Warm Gas in Transitional Disks around Herbig Ae/Be Stars

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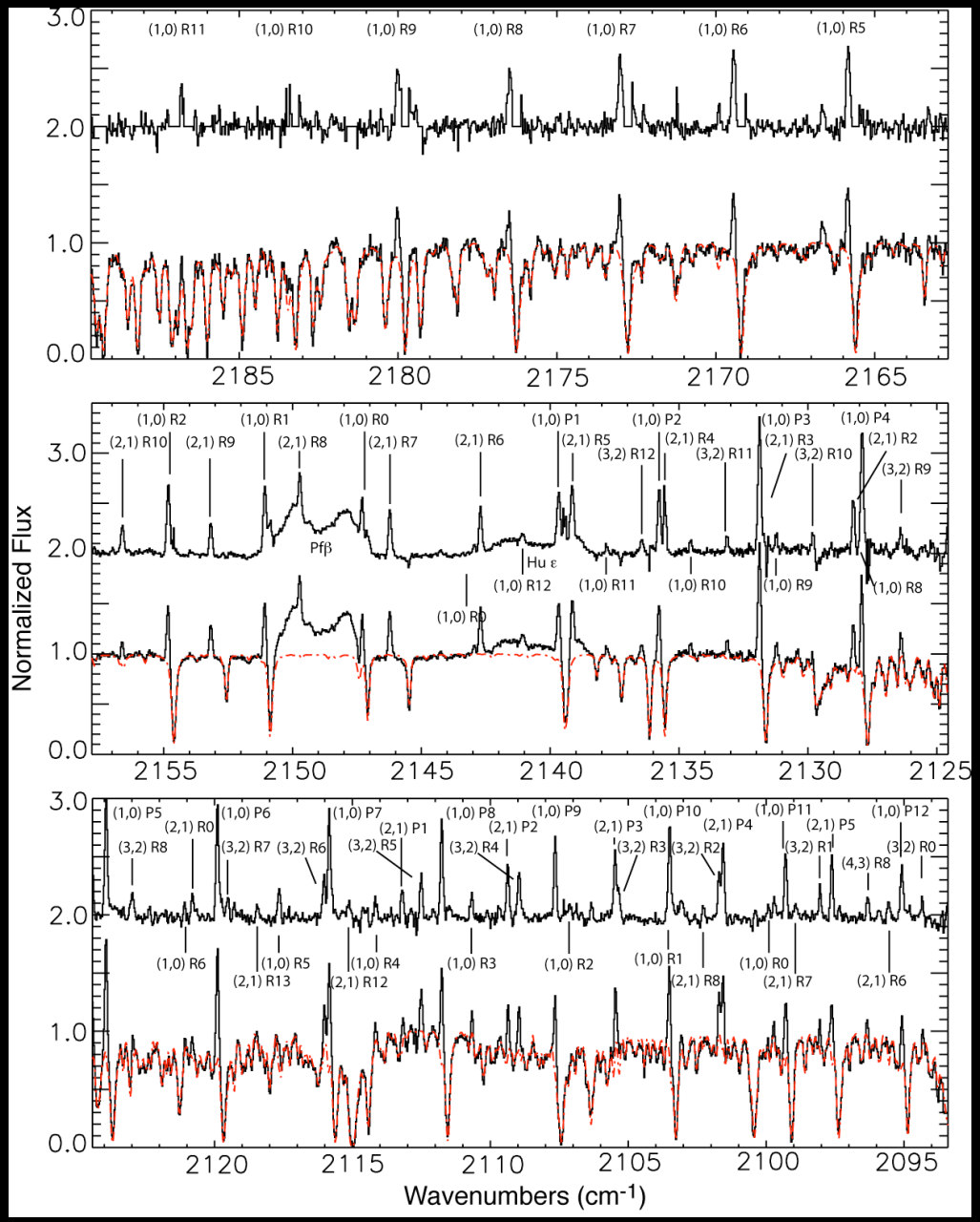
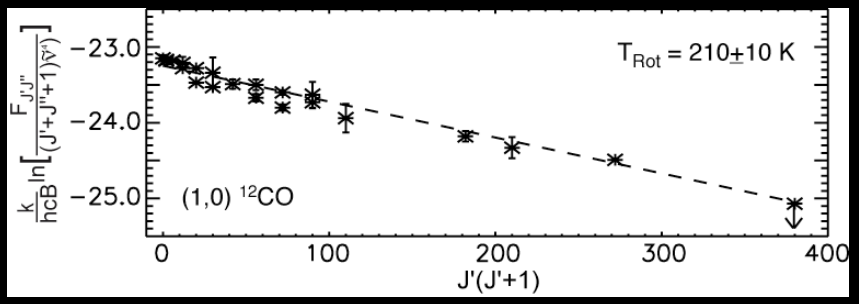
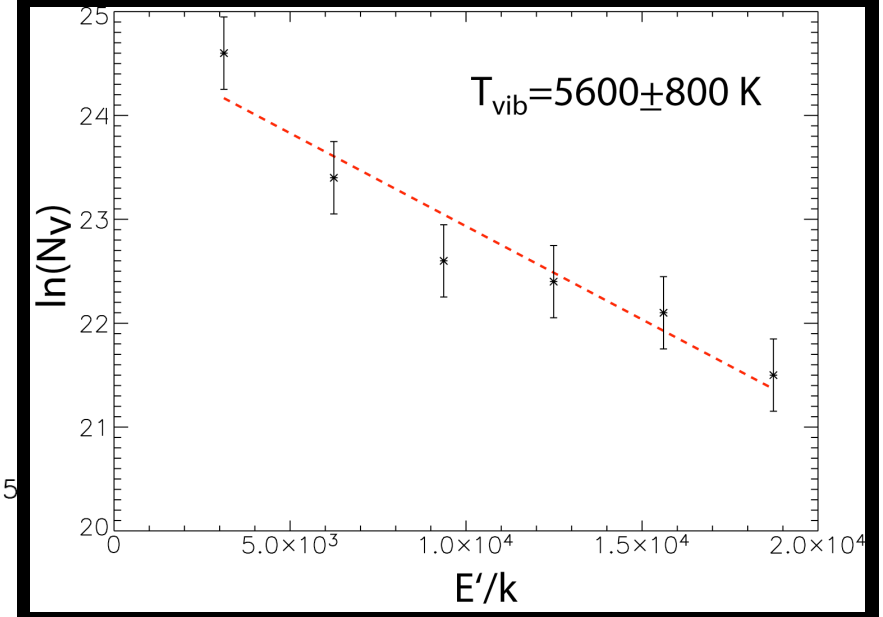
HD 141569

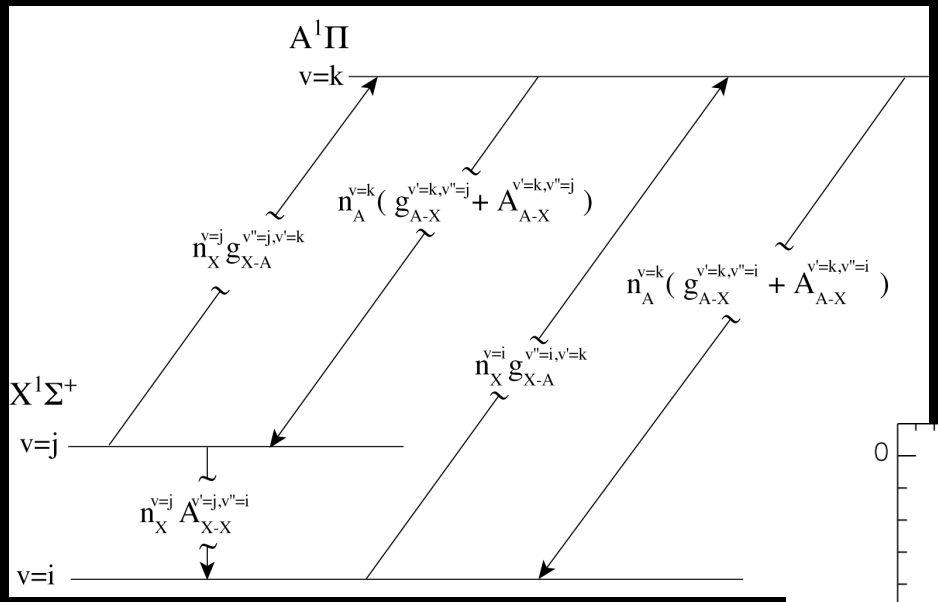






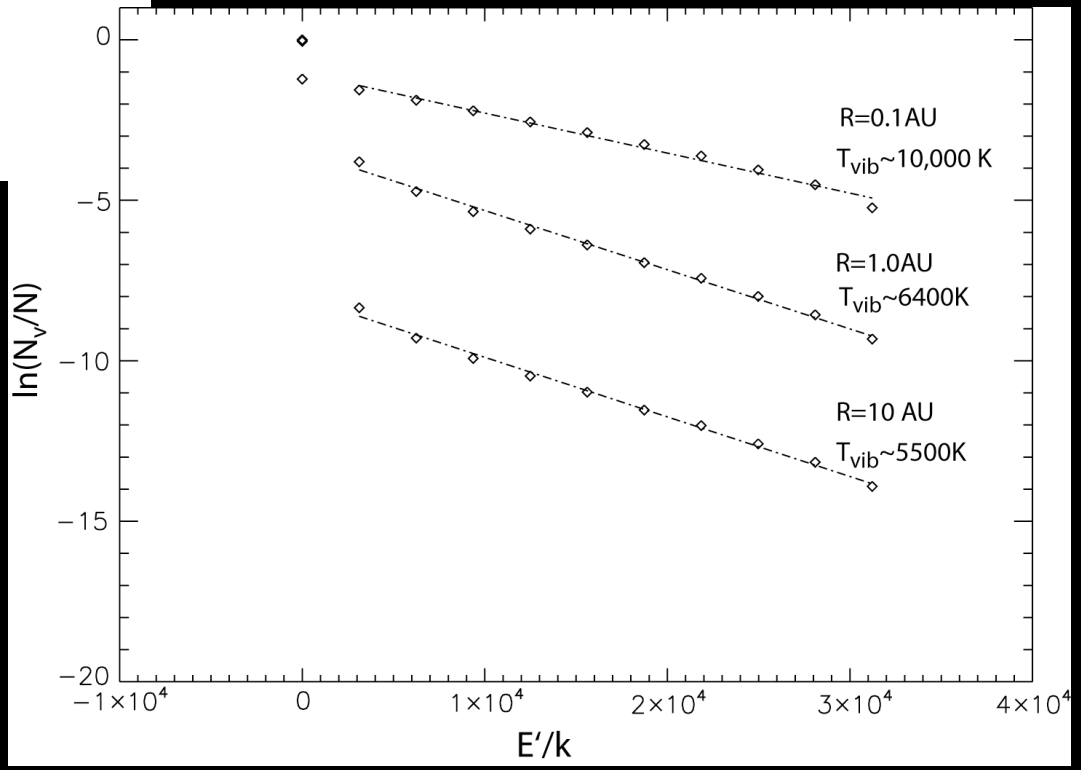
Brittain et al. 2007 (see also Goto et al. 2006, Pontoppidan et al. 2008, van der Plas et al. poster #72, Bast et al. poster #53)

UV Fluorescence

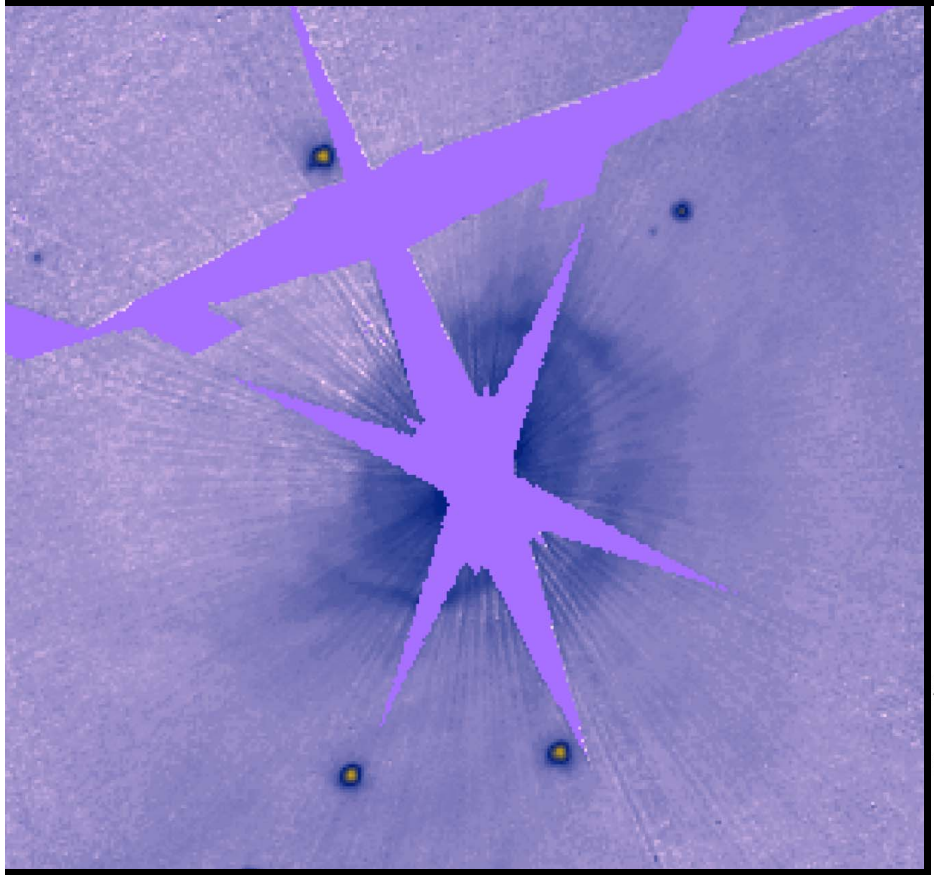


c.f. Krotkov et al. 1980

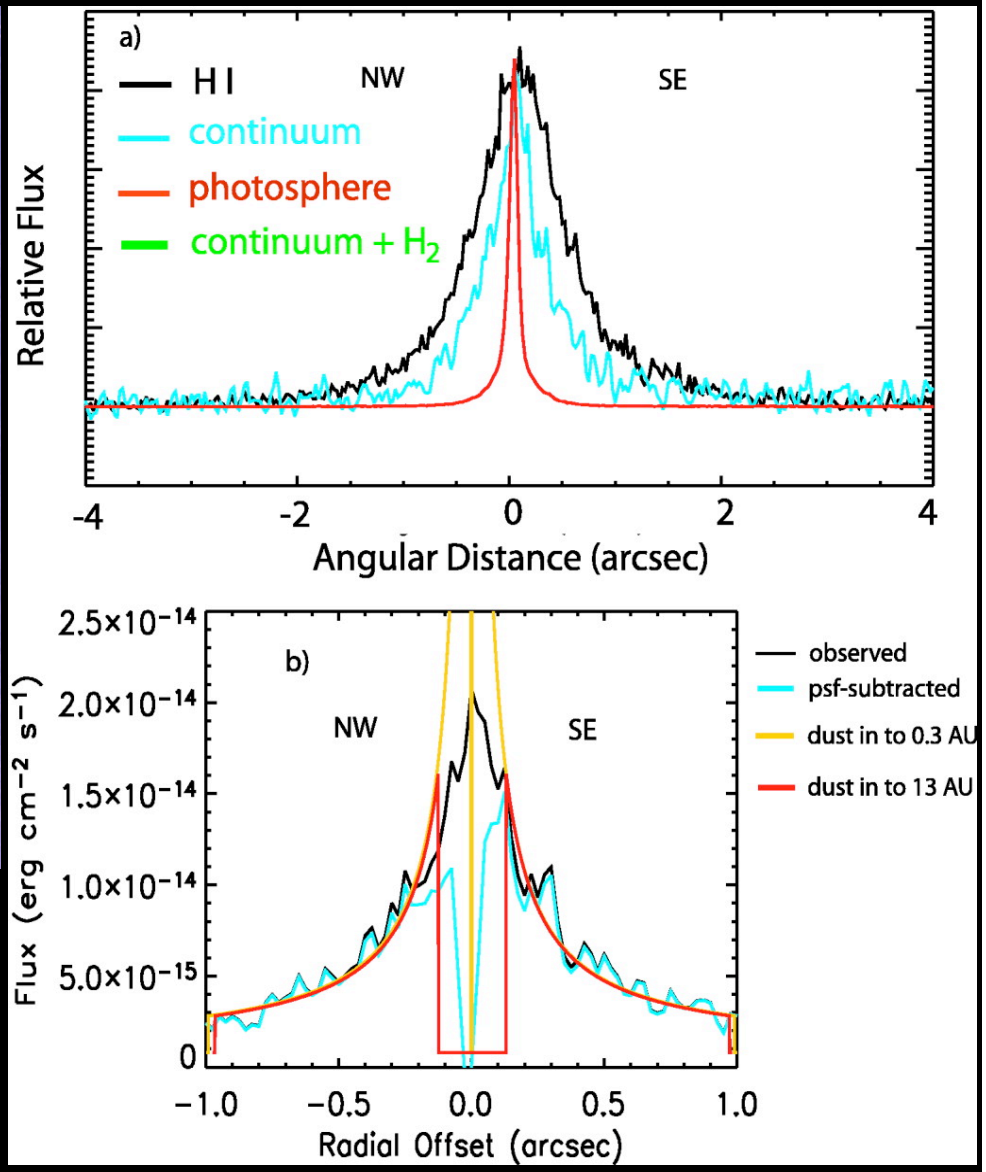
$f_{elec} \sim 10^5 f_{ro\text{-}vib}$



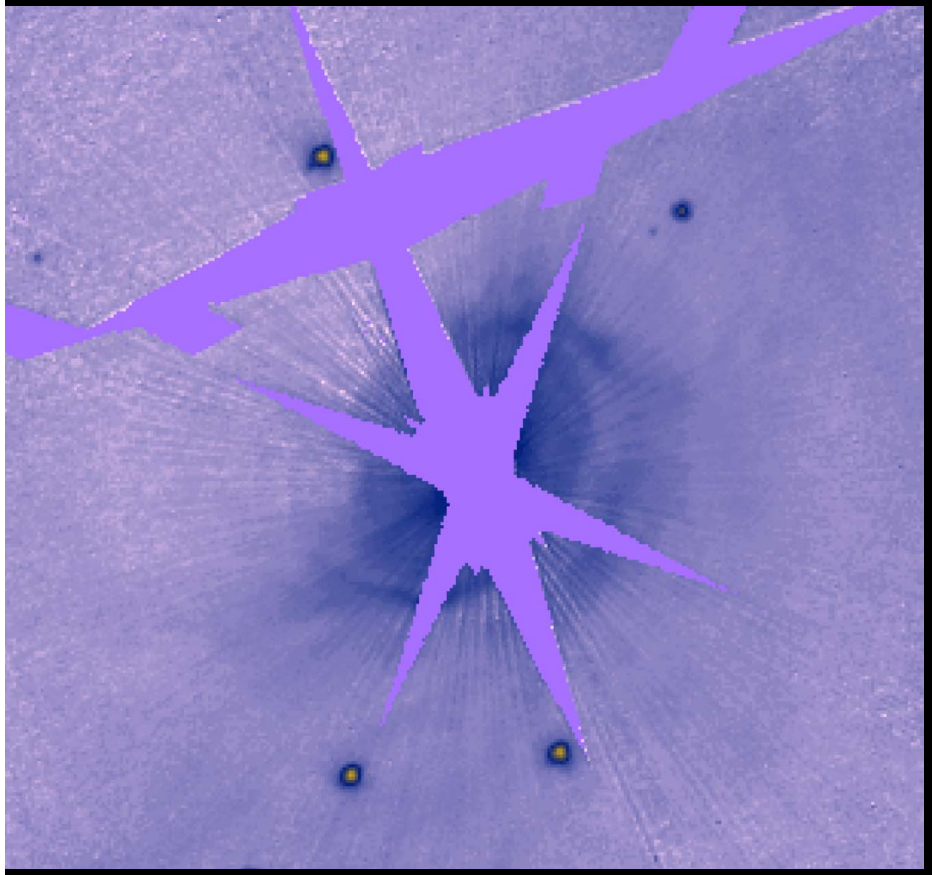
HD 100546: A Transitional Disk



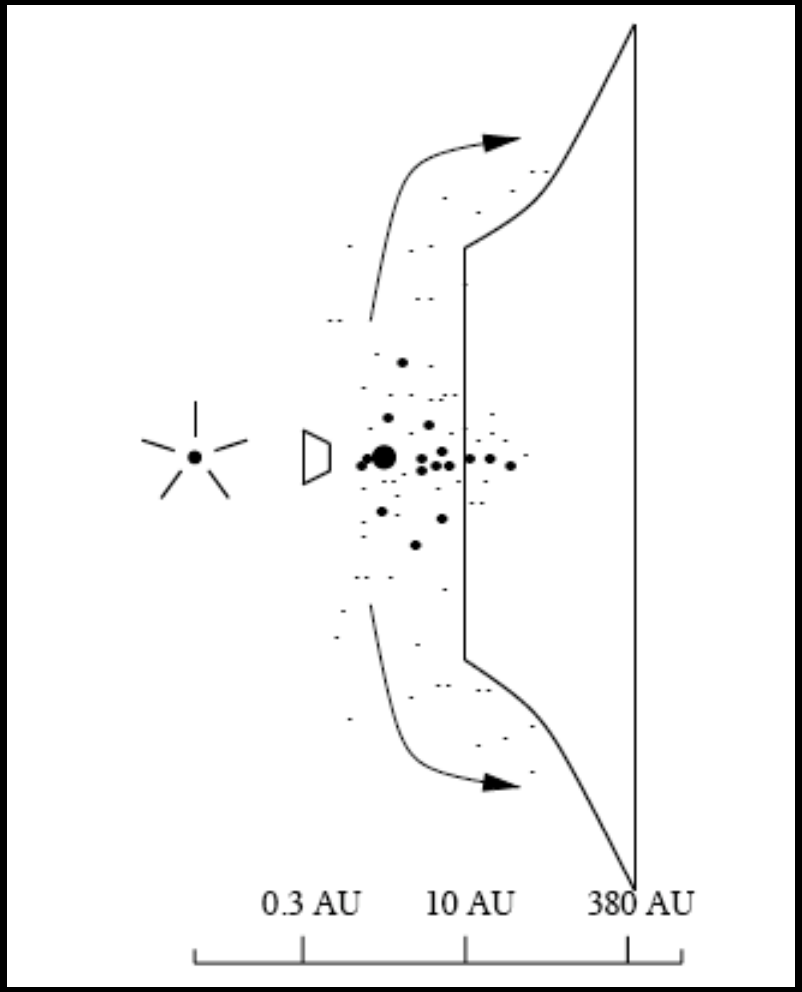
Grady et al. 2005 (see also Augereau et al. 2001; Ardila et al. 2007)



HD 100546: A Transitional Disk

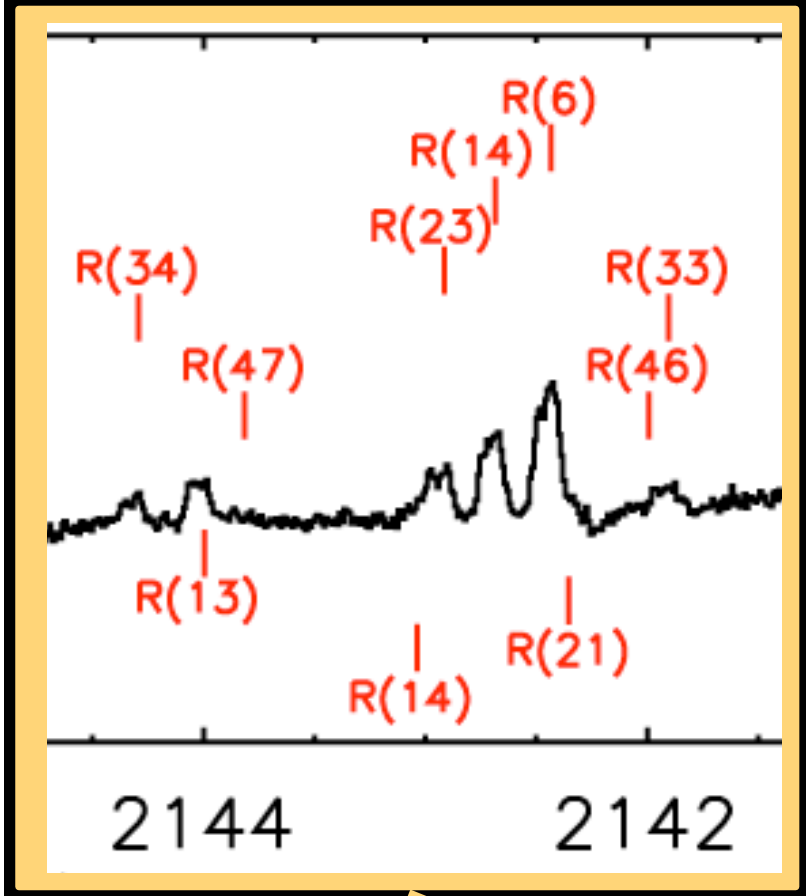


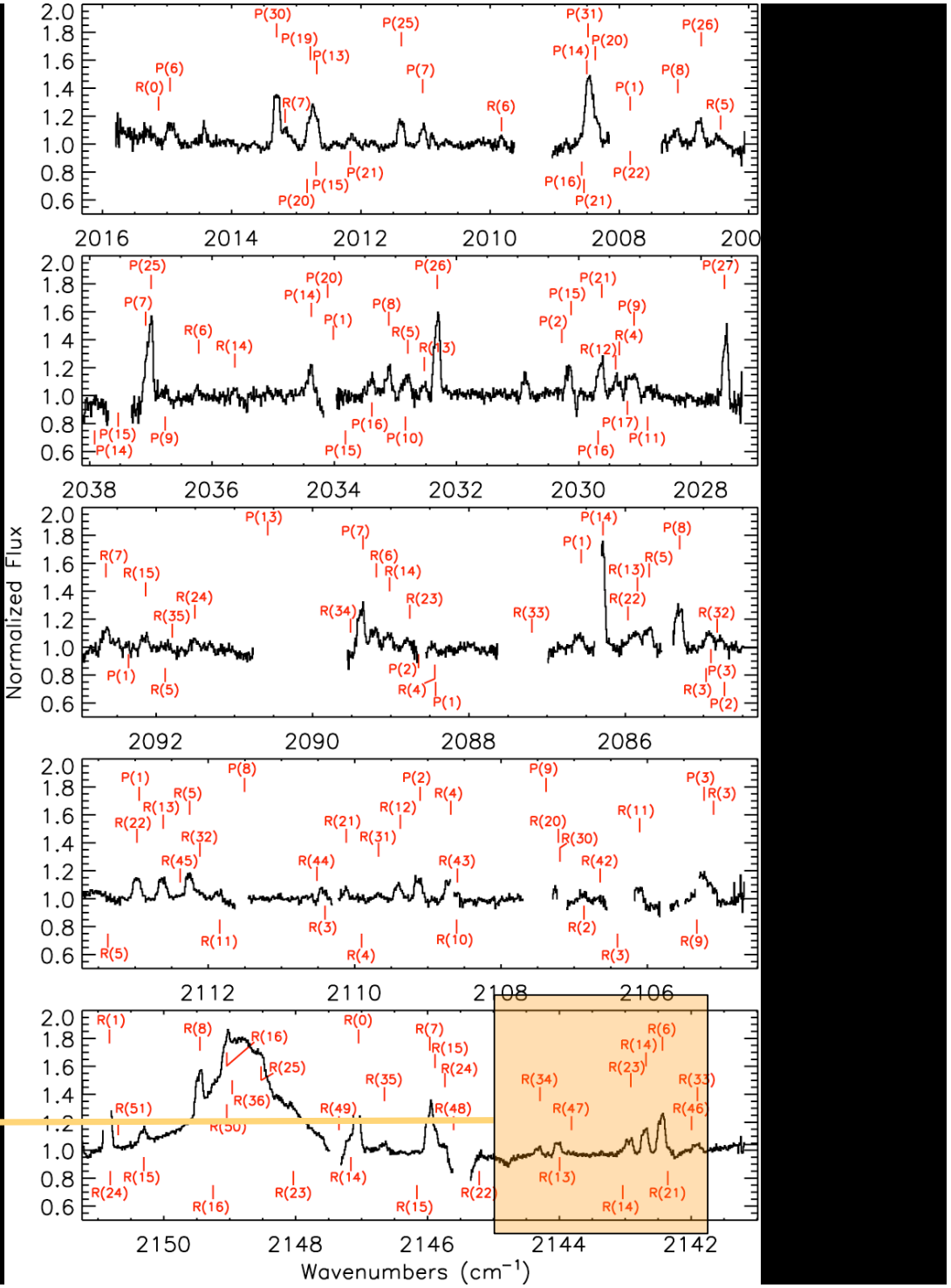
Grady et al. 2005 (see also Augereau et al. 2001; Ardila et al. 2007)



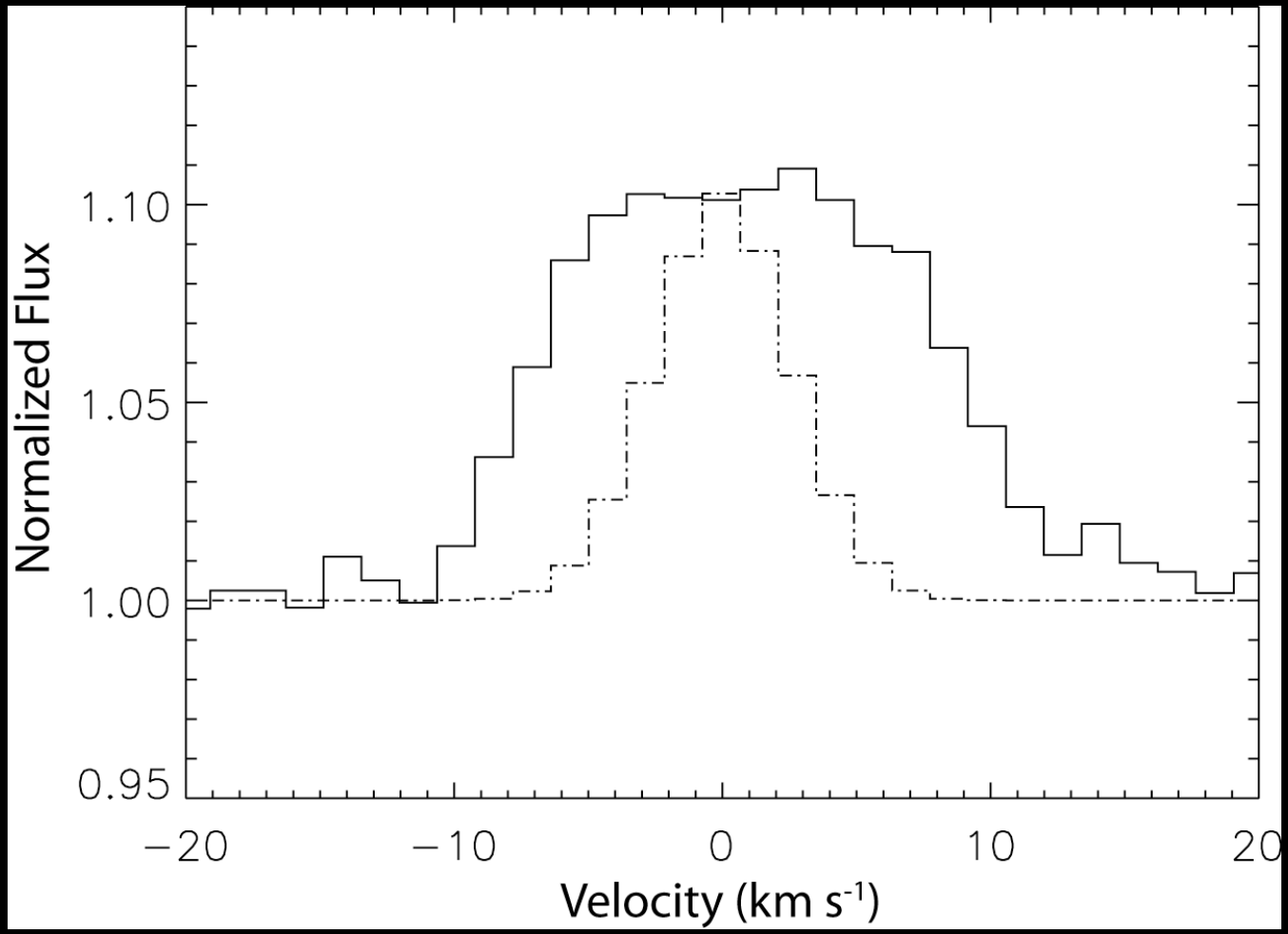
Bouwman et al. 2003 (see also Vinkovic et al. 2006)

HD 100546

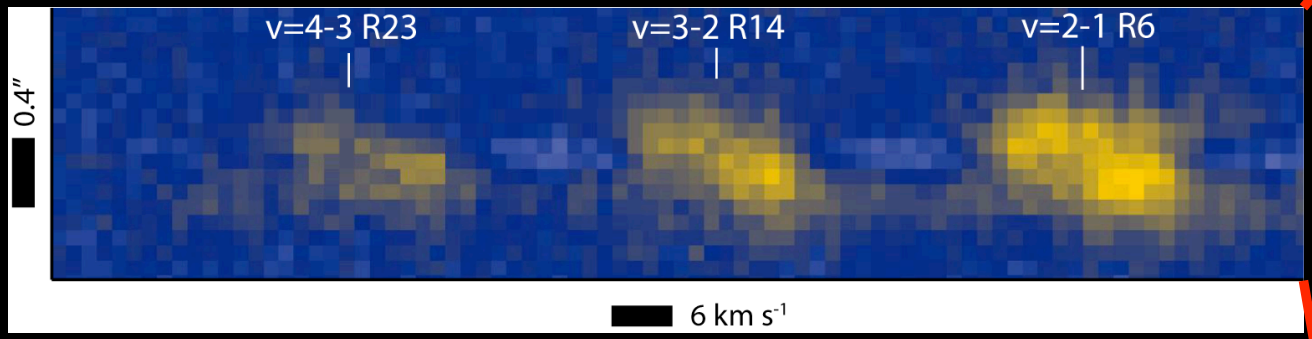

R(6)
R(14)
R(23)
R(34)
R(33)
R(47)
R(46)
R(13)
R(21)
R(14)
2144
2142

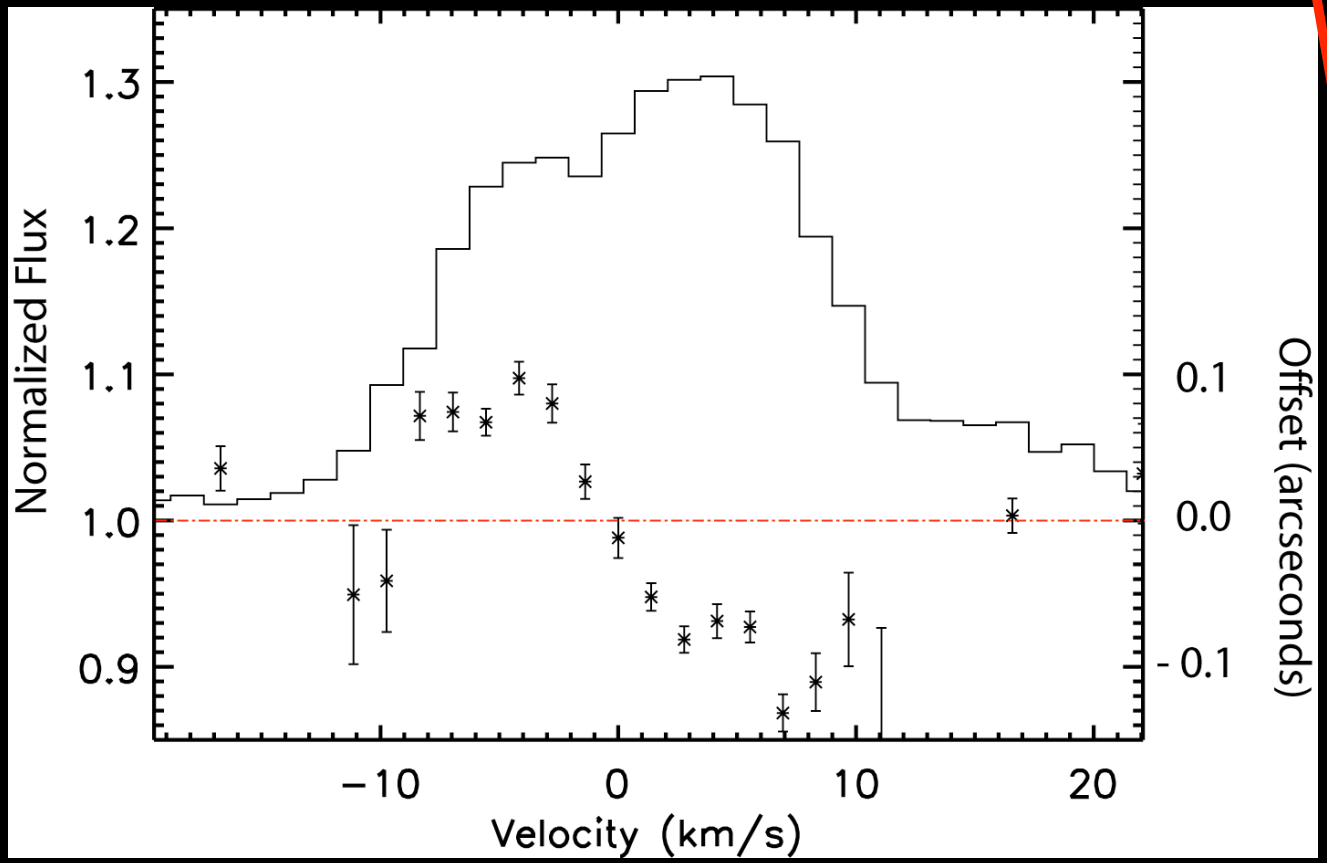

Normalized Flux
Wavenumbers (cm^{-1})
2016
2014
2012
2010
2008
2038
2036
2034
2032
2030
2028
2092
2090
2088
2086
2112
2110
2108
2106
2150
2148
2146
2144
2142

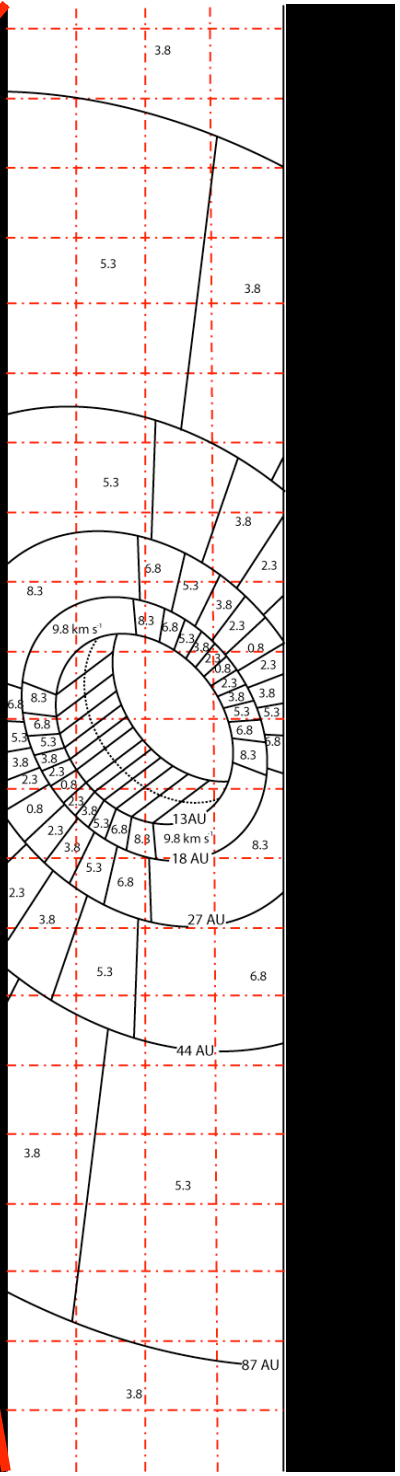
CO in HD100546



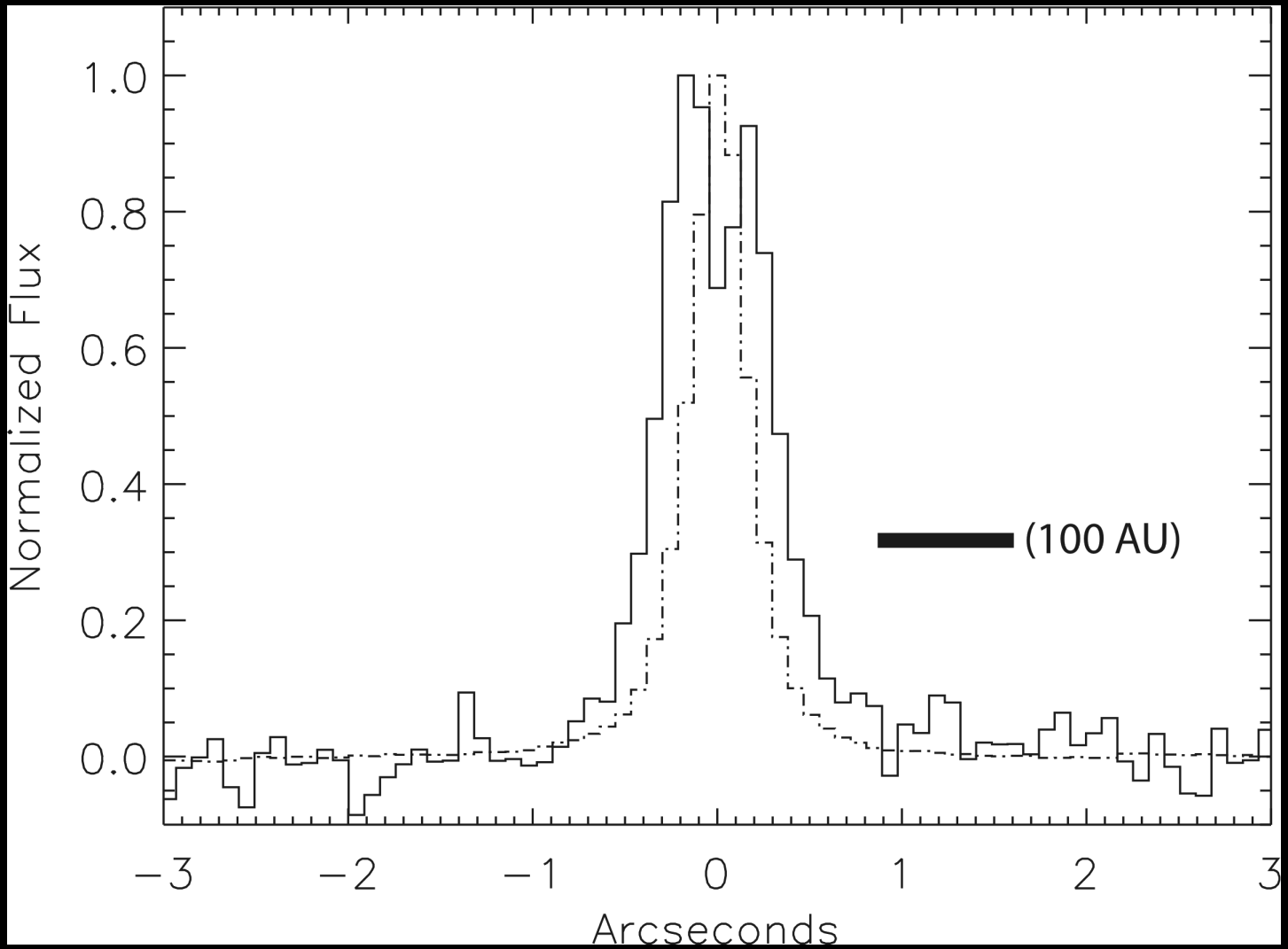
HD 100546


v=4-3 R23
v=3-2 R14
v=2-1 R6
0.4″
6 km s-1

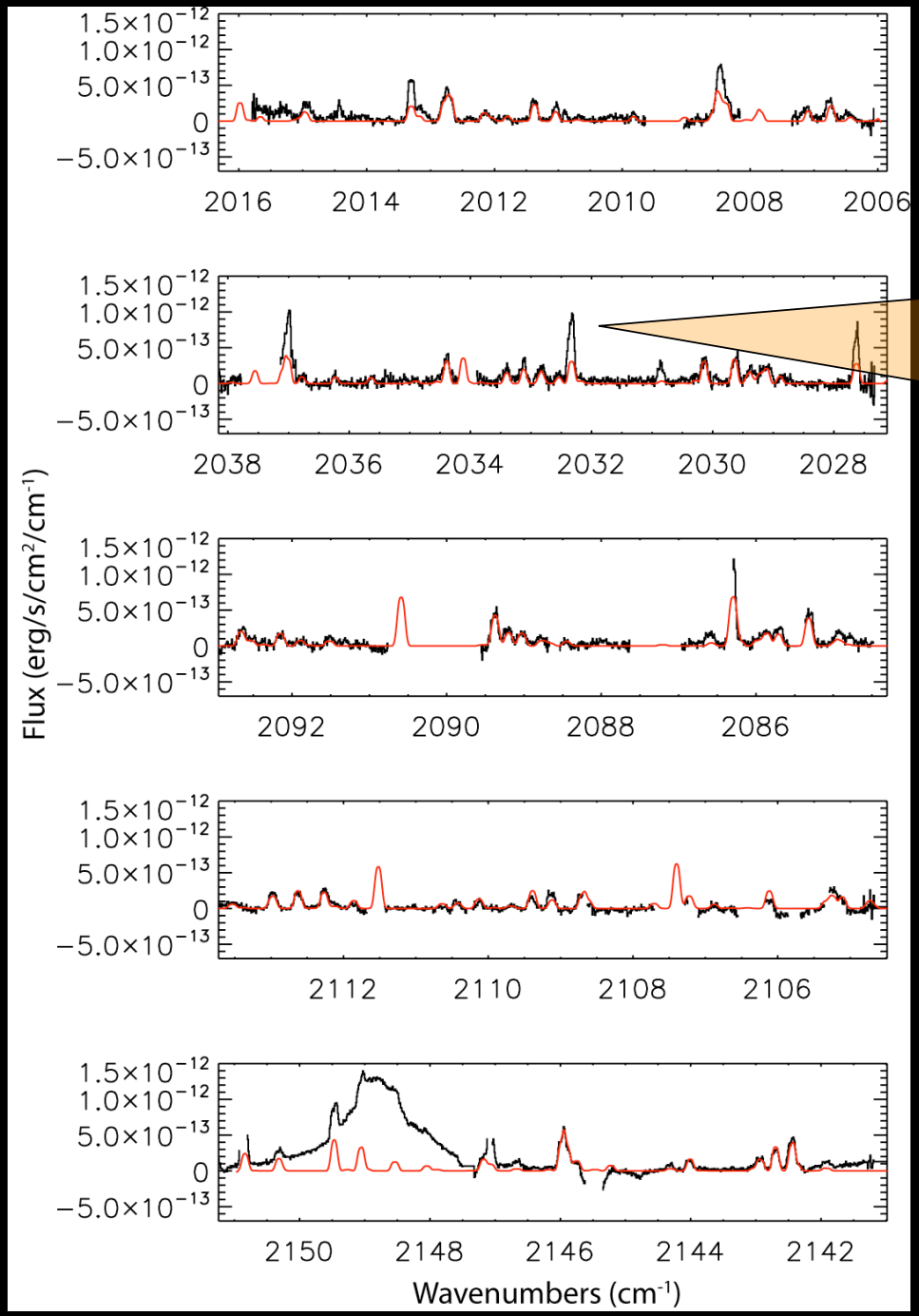

Normalized Flux
1.3
1.2
1.1
1.0
0.9
0.1
0.0
- 0.1
Offset (arcseconds)
−10
0
10
20
Velocity (km/s)

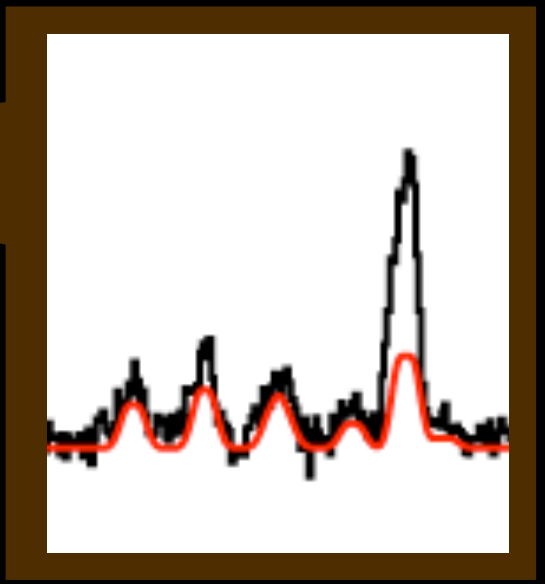

9.8 km s-1
13AU
18 AU
27 AU
44 AU
87 AU

HD 100546



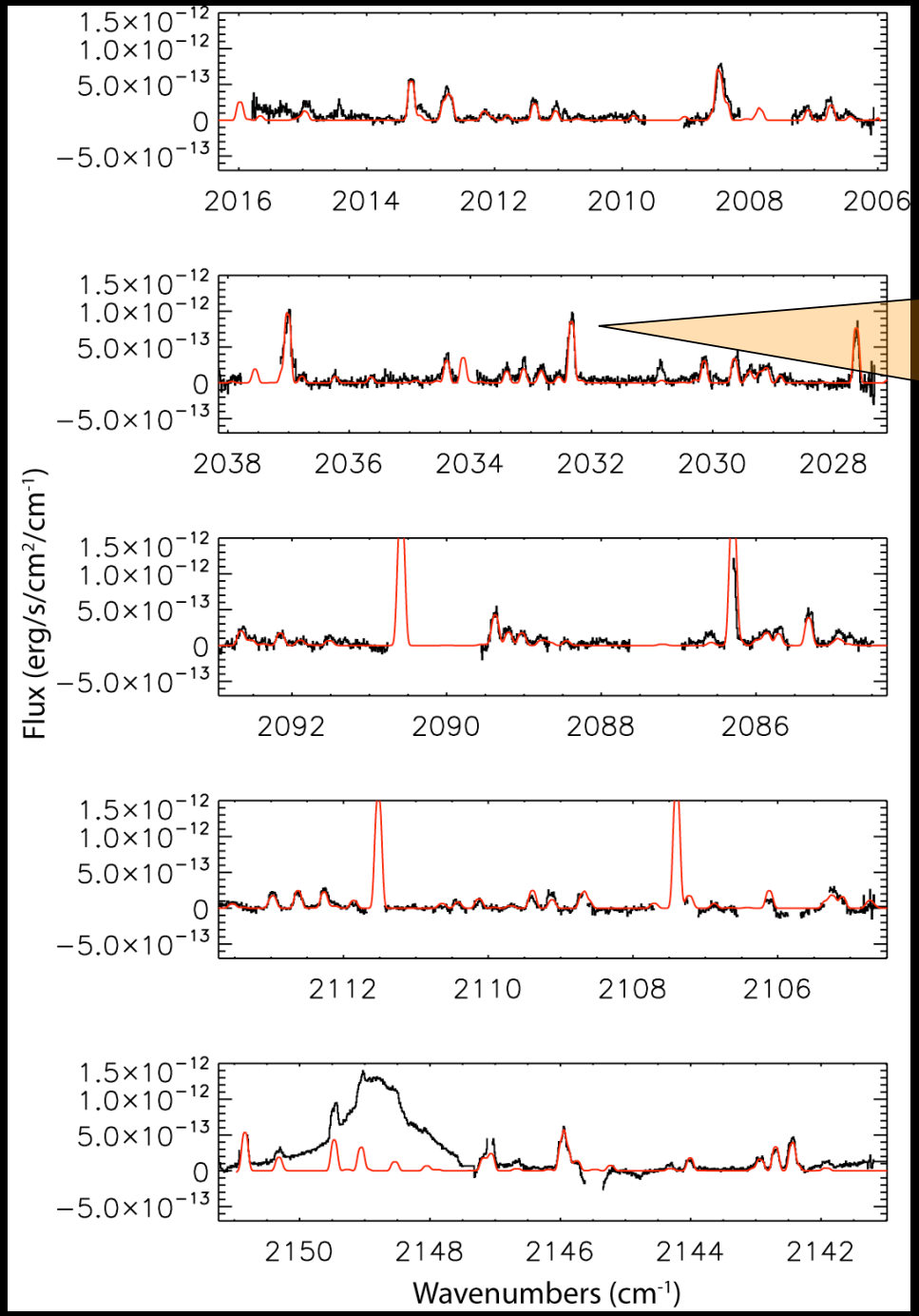
HD 100546

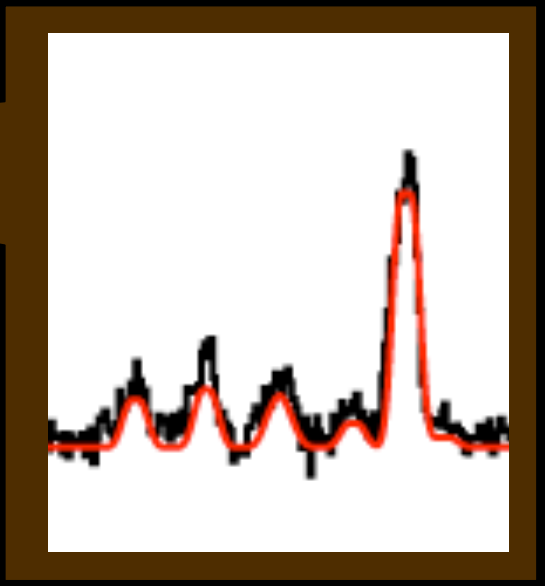




- R_{in}(CO)=13 AU
- R_{out}(CO)~100 AU
- $T(r)=1400\ (r/13AU)^{-0.35}$ K
- b=2.0 km s^{-1}
- $N_{fl}(CO)=10^{14}$ cm^{-2}

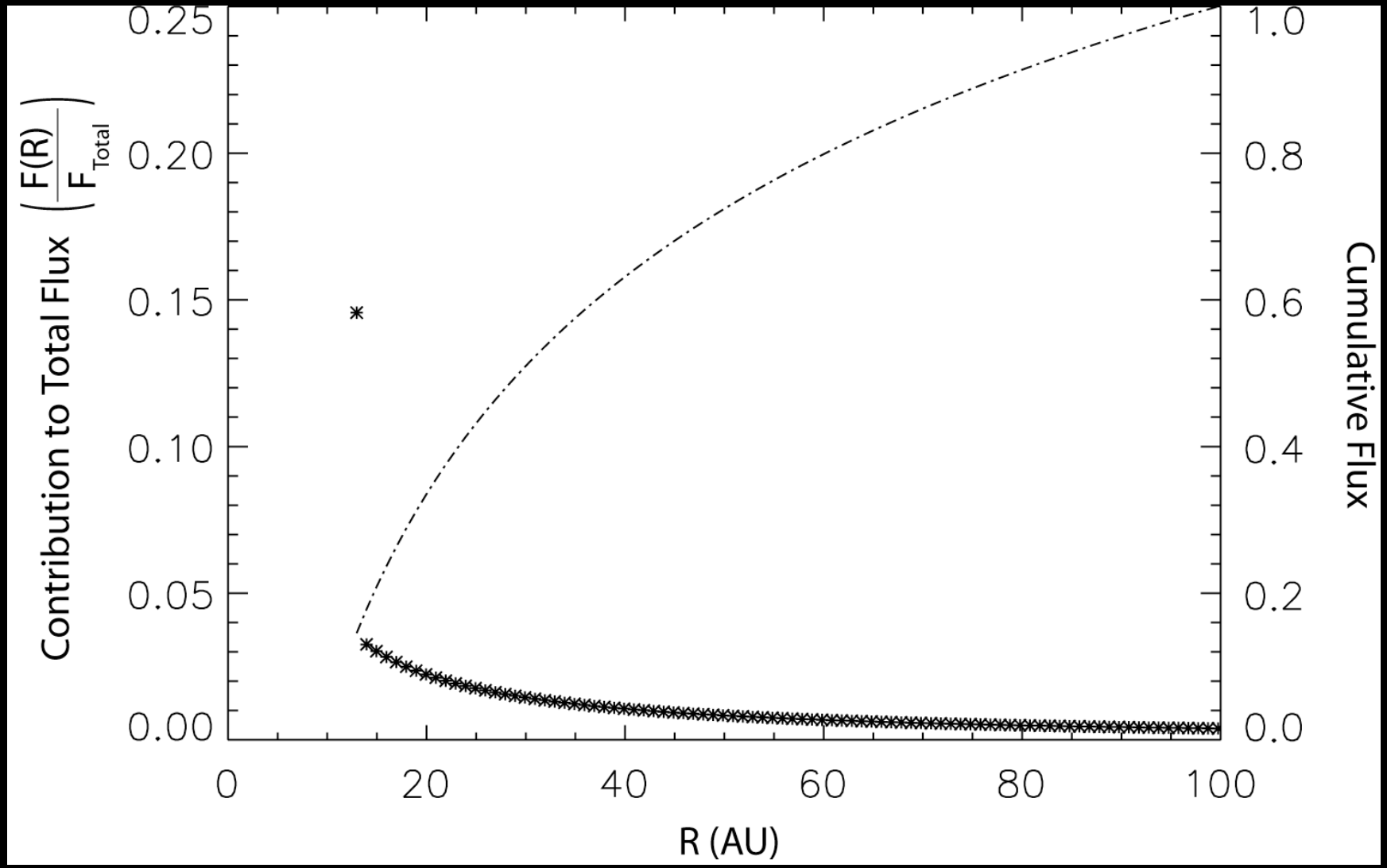
HD 100546



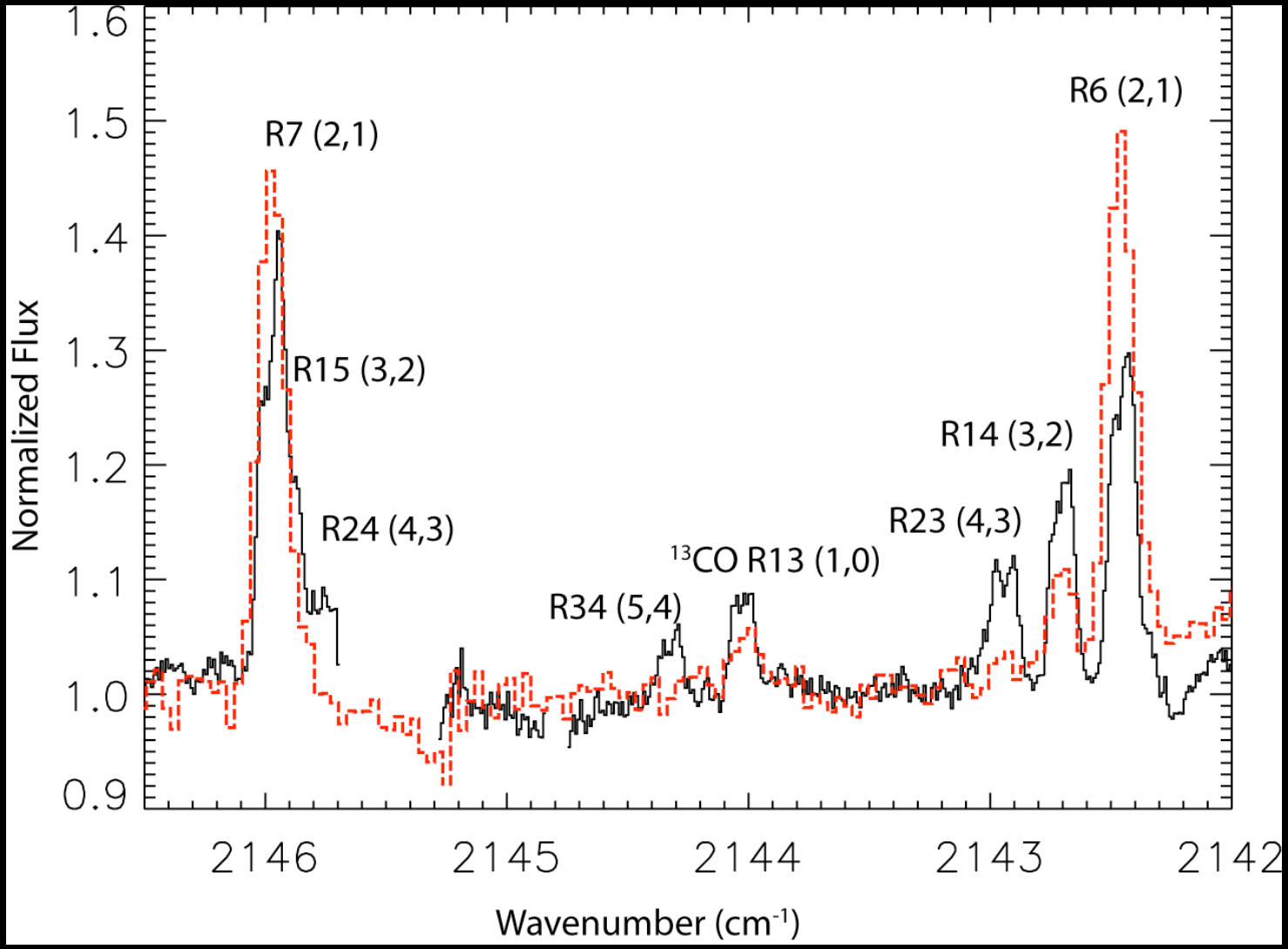


- R_{in}(CO)=13 AU
- R_{out}(CO)~100 AU
- $T(r)=1400\ (r/13AU)^{-0.35}$ K
- b=2.0 km s^{-1}
- $N_{fl}(CO)=10^{14}$ cm^{-2}
- $N_{cl}(CO)=1.5 \times 10^{17}$ cm^{-2}
- $n(H)=3\times10^{8}\ (r/13\ AU)^{-1}$ cm^{-3}

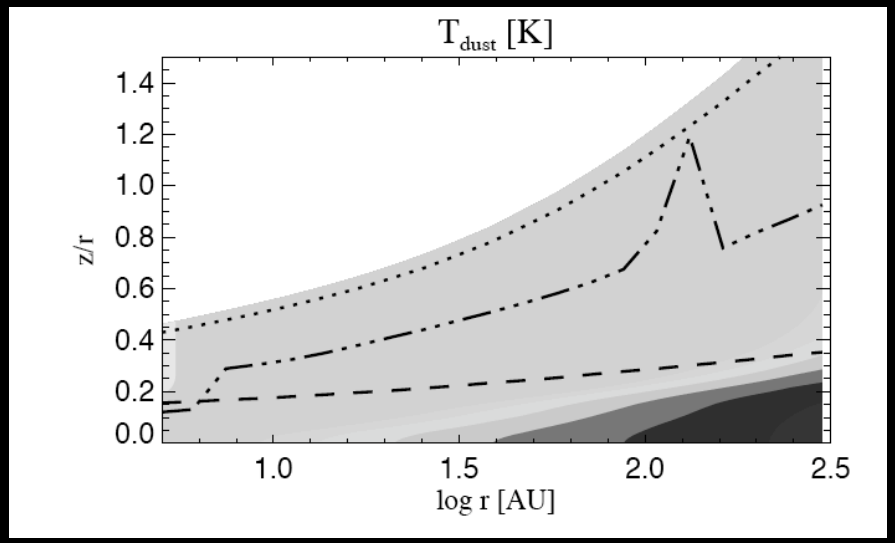
HD 100546

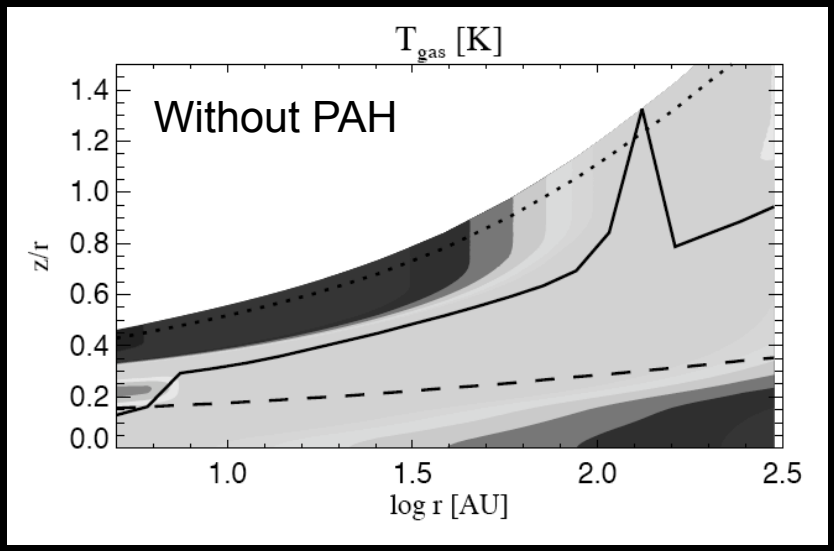

Contribution to Total Flux $\left(\frac{F(R)}{F_{Total}}\right)$
Cumulative Flux
R (AU)
0.25
0.20
0.15
0.10
0.05
0.00
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
100

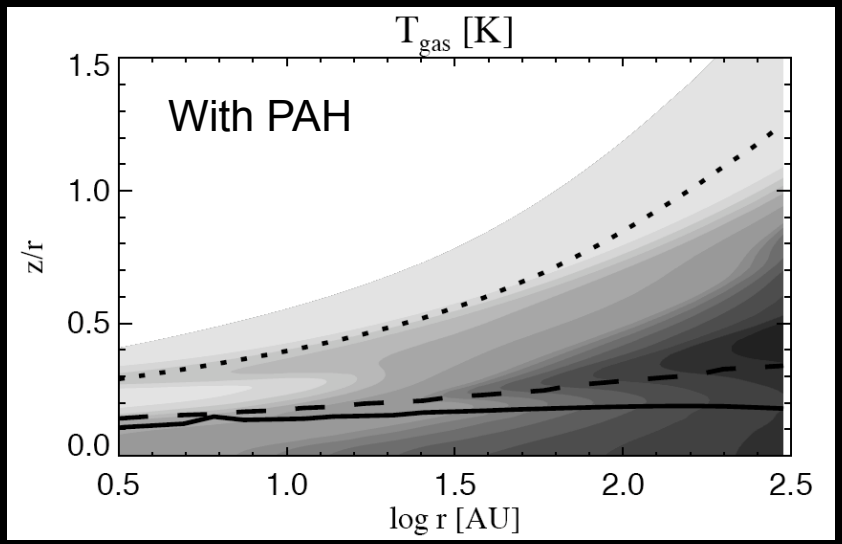
HD 100546 vs HD 141569



HD 100546 vs HD 141569

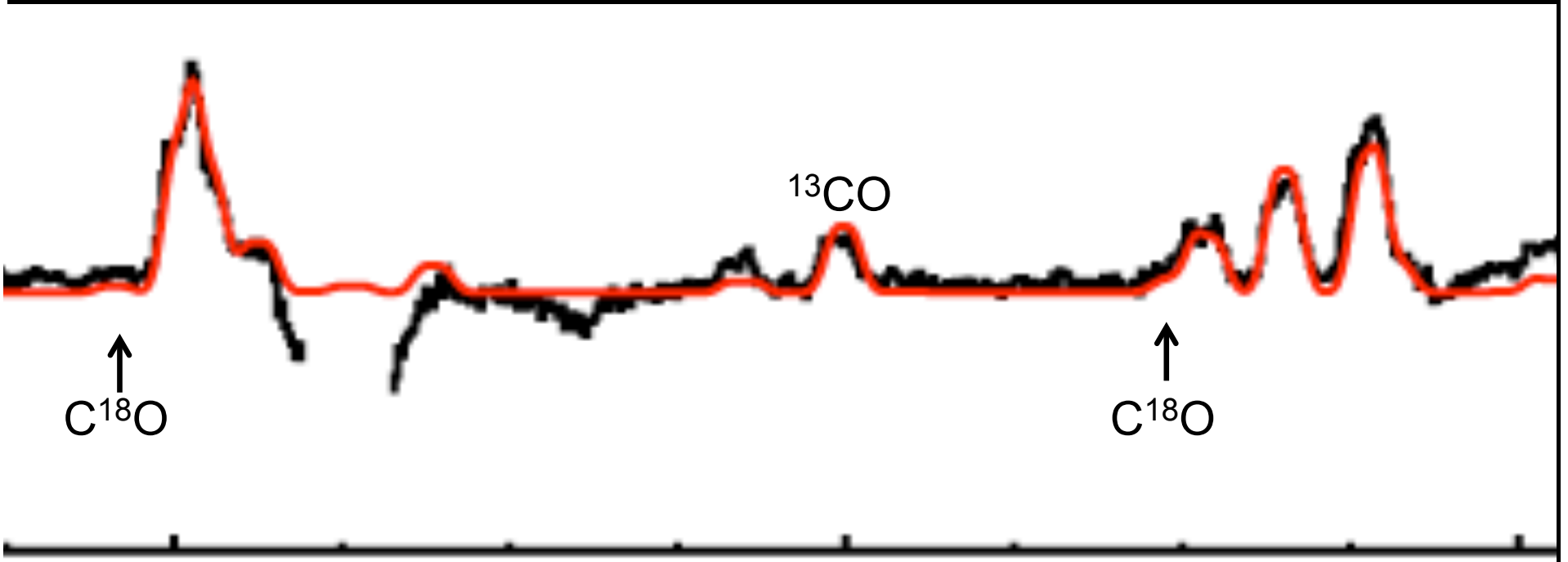






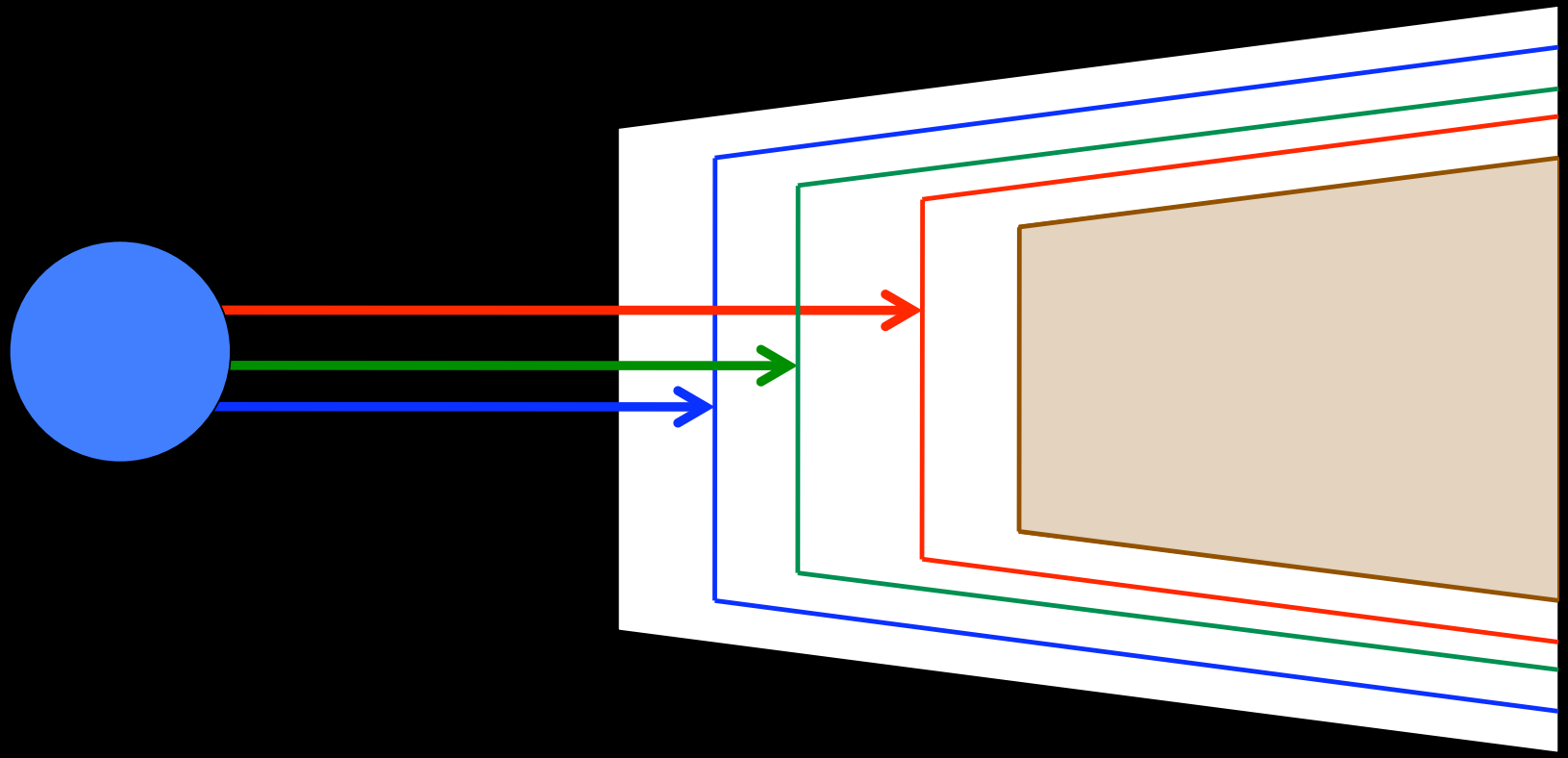
Kamp et al. (2005)

CO Isotopomers

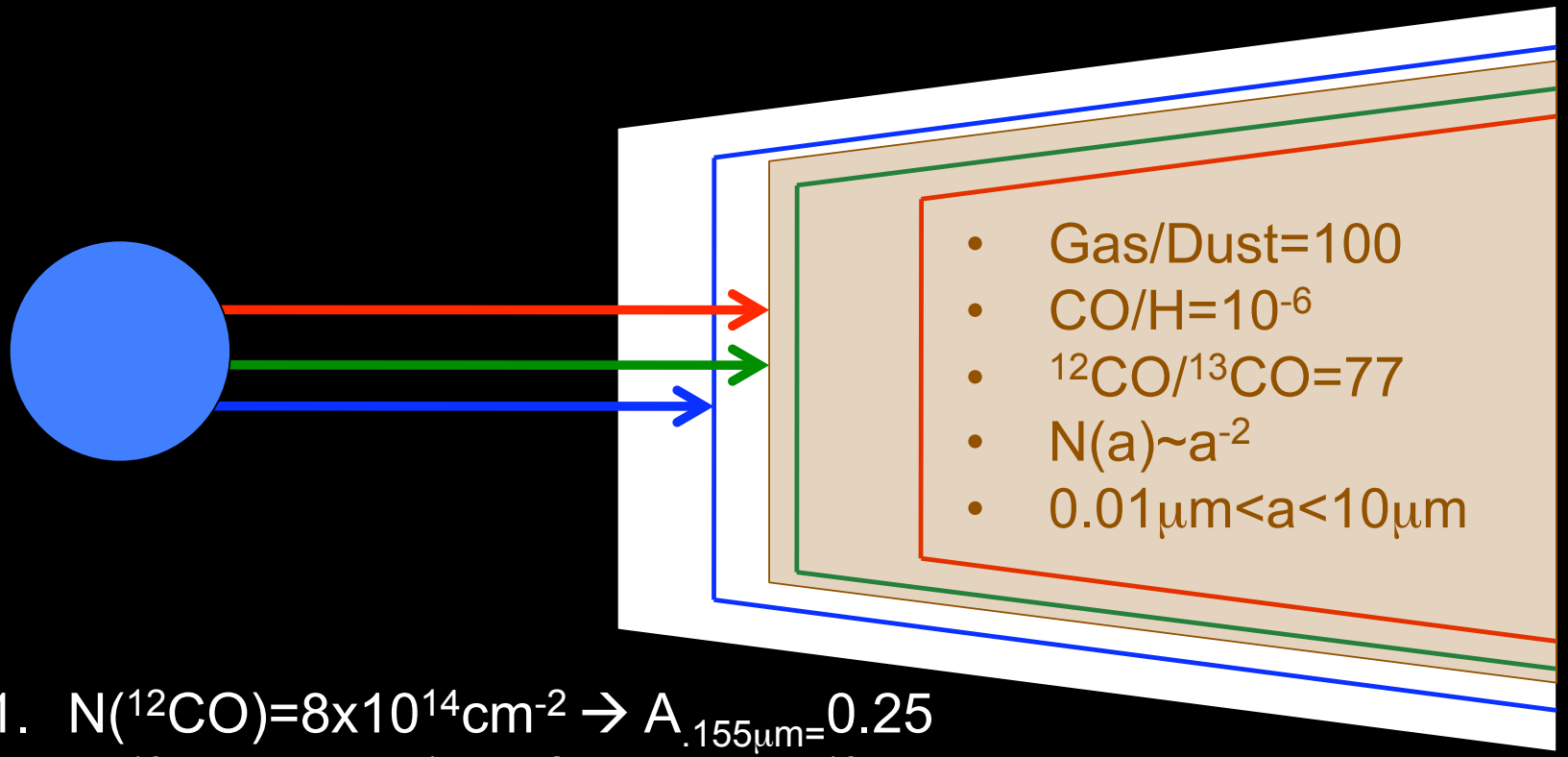


$^{12}C^{16}O/^{13}C^{16}O$=4 (77)
$^{12}C^{16}O/^{12}C^{18}O$=26 (550)
$^{13}C^{16}O/^{12}C^{18}O$=6.5 (7.1)

CO Isotopomers



CO Isotopomers



1. $N(^{12}CO)=8x10^{14}cm^{-2} \rightarrow A_{.155\mu m=}0.25$
2. $N(^{13}CO)=8x10^{14}cm^{-2} \rightarrow A_{.155\mu m}(^{13}CO)=19$
3. $L_{^{13}CO} \sim ¼\ L_{^{12}CO}$

Tilley et al. Poster #55

Conclusions

- Ro-vibrational CO emission can be resolved in the disk.
- The temperature of disk is not set by the SpT of the star.
- Gas can be much hotter than the dust.
- Overabundant isotopomers do not necessarily indicate optically thick emission.