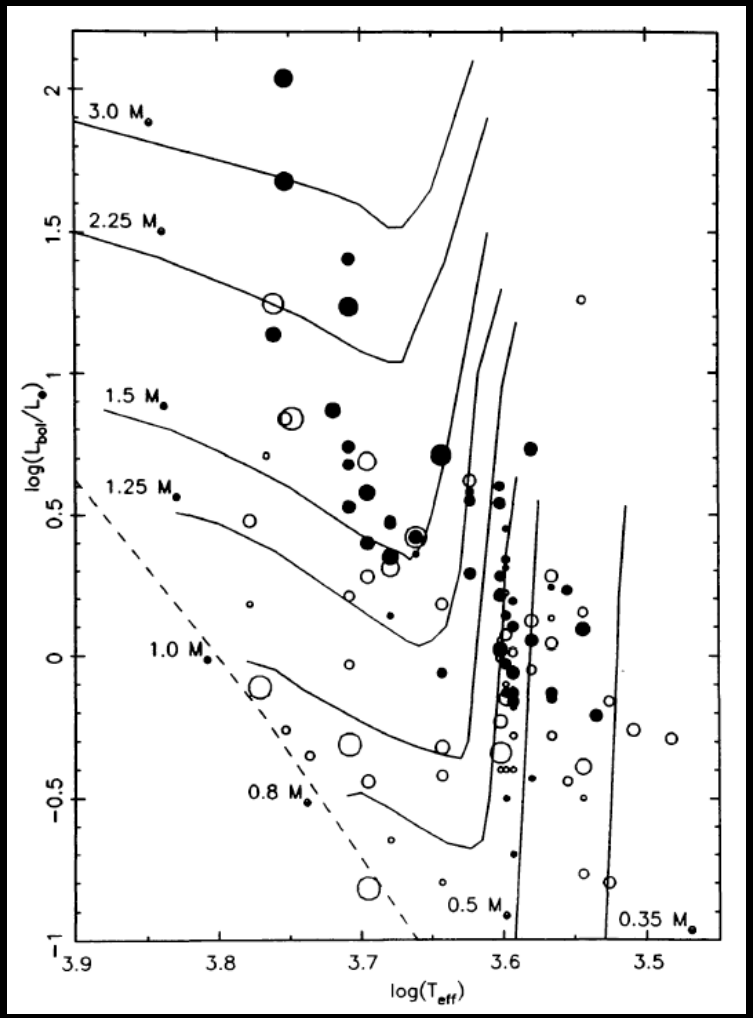


Reipurth & Bally (2001)

Central Stars

Pre-main sequence stars with accretion disks:

- Embedded Protostars (Class 0, I)
- T-Tauri Stars (Class II, III)



T-Tauri Stars; Bertout et al. (1989)

Central Stars

Spatially unresolved, spectral evidence for outflows: e.g., P-Cygni profiles

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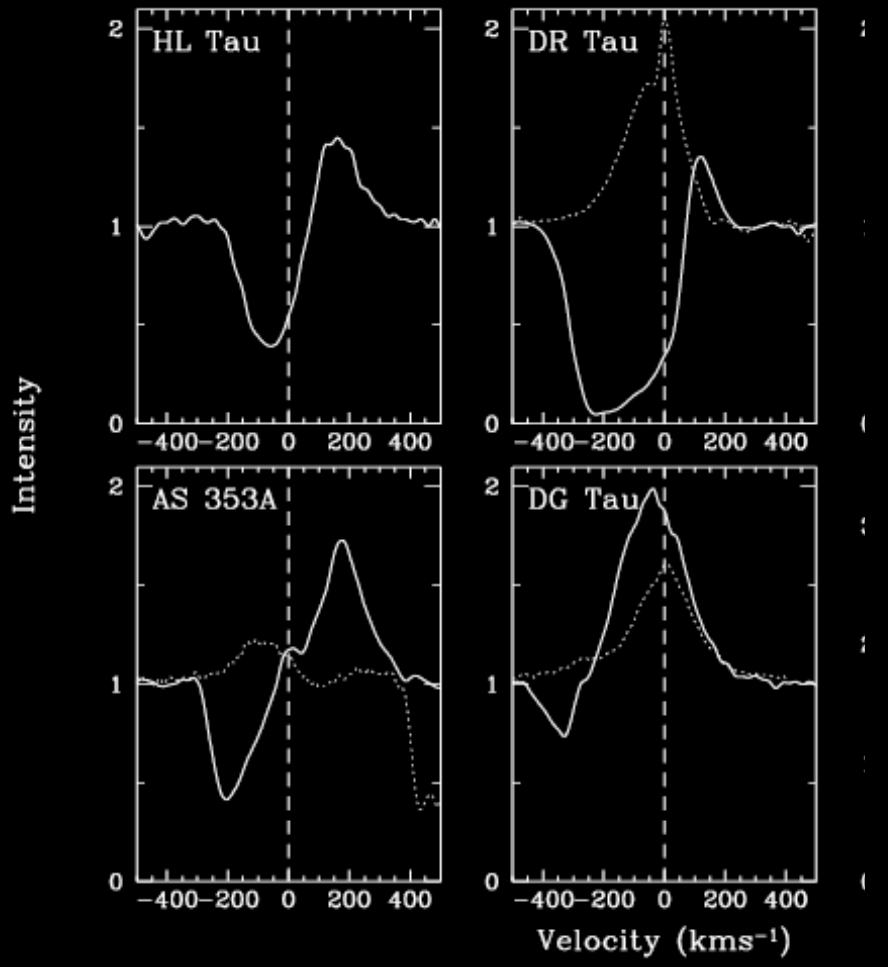
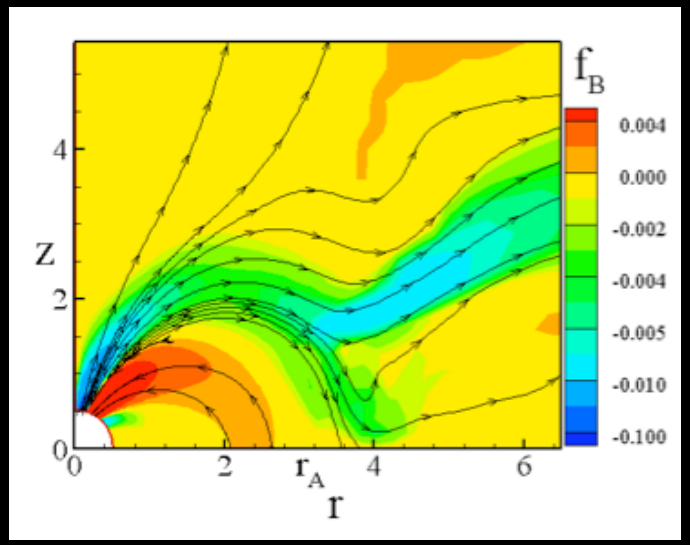


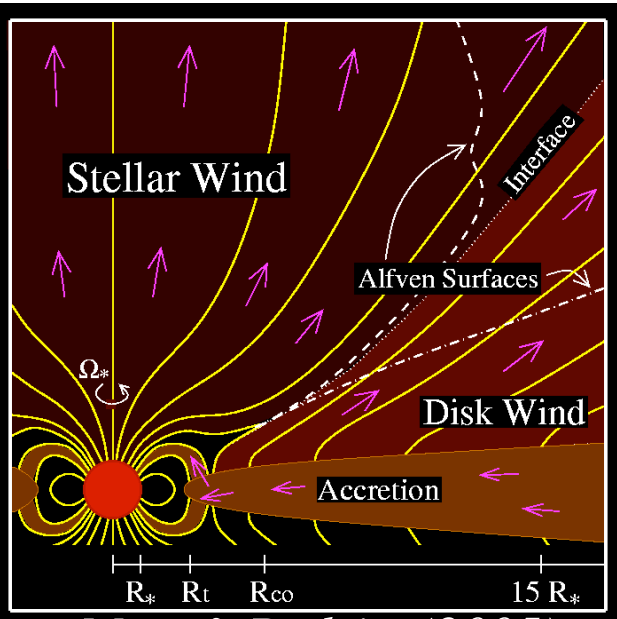
Edwards et al. (2003)

How Are Jets Launched?

Star-disk Interaction; Long et al. (2006)



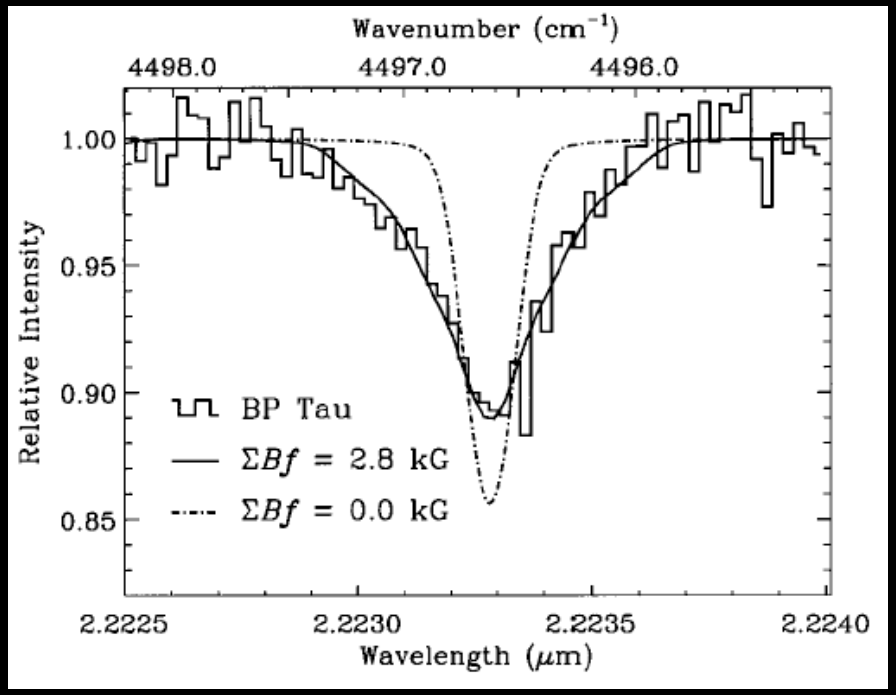
Stellar winds



Matt & Pudritz (2005)

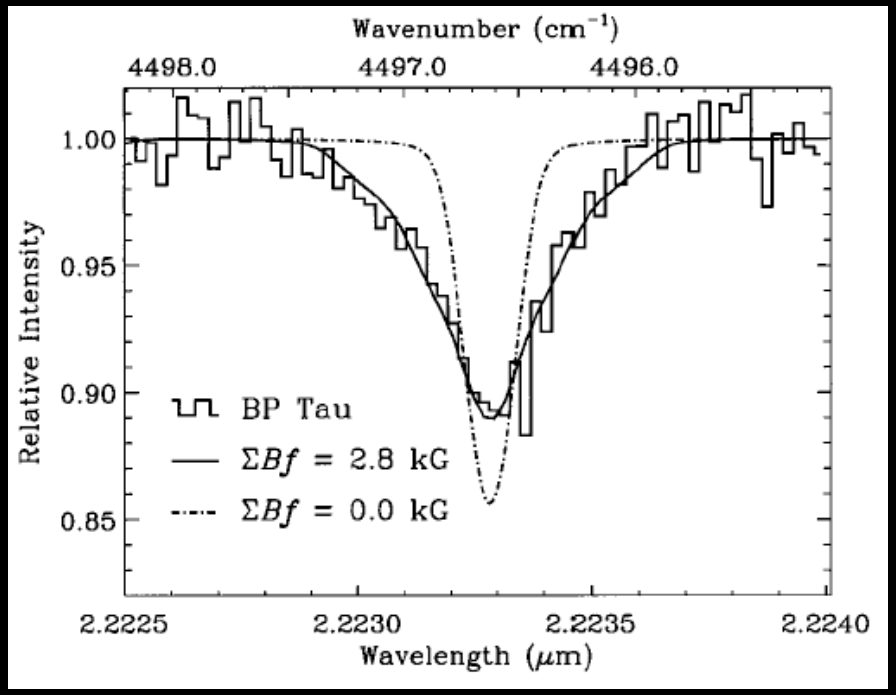
Extended disk winds.

How Are Jets Launched?



Magnetically sensitive Ti I line in BP Tau, 2.8 kG mean field (Johns-Krull et al. 1999).

How Are Jets Launched?



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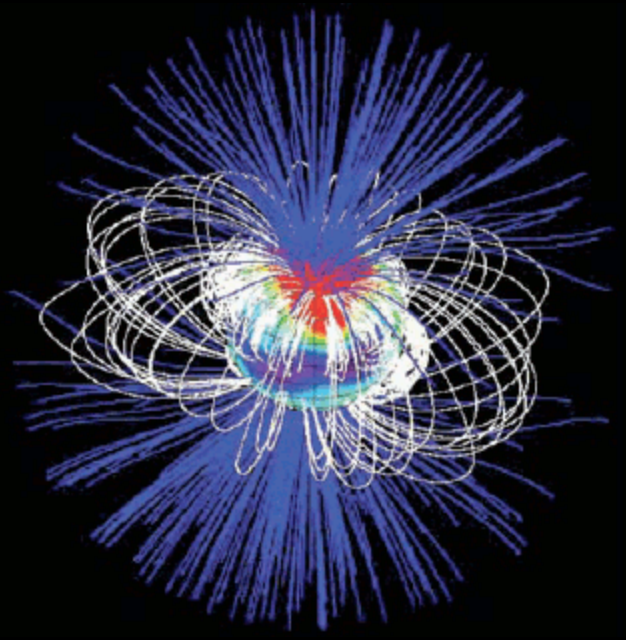
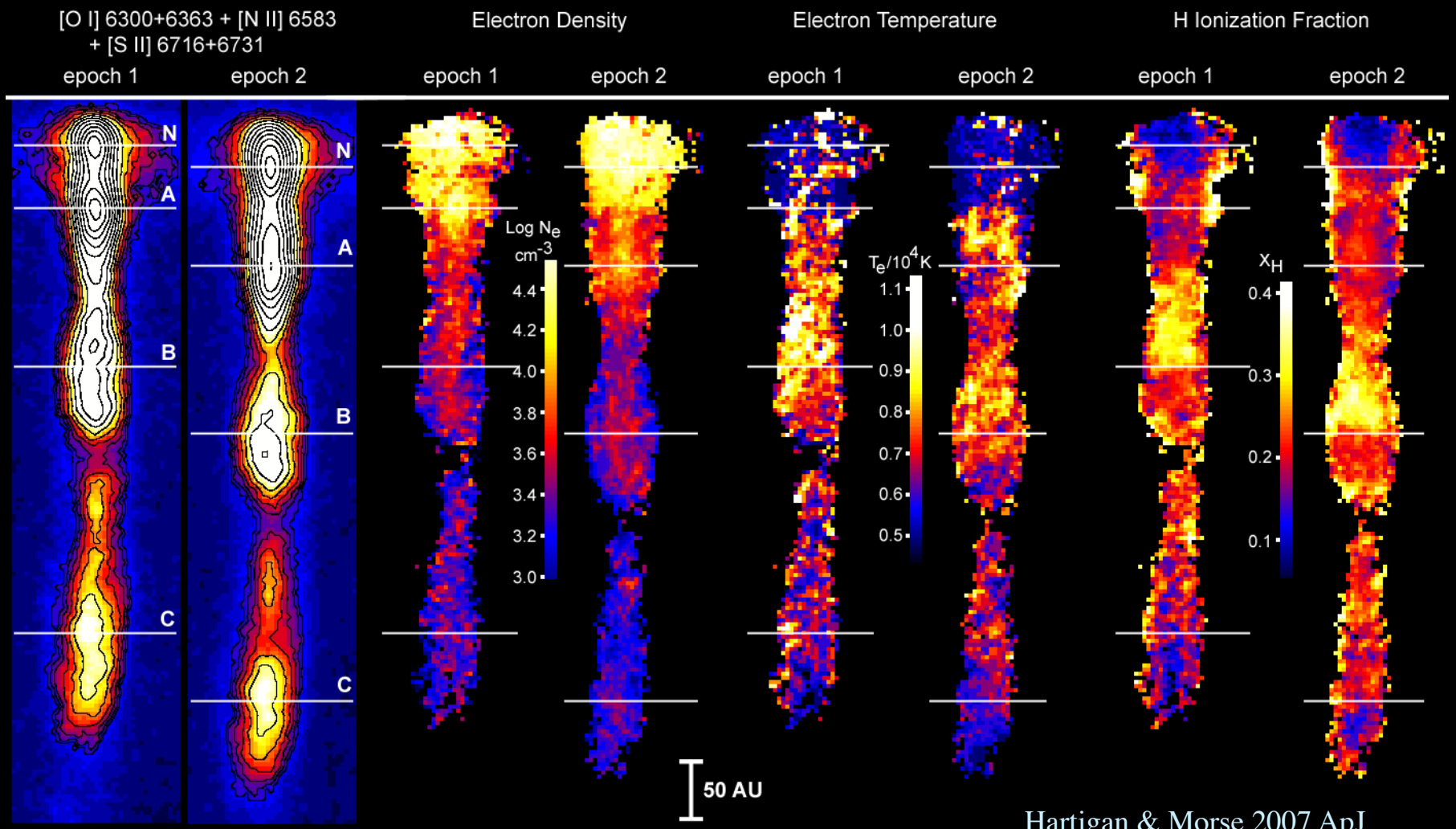


Magnetic field of BP Tau using Zeeman Doppler Imaging, (Donati et al 2008).

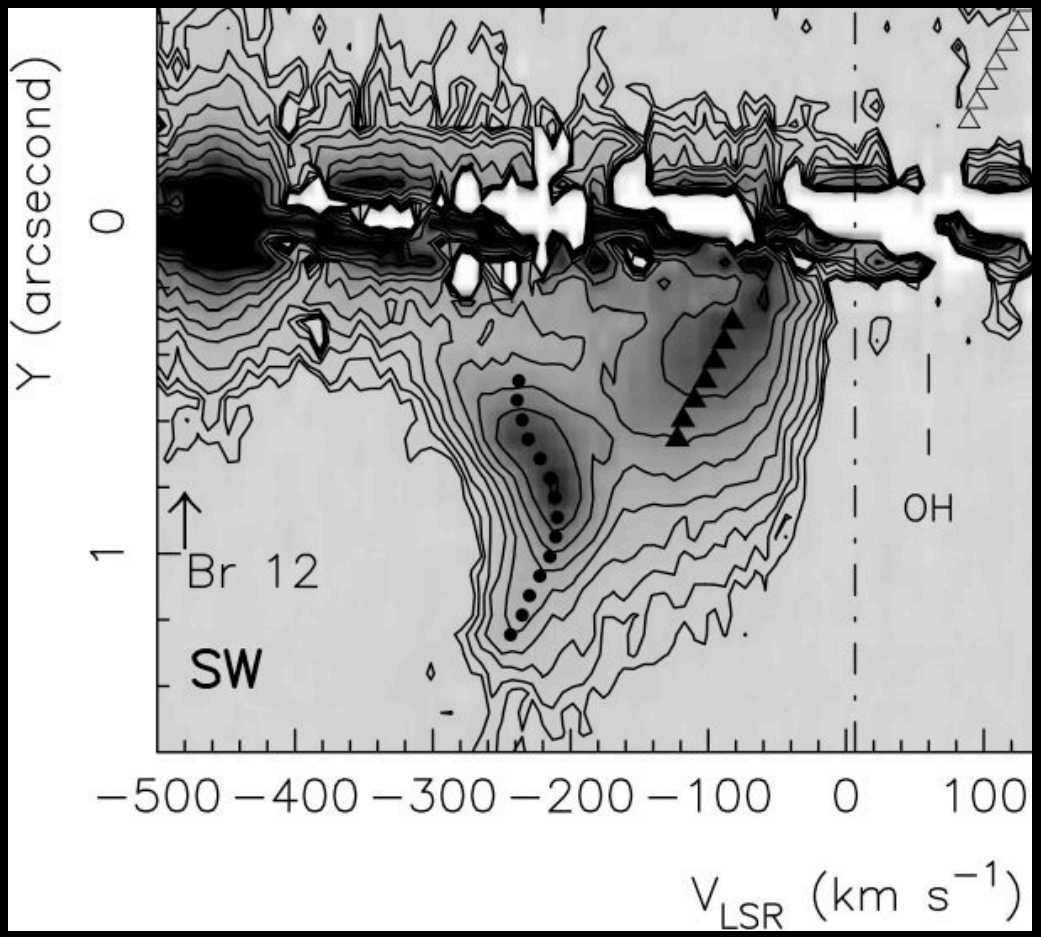
How Are Jets Launched?



Hartigan & Morse 2007 ApJ

How Are Jets Launched?

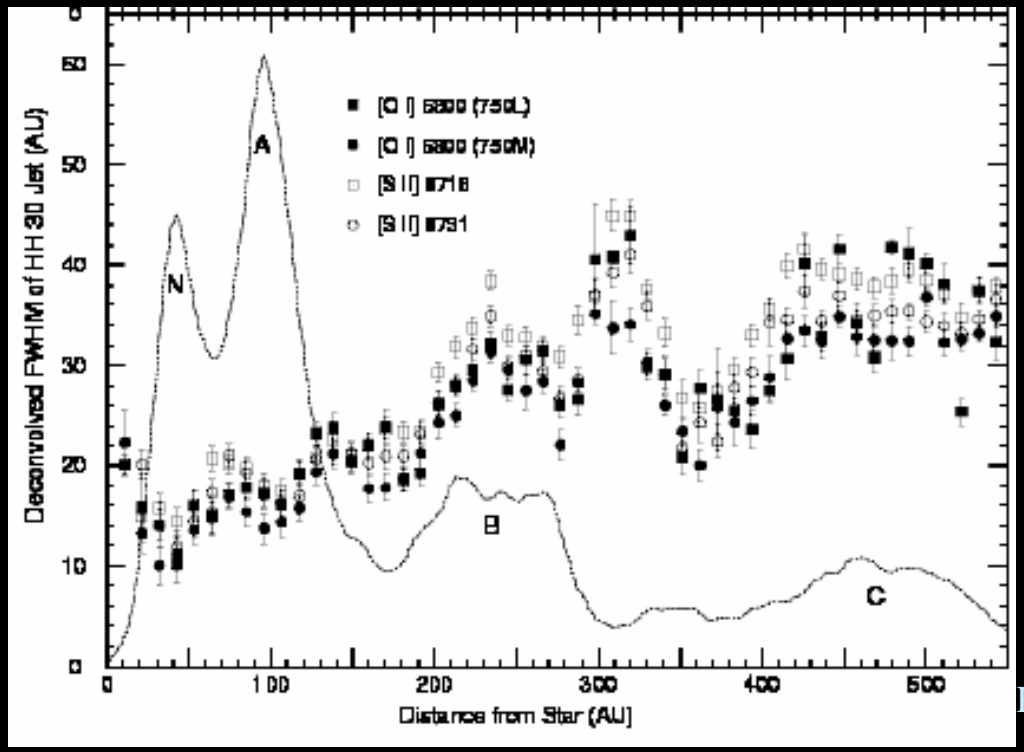
Position-Velocity diagrams from long-slit spectroscopy of [Fe II] line.



DG Tau PVD (Pyo et al. 2003)

Collimation

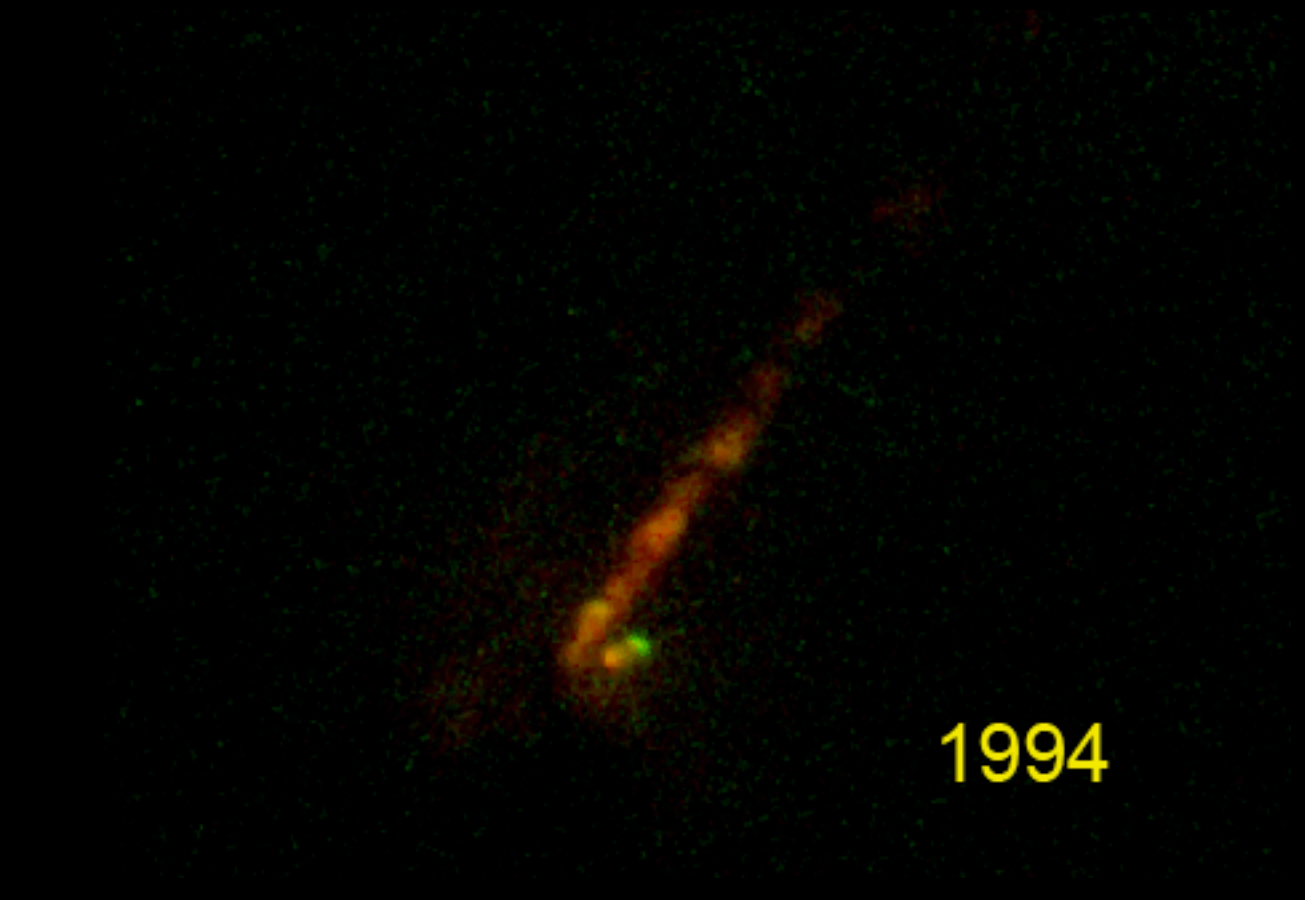
The jet width increases linearly with distance ….
but the edges of the jet do not project to a point



Hartigan & Morse 2007 ApJ

Outflows initially have wide opening angles and become collimated within ~20 AU

Episodic Nature



Hartigan; http://sparky.rice.edu/movies.html

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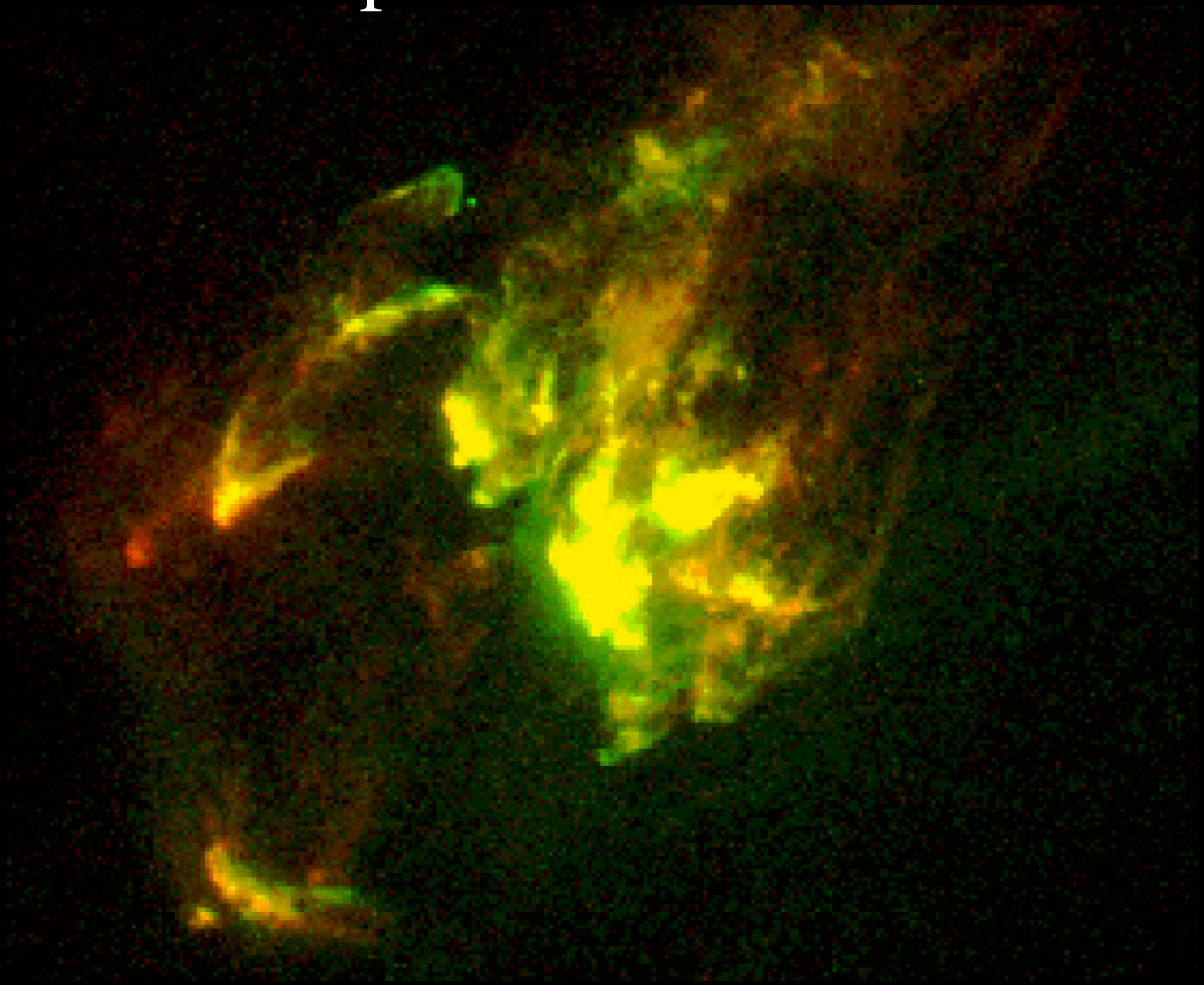

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Angular Momentum

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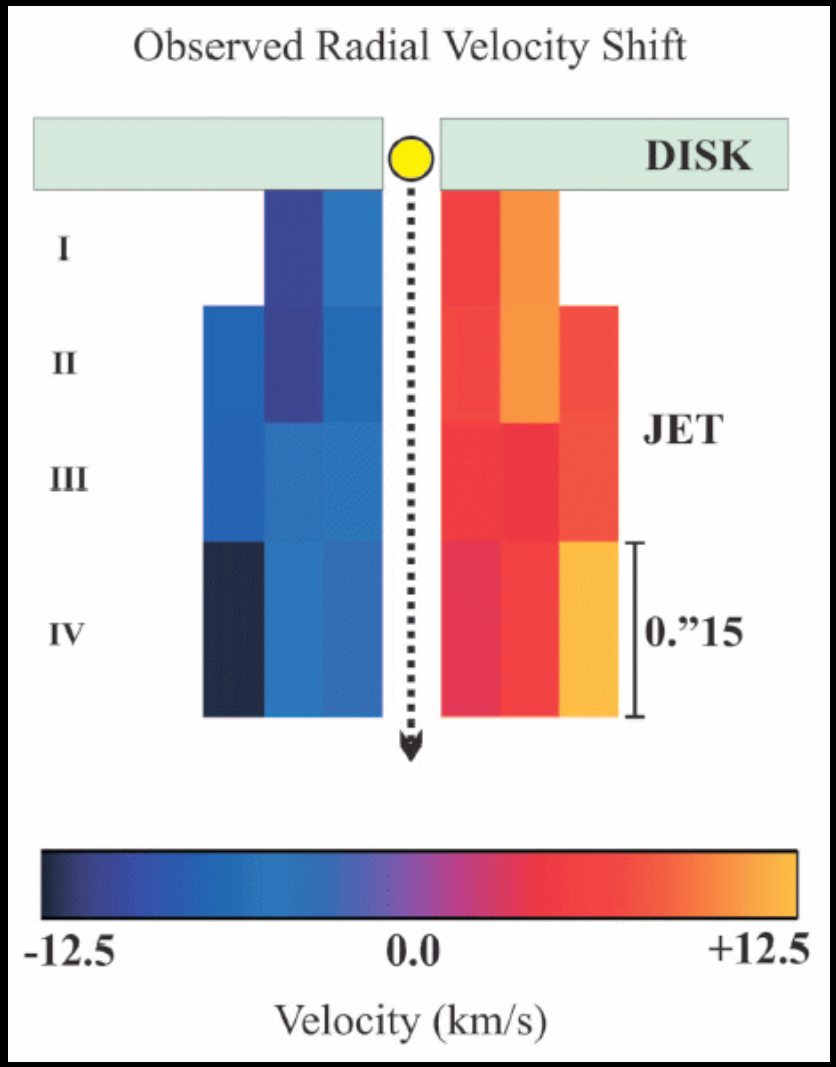
Measured rotation of DG Tau jet? … and a handful of others.



Bacciotti et al. (2002)