Physical Conditions of Accreting Gas

Jeff Bary
University of Virginia
Star-Disk Interactions in Young Stars
IAU Symposium 243
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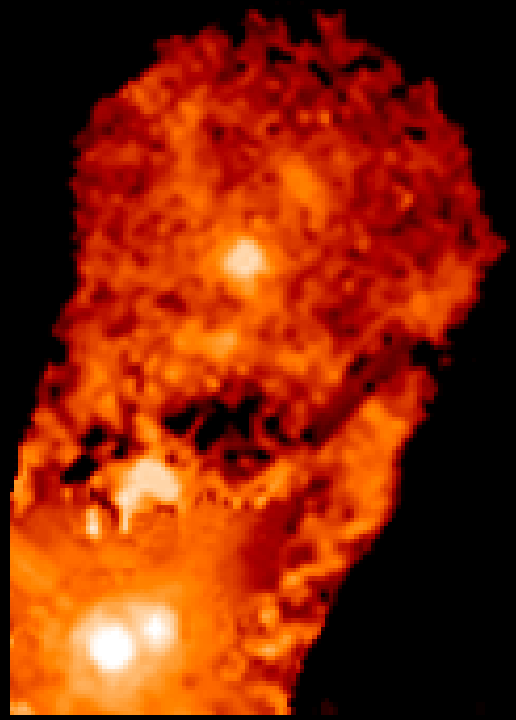
"Investigating the Infrared Spectral Variability of T Tauri Stars"



Credit: John Krist (STScI) et al., WFPC2, HST, NASA

Collaborators:

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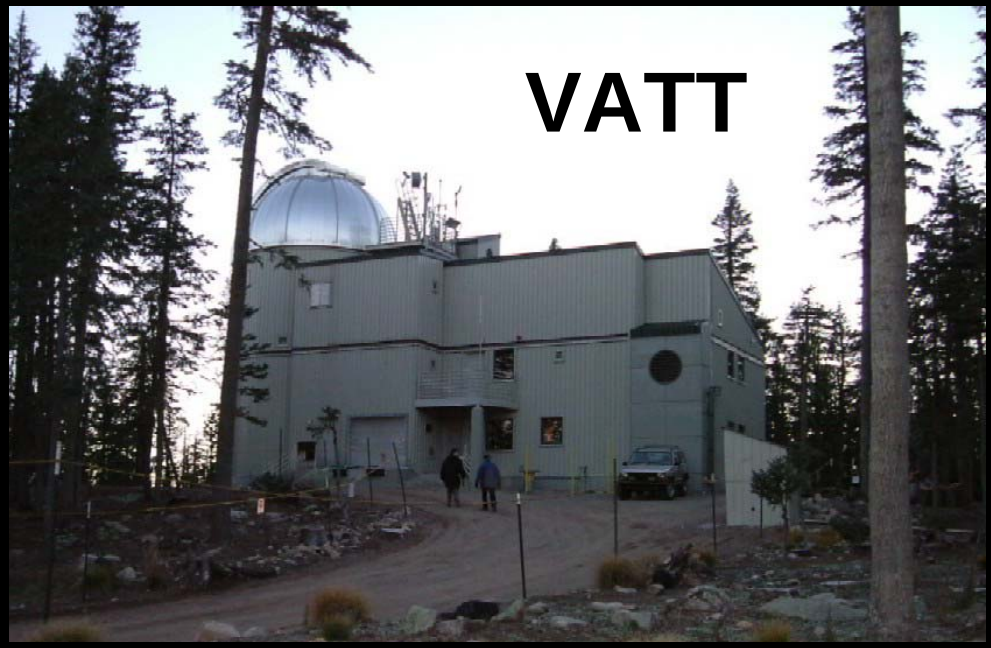
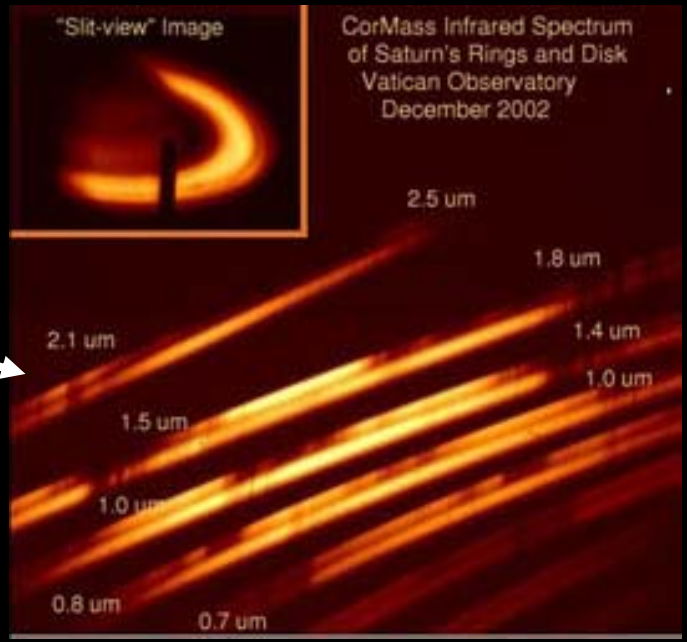
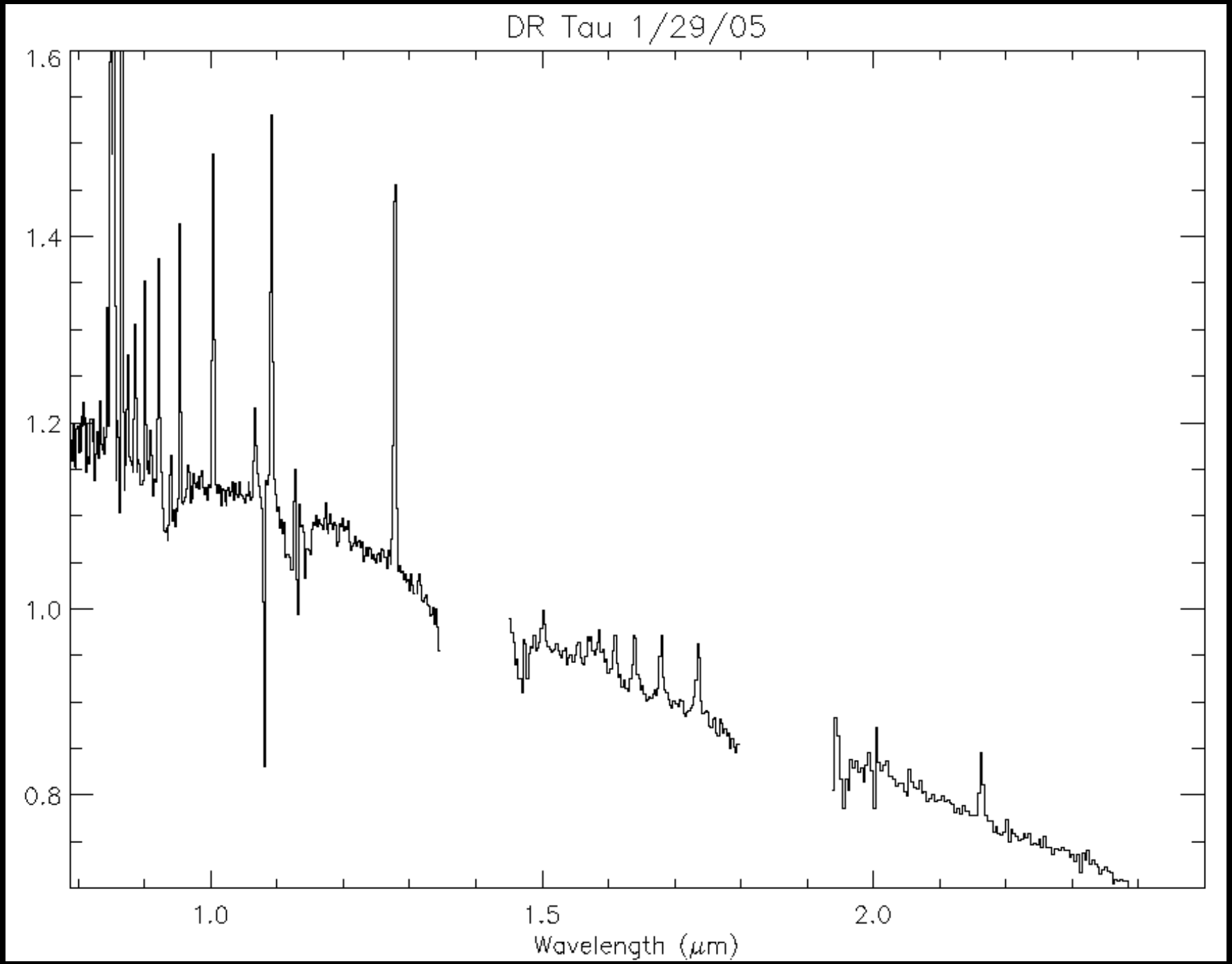
CorMass: NIR Multi-epoch Survey



CorMASS

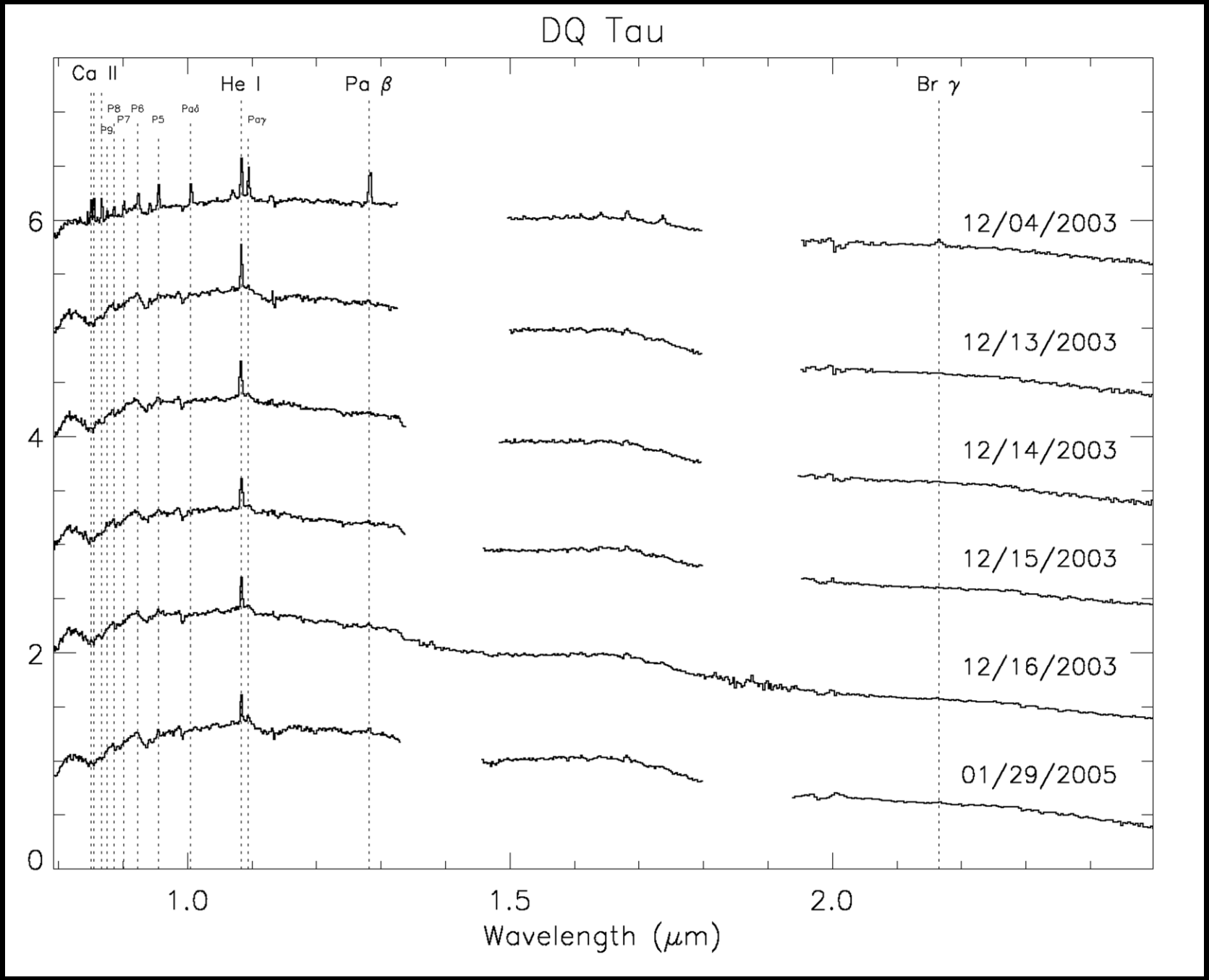
Cross-dispersed spectra



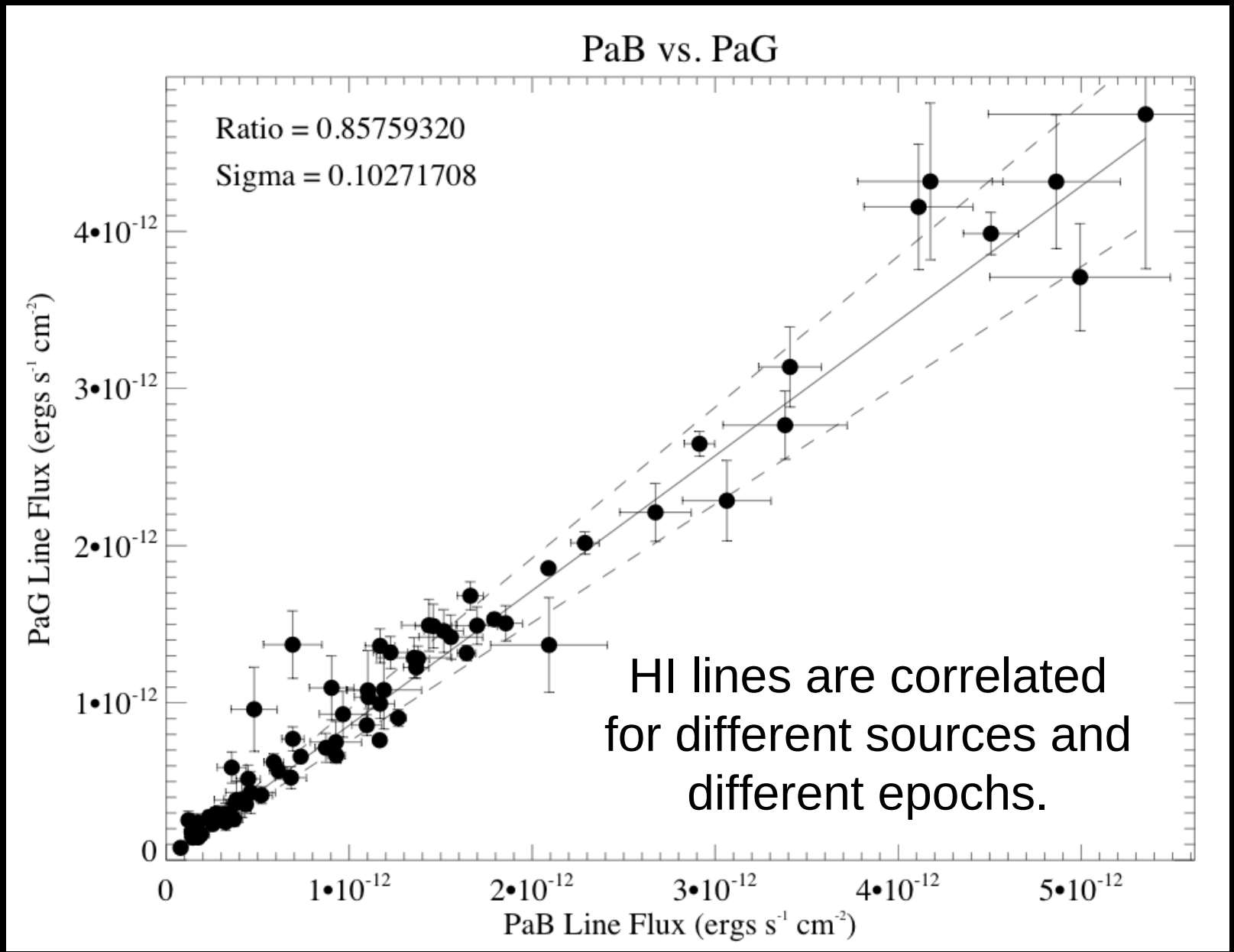

DR Tau 1/29/05
1.6
1.4
1.2
1.0
0.8
1.0
1.5
2.0
Wavelength (μm)

Source List

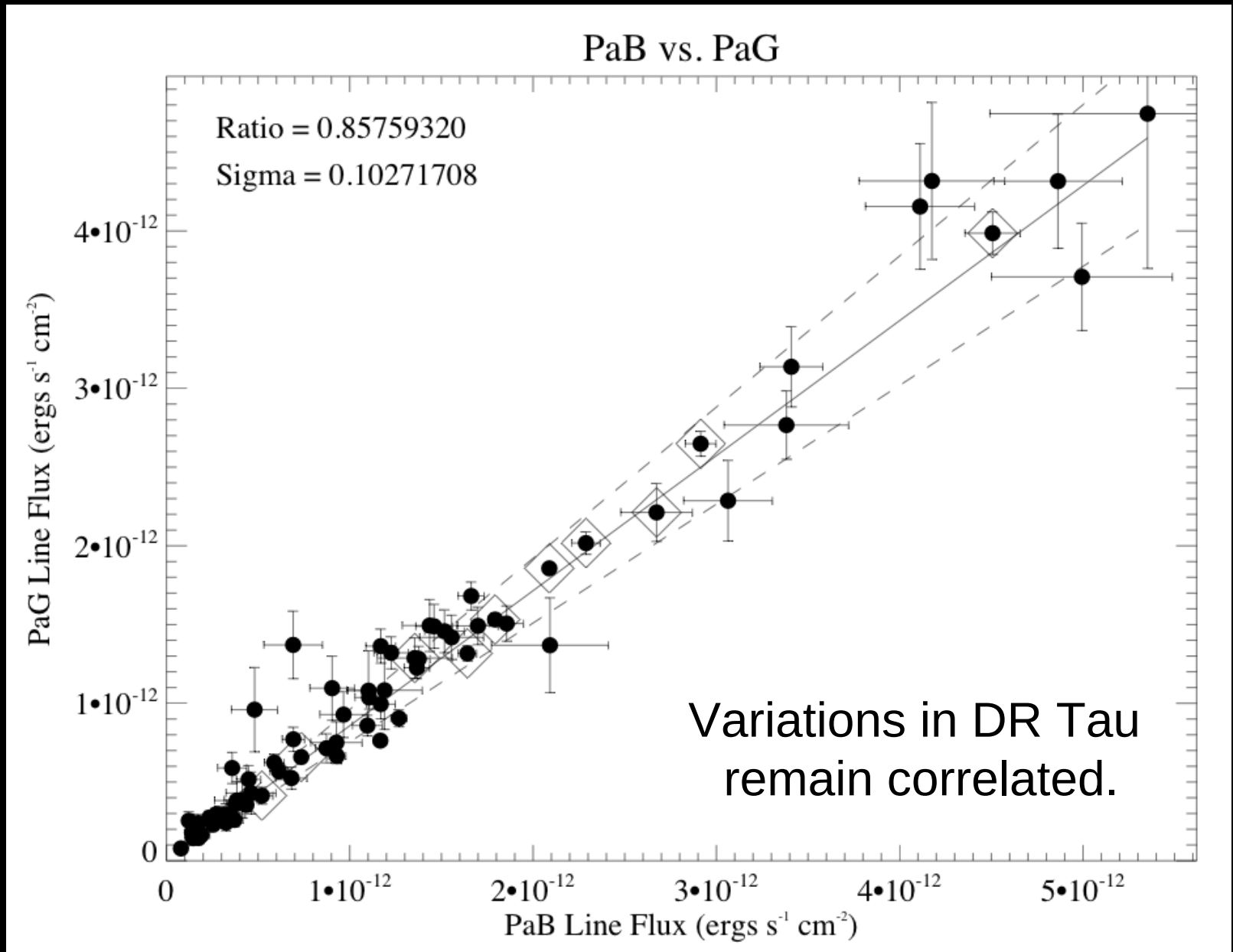
AA Tau	DQ Tau
BP Tau	DR Tau
CW Tau	FP Tau
CY Tau	GK Tau
DF Tau	RY Tau
DG Tau	T Tau
DM Tau	UY Aur
DO Tau	XZ Tau


DQ Tau
Ca II
He I
Pa β
Br γ
P8
P6
P9
P7
P5
Paδ
Paγ
12/04/2003
12/13/2003
12/14/2003
12/15/2003
12/16/2003
01/29/2005
0
2
4
6
1.0
1.5
2.0
Wavelength (μm)

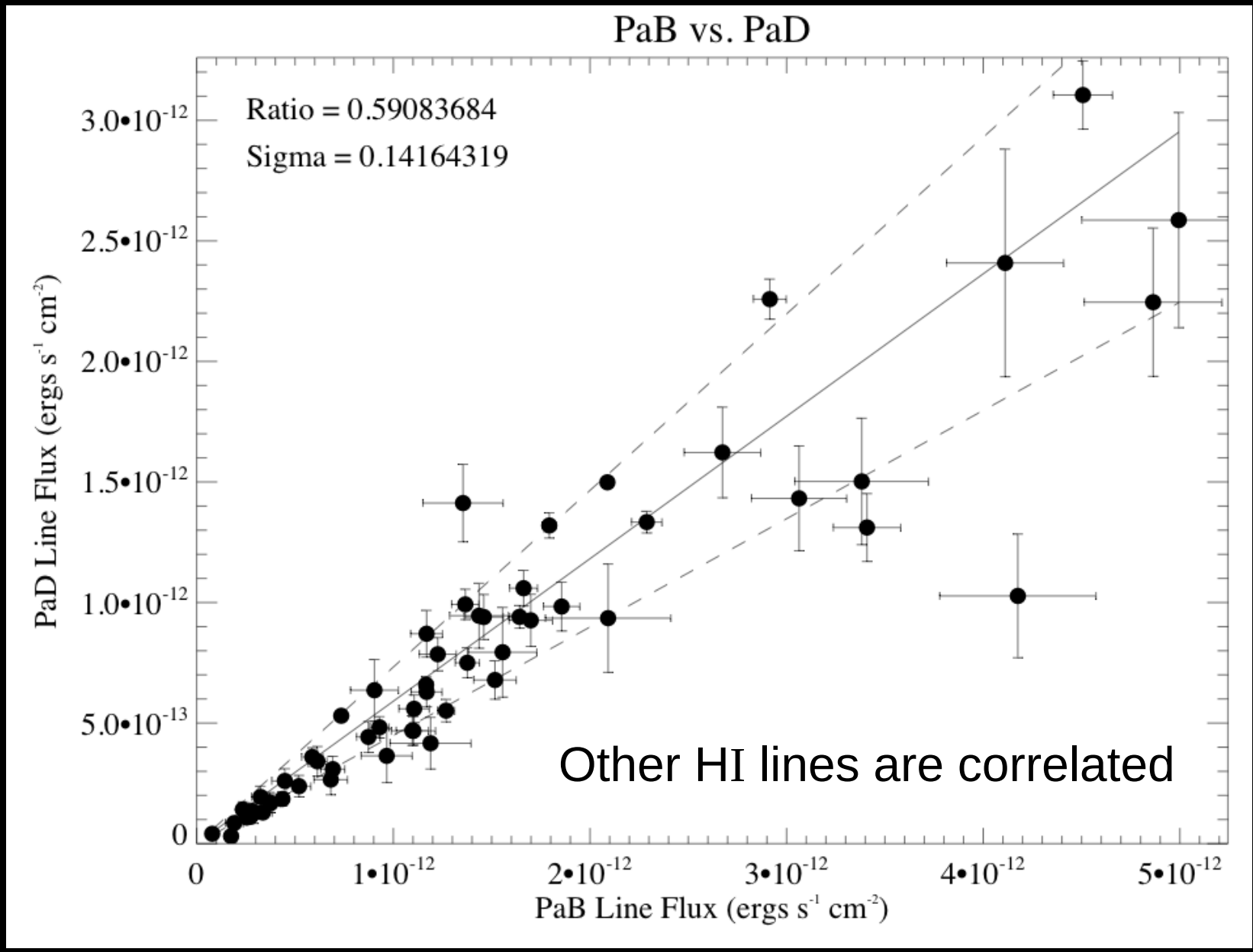
HI Line Ratios



HI Line Ratios



HI Line Ratios



Case B: HI Recombination Theory

Case B assumptions

- $\tau >> 1$ for Lyman photons
- $\tau << 1$ for all other transitions

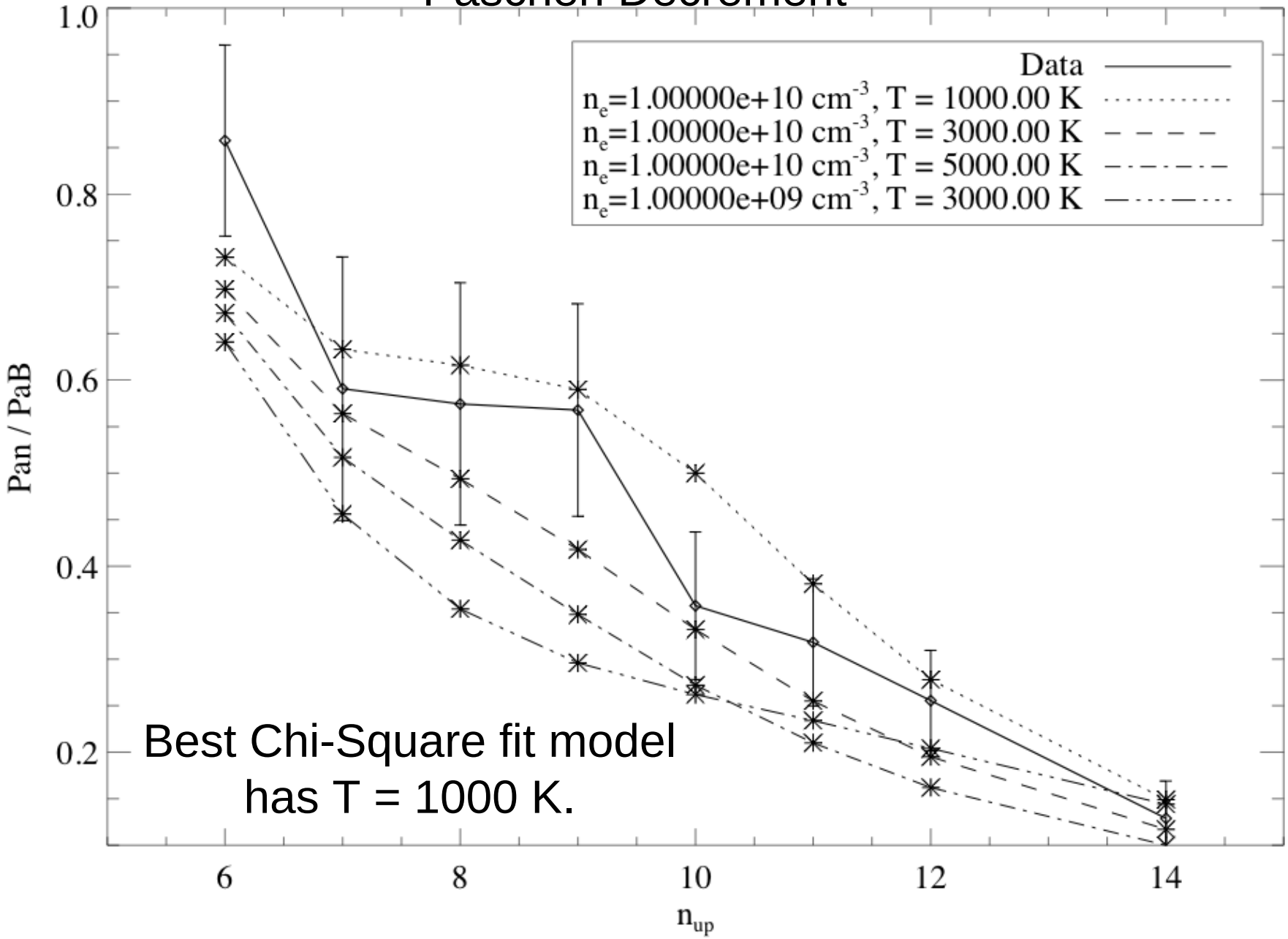
Hummer & Storey (1987) and Storey & Hummer (1995) calculate the level populations and relative intensities for a variety of temperatures and electron densities.

Model Parameters

$500\ K < T < 30{,}000\ K$

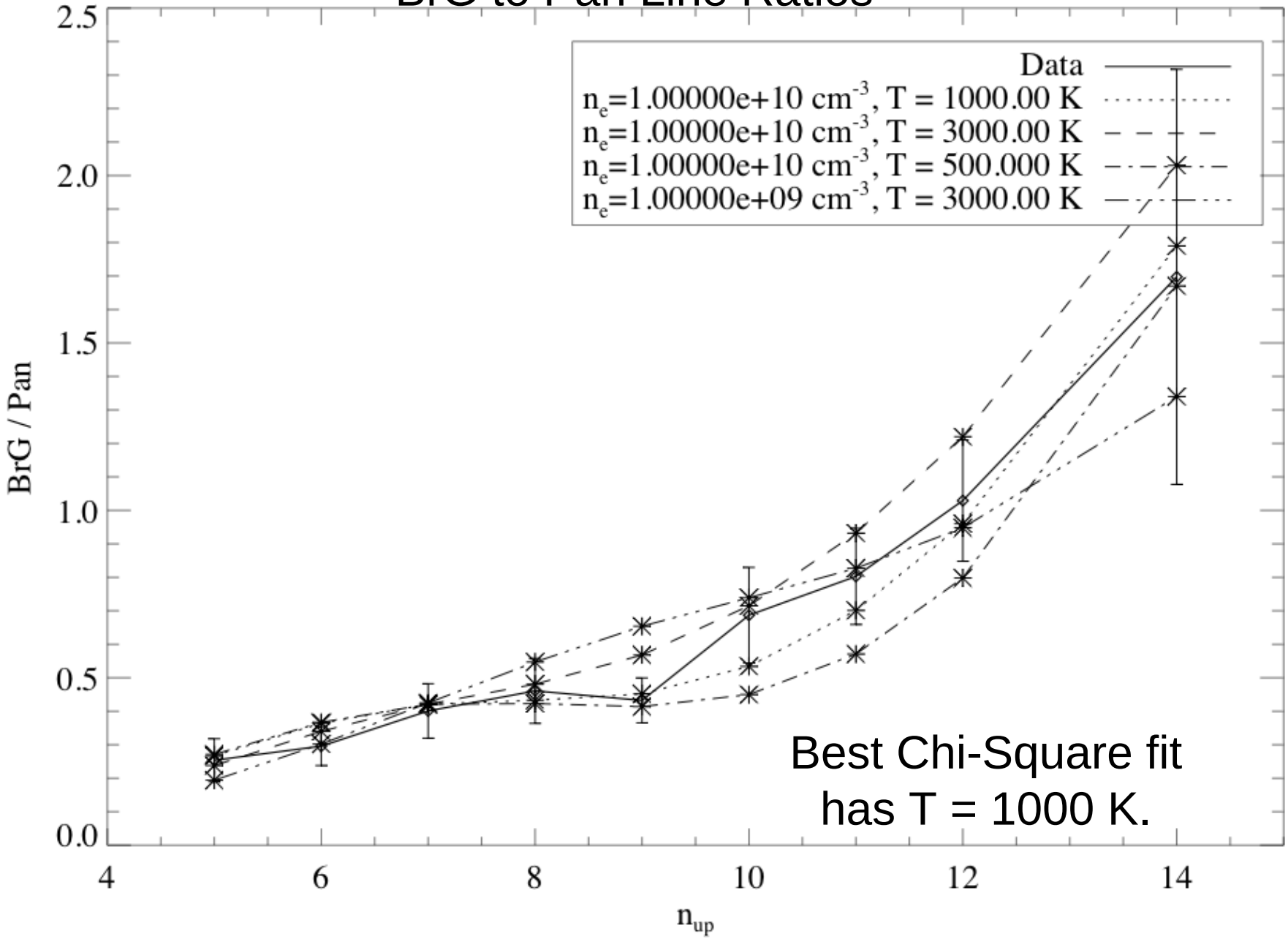
$10^2\ cm^{-3} < n_e < 10^{14}\ cm^{-3}$

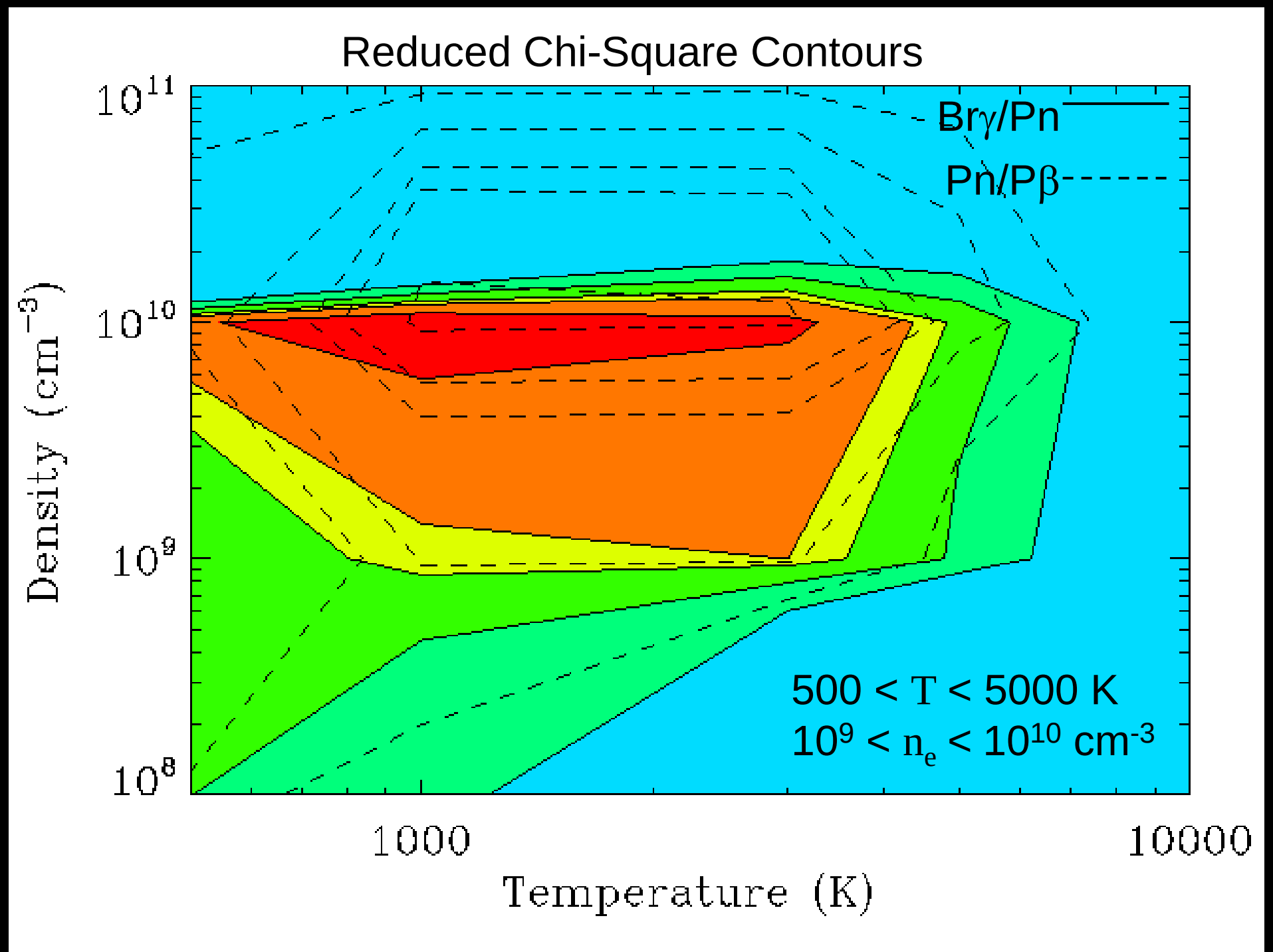
Paschen Decrement



Best Chi-Square fit model has T = 1000 K.

BrG to Pan Line Ratios




Reduced Chi-Square Contours
Brγ/Pn
Pn/Pβ
500 < T < 5000 K
10^9 < n_e < 10^10 cm^-3
Density (cm^-3)
10^11
10^10
10^9
10^8
1000
10000
Temperature (K)

Explaining the Lower Temperature…

- Could the gas not be in the accretion flow?
- $t_{cool} << t_{infall}$
- Previous models used high T to explain HI fluxes
- How does low T gas produce high luminosity emission?

***Possible solution*: High ionizing incident flux!!!**