hamburger sternwarte

High-resolution X-ray spectroscopy of cool A-type stars

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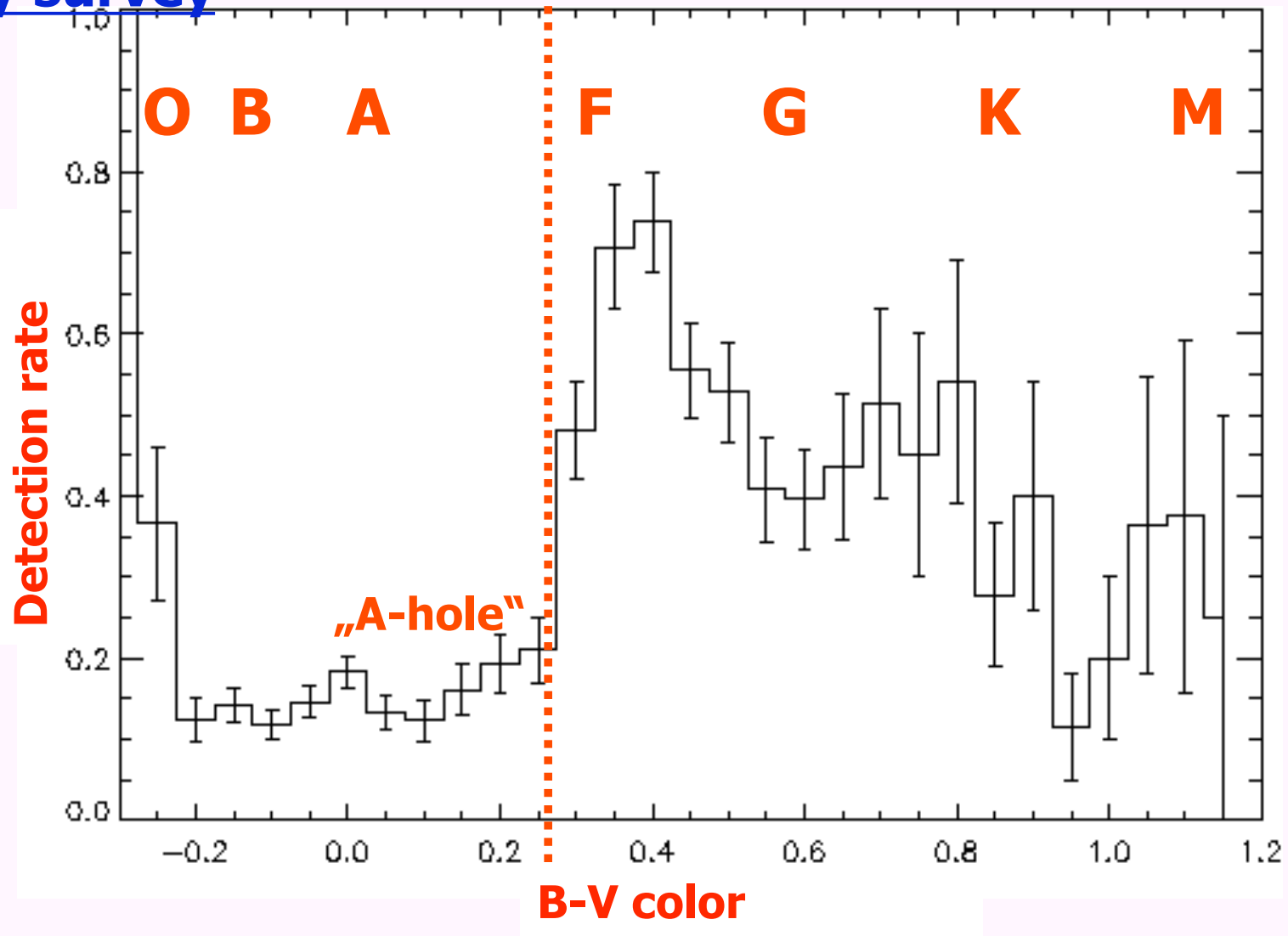
Topics:

- Altair: The hottest cool star
- HD 163296: X-rays from a shocked outflow ?
- β Pic: ????

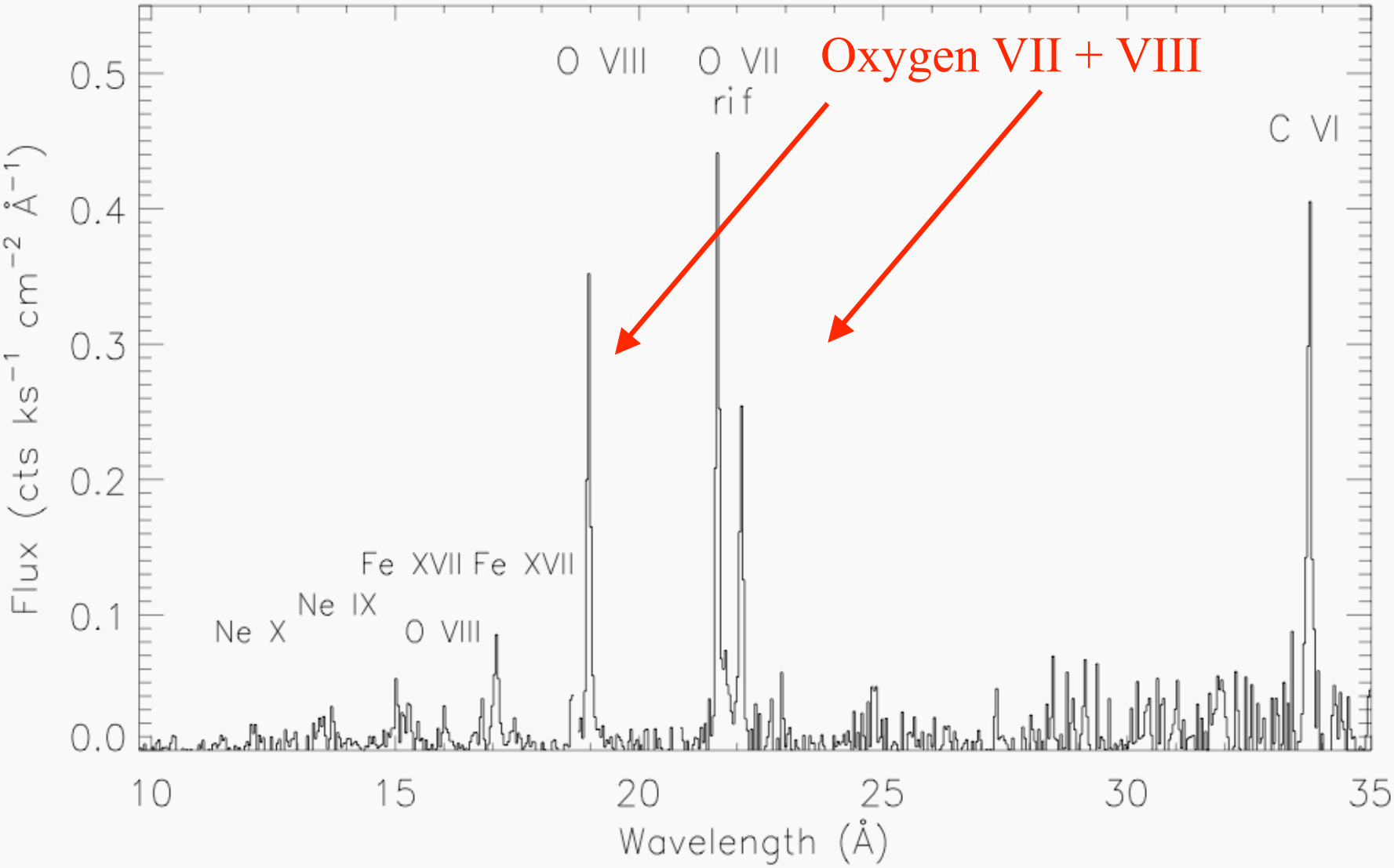
Detection rate of bright stars in ROSAT- (flux limited sample) all sky survey



Schröder & Schmitt (2007)

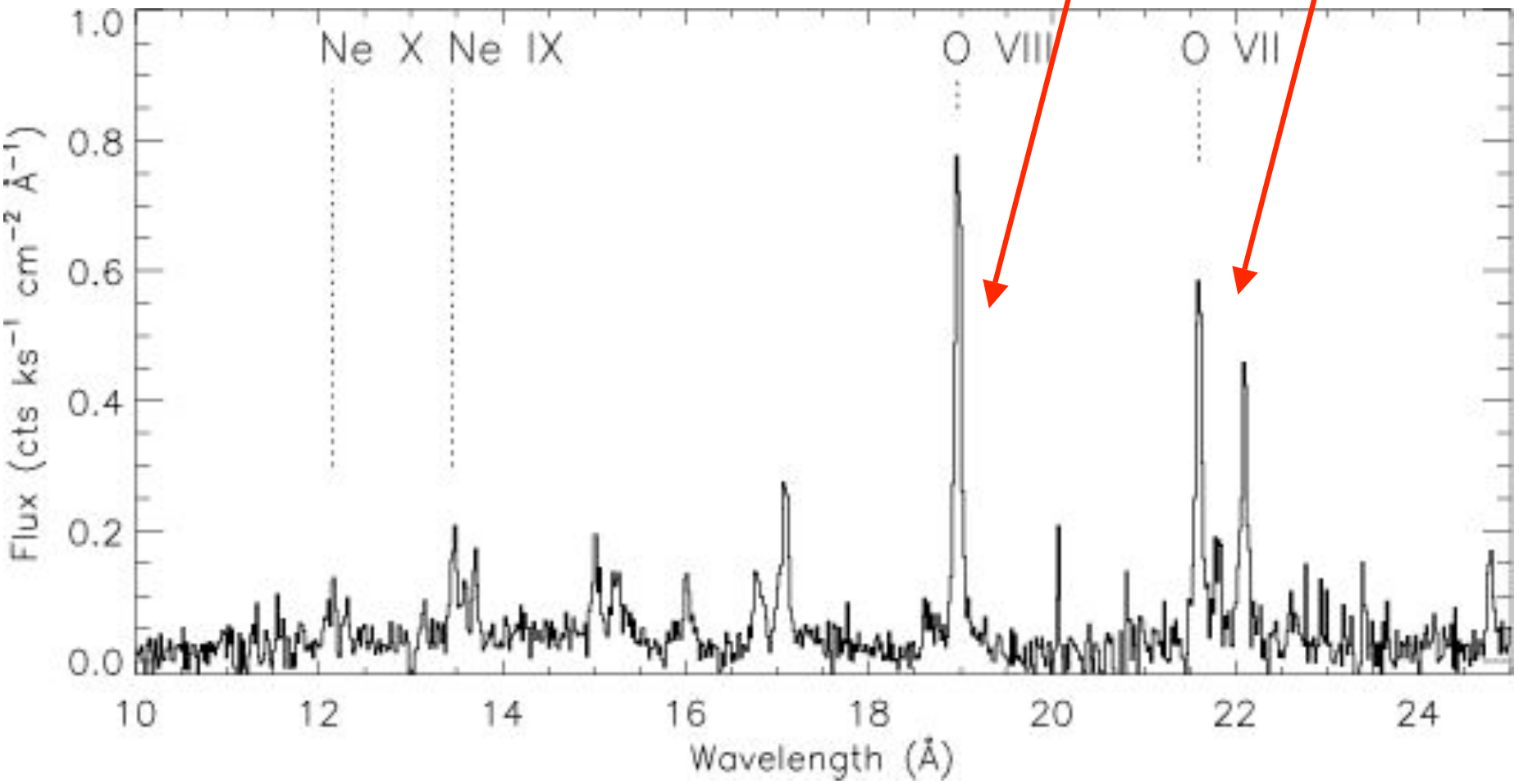
„Onset" of outer convection zones

Altair -- the hottest cool star: XMM-Newton RGS

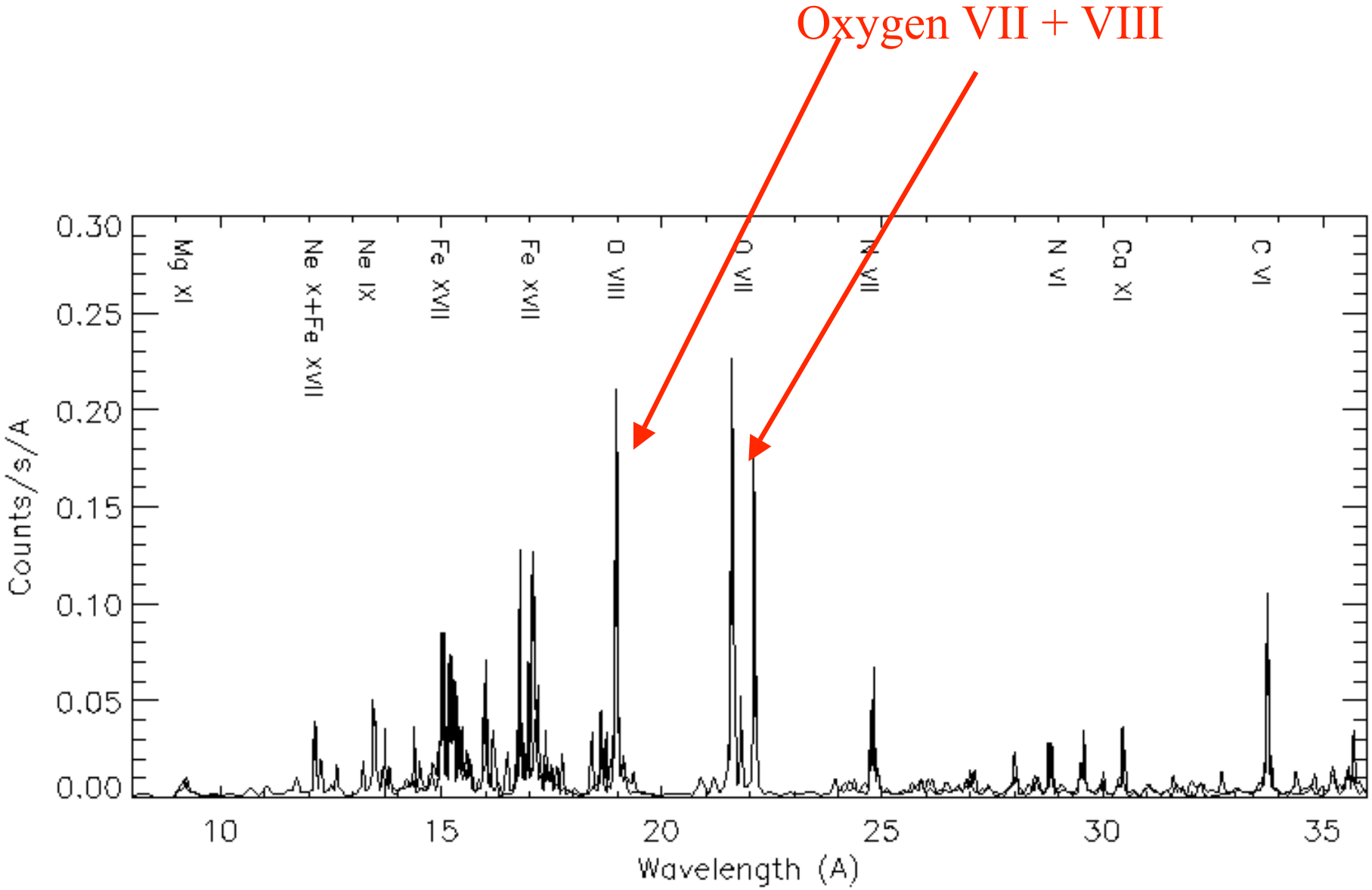


Robrade & Schmitt (2009)

61 Cygni

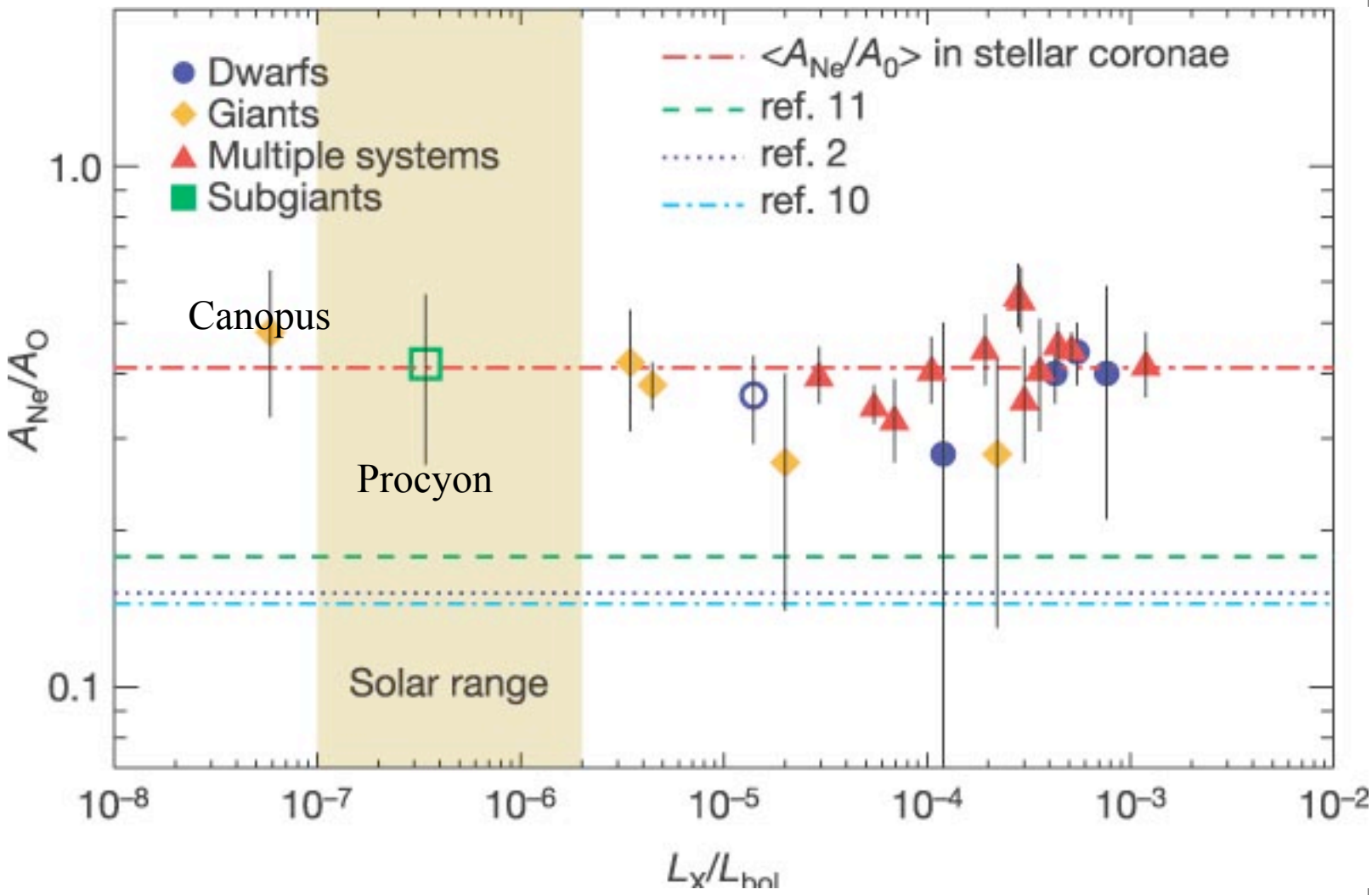


Robrade & Schmitt (2008)

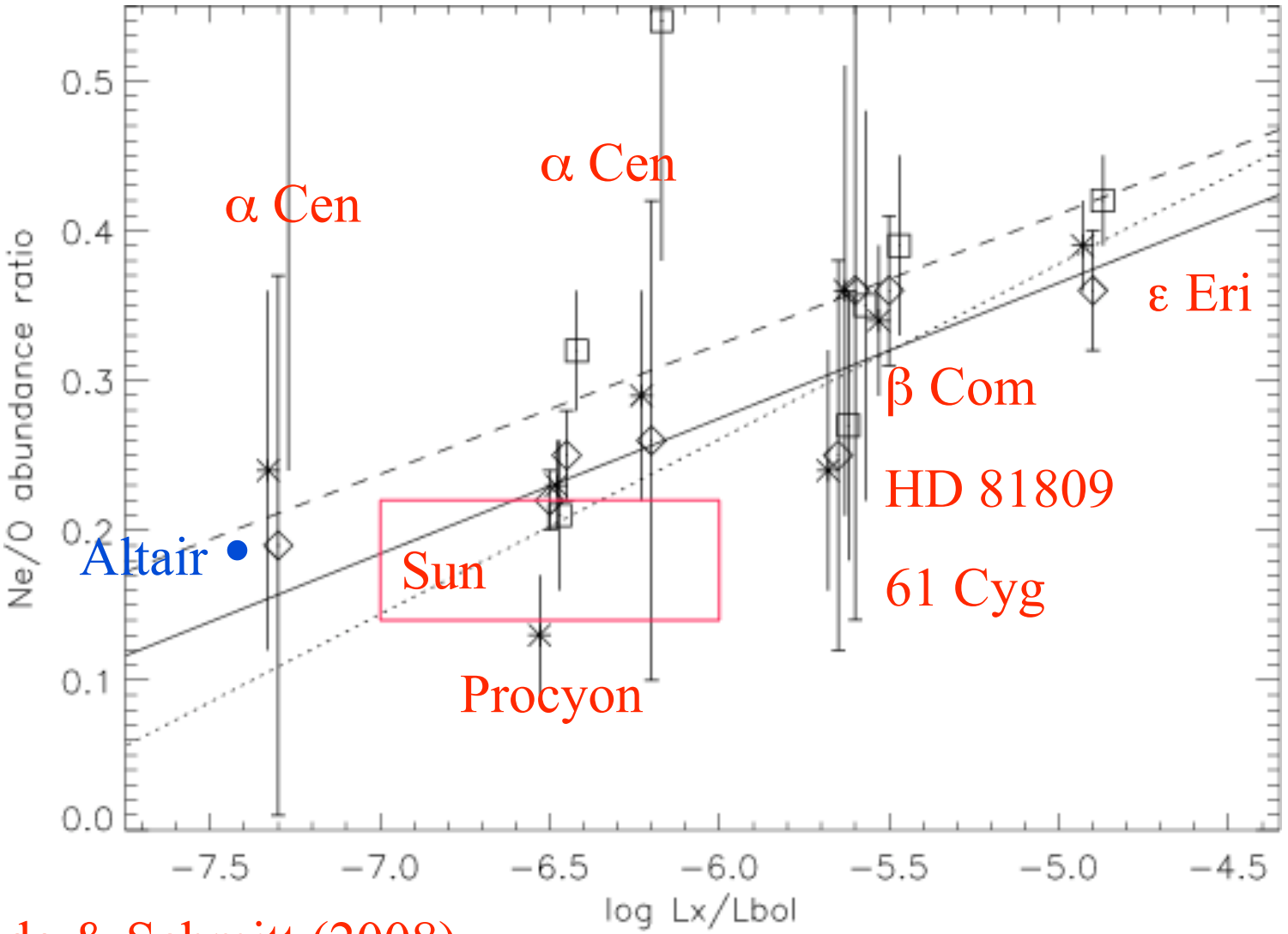


XMM-Newton RGS: α Centauri A+B (Liefke & Schmitt 2006)

Drake & Testa (2005)



Suggestion: **Increased neon abundance typical for local cosmos at large**

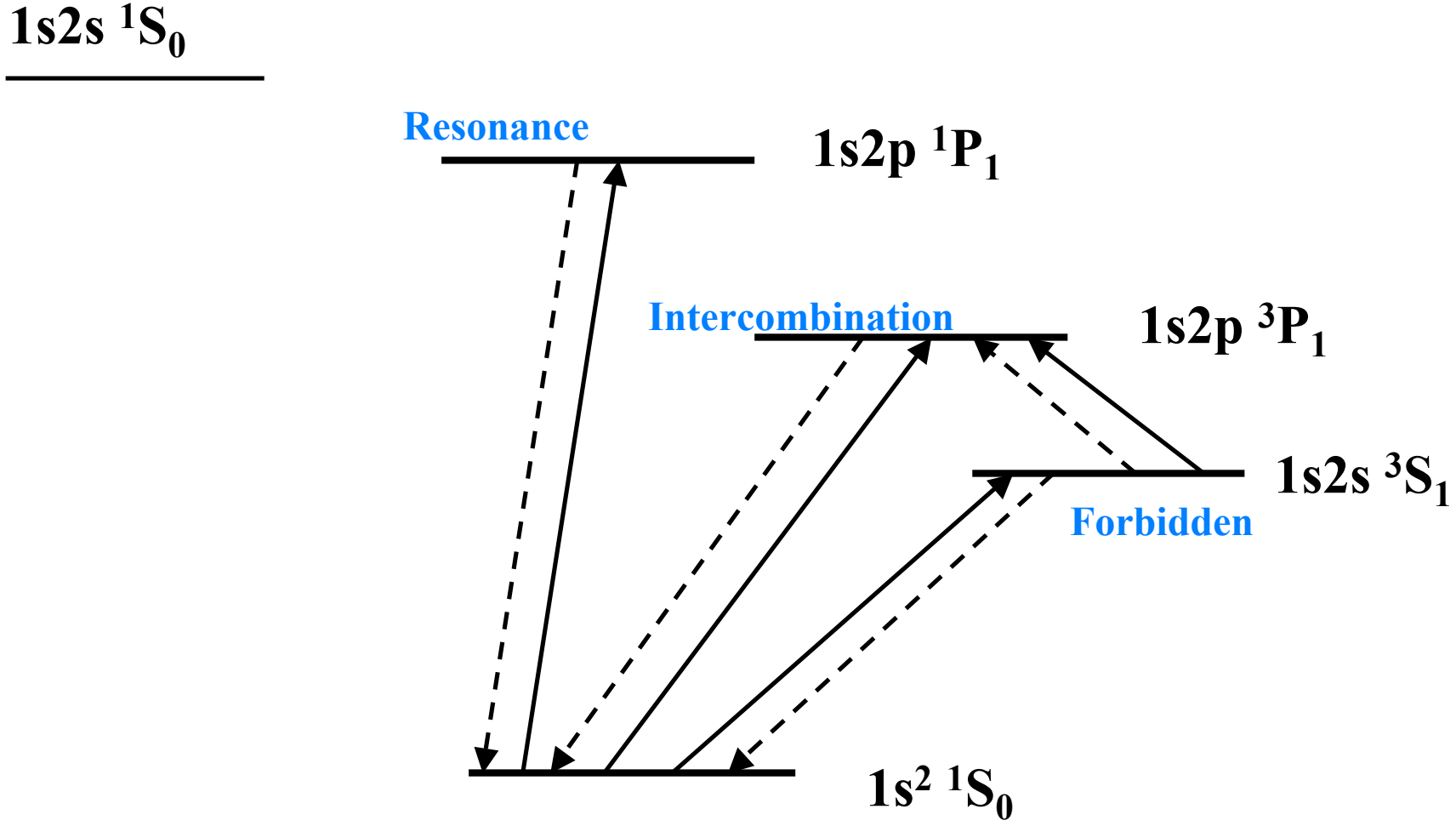


Robrade & Schmitt (2008)

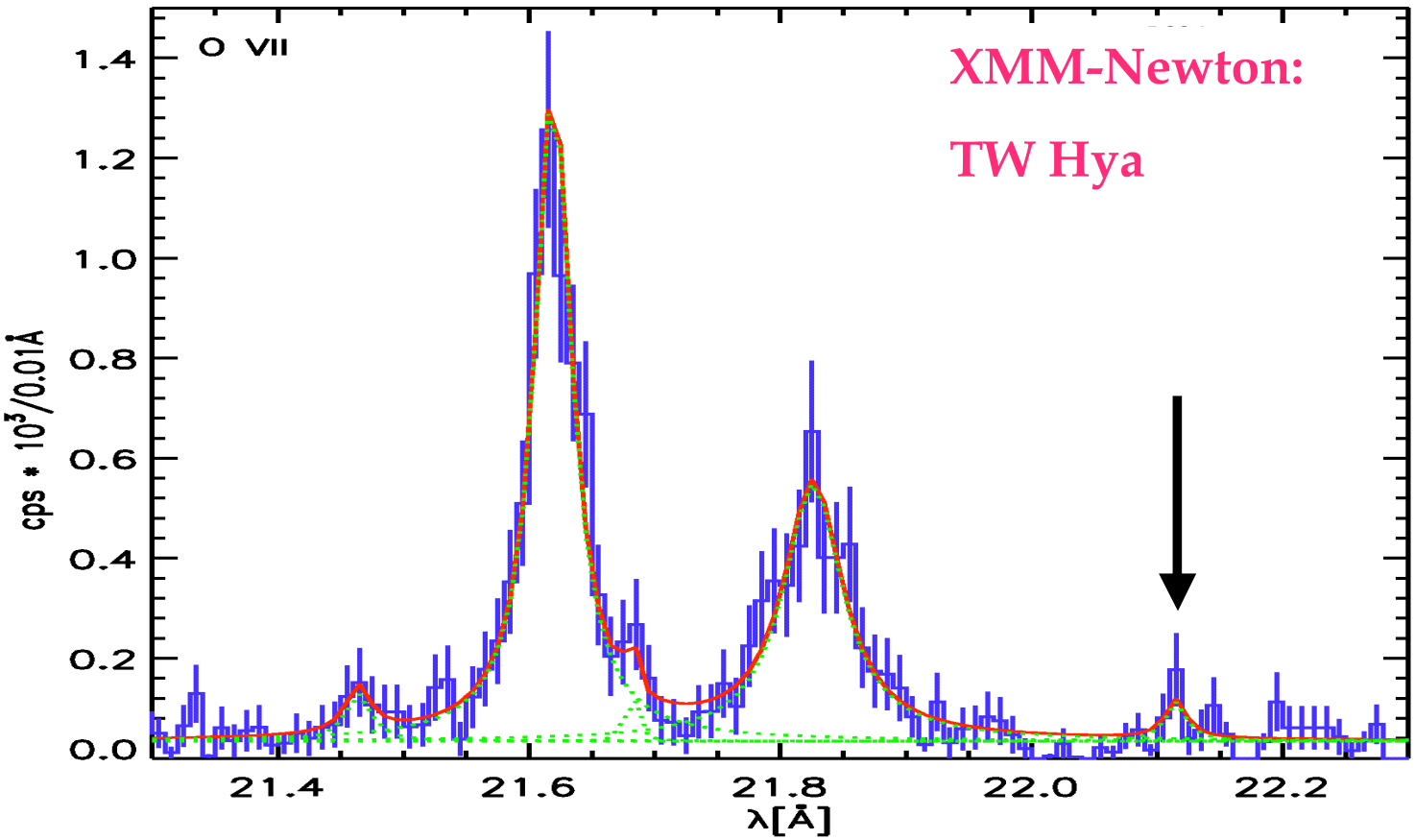
Robrade & Schmitt (2009)

Altair: Ne/O= 0.20±0.05, 0.19±0.07, 0.17±0.04, 0.24±0.07

Energy levels for He-like ions



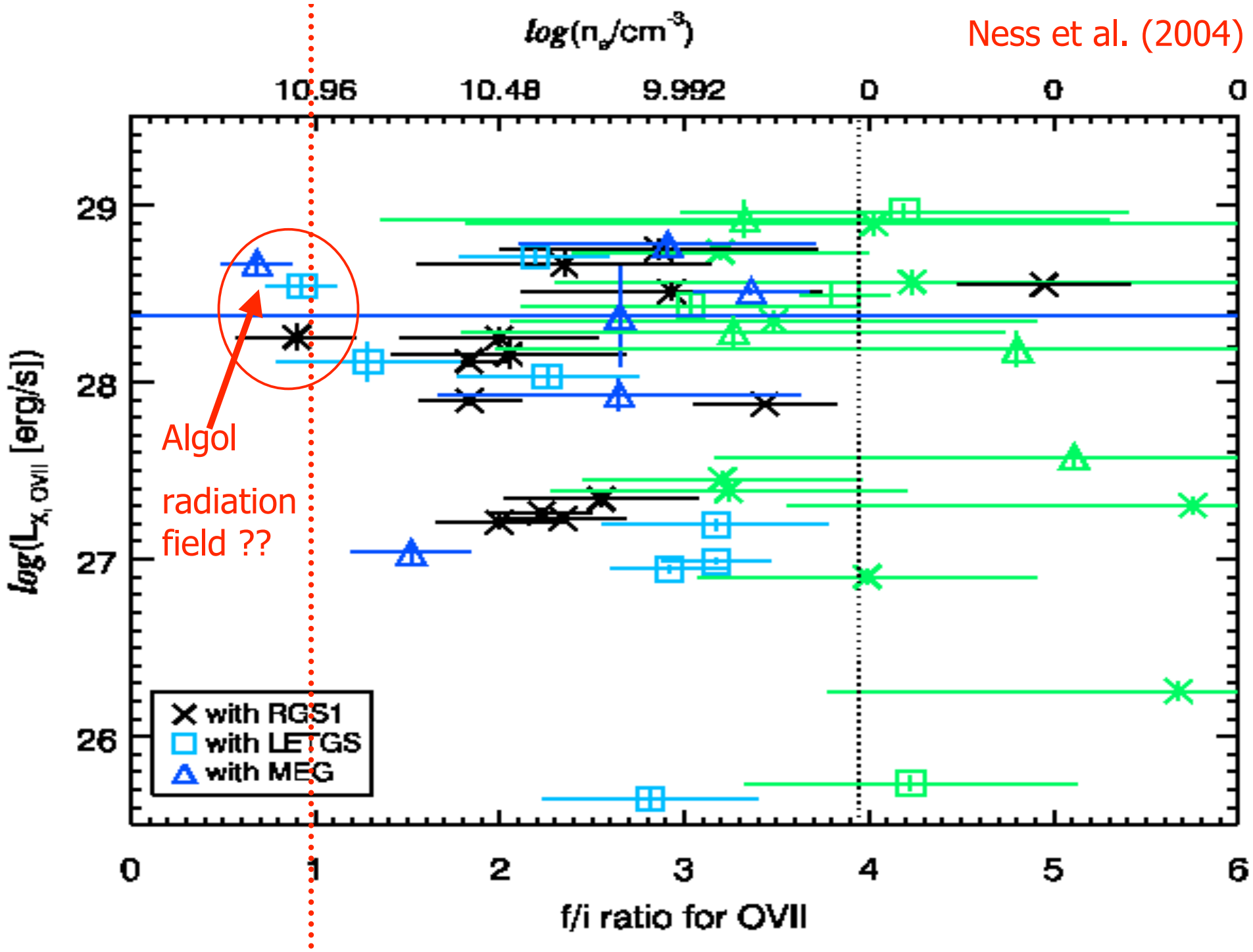
X-ray spectrum of TW Hya (CTTS): OVII triplet



forbidden line (almost) absent !

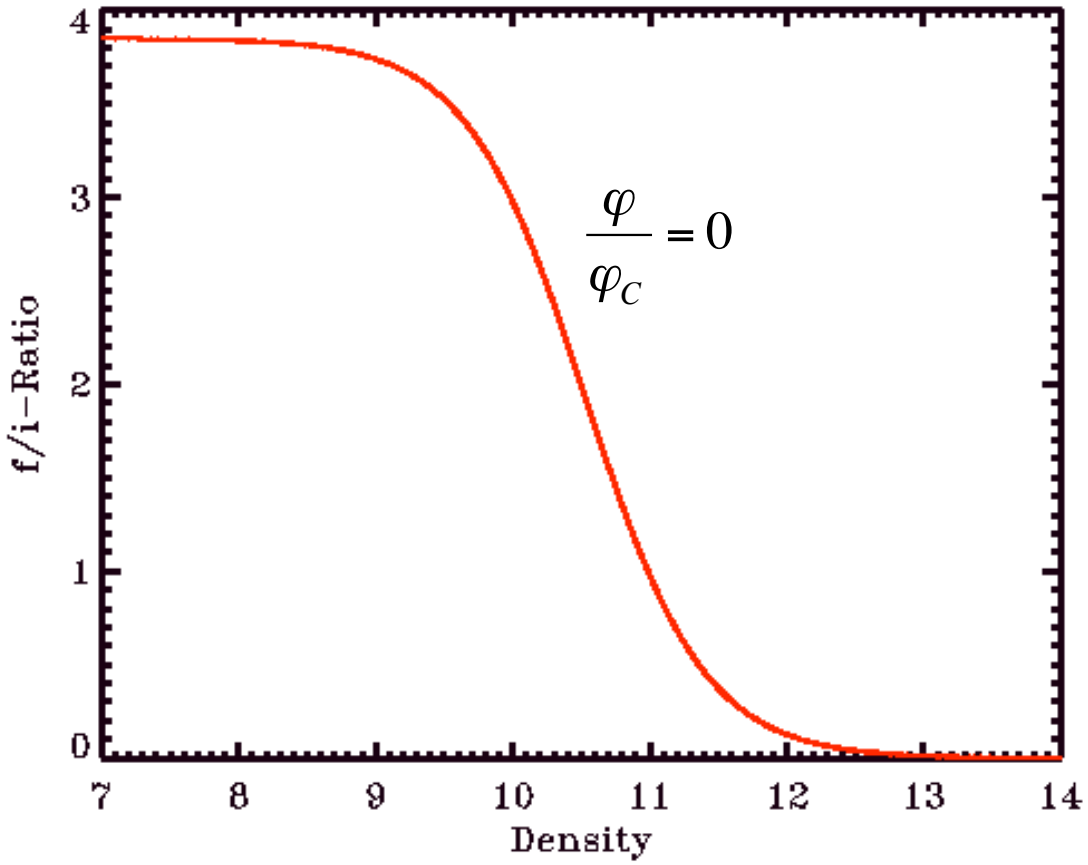
XMM-RGS: Stelzer & Schmitt (2004)

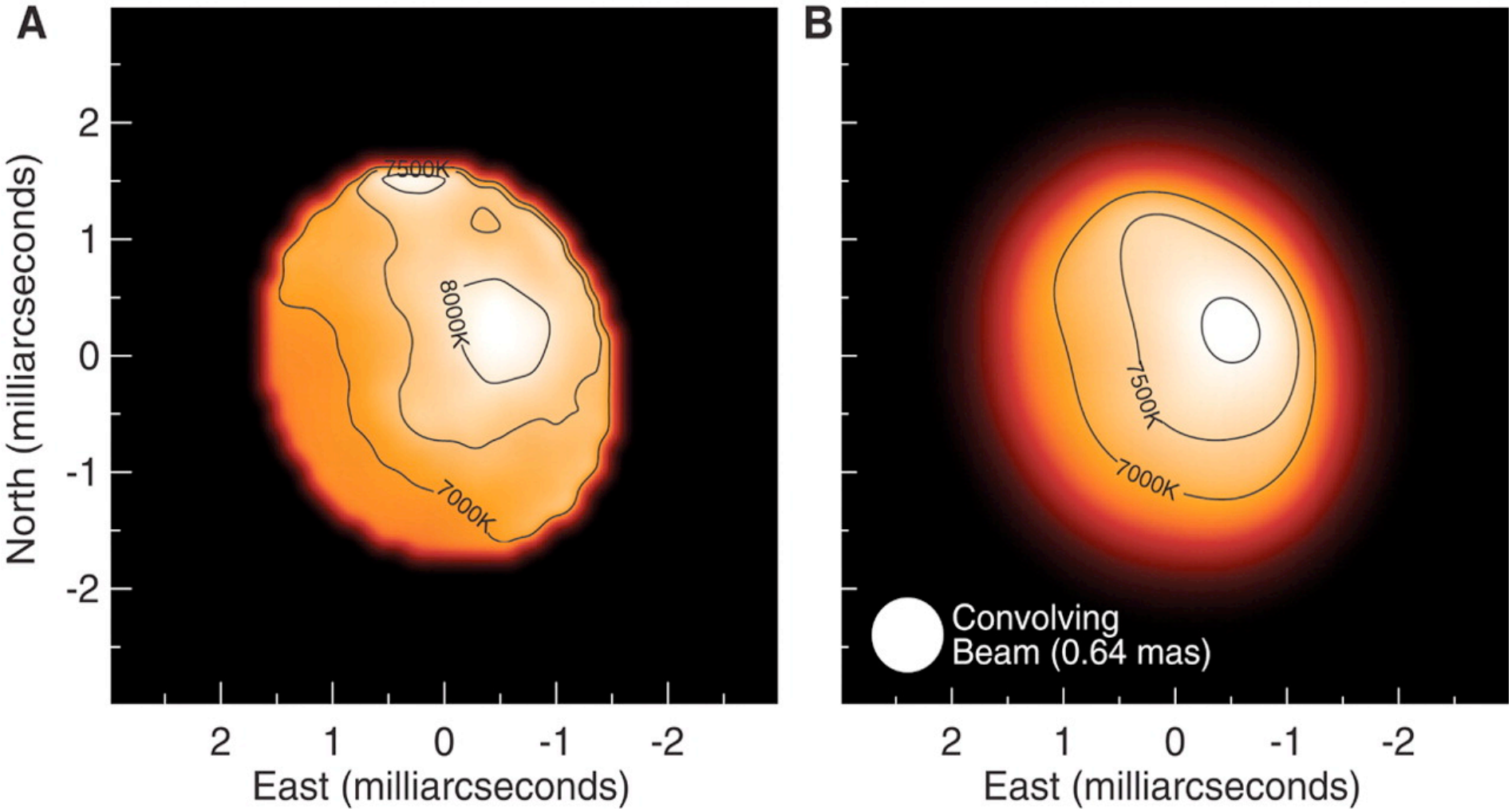
Chandra: Kastner et al. (2002)


log(n_e/cm^-3)
10.96
10.48
9.992
0
0
0
Ness et al. (2004)
29
28
27
26
log(L_X, OVII [erg/s])
Algol
radiation
field ??
with RGS1
with LETGS
with MEG
0
1
2
3
4
5
6
f/i ratio for OVII

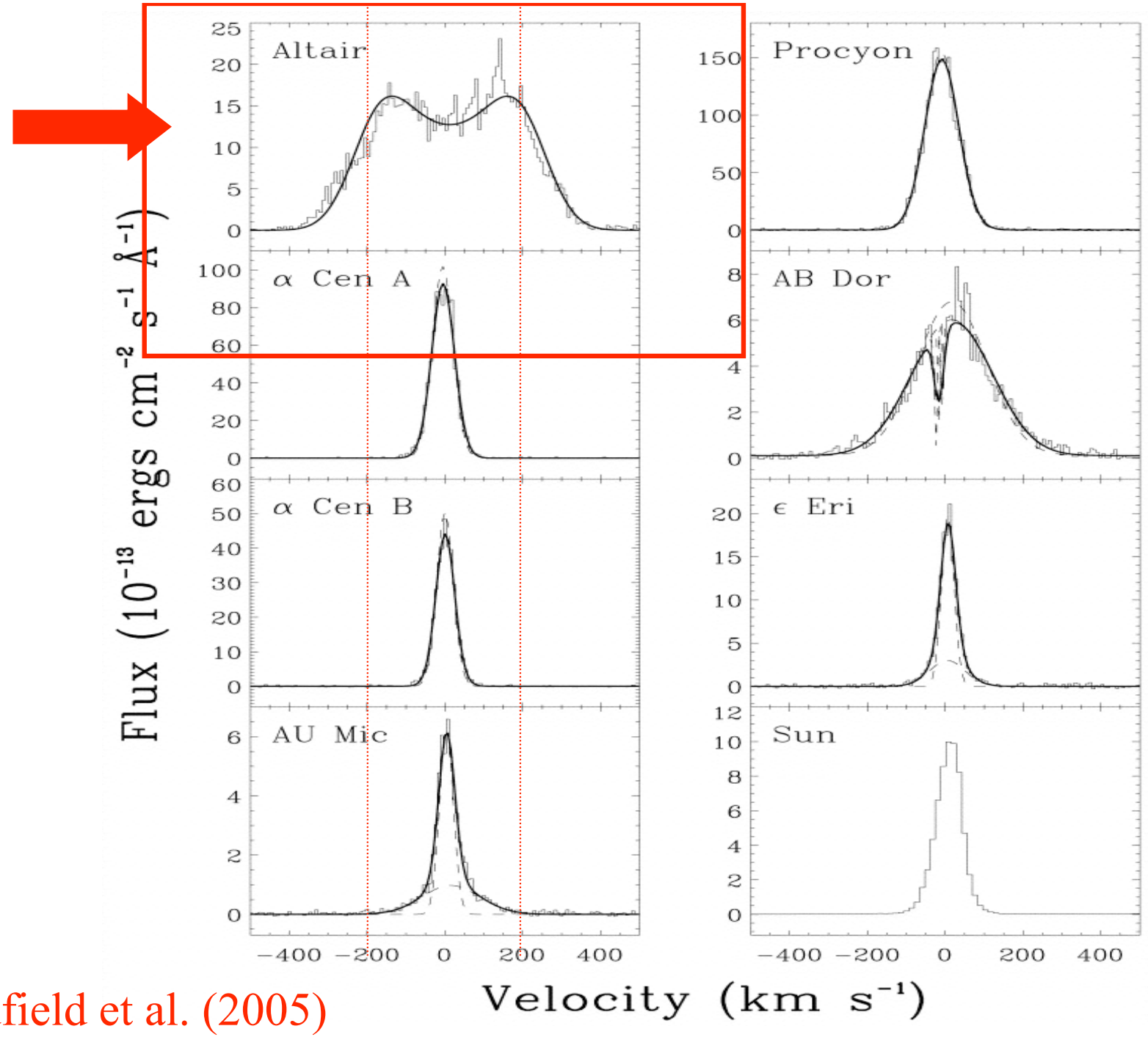
How do we obtain coronal densities ?

$$R = \frac{f}{i} = \frac{R_O}{1 + \frac{\varphi}{\varphi_C} + \frac{N_e}{N_C}}$$

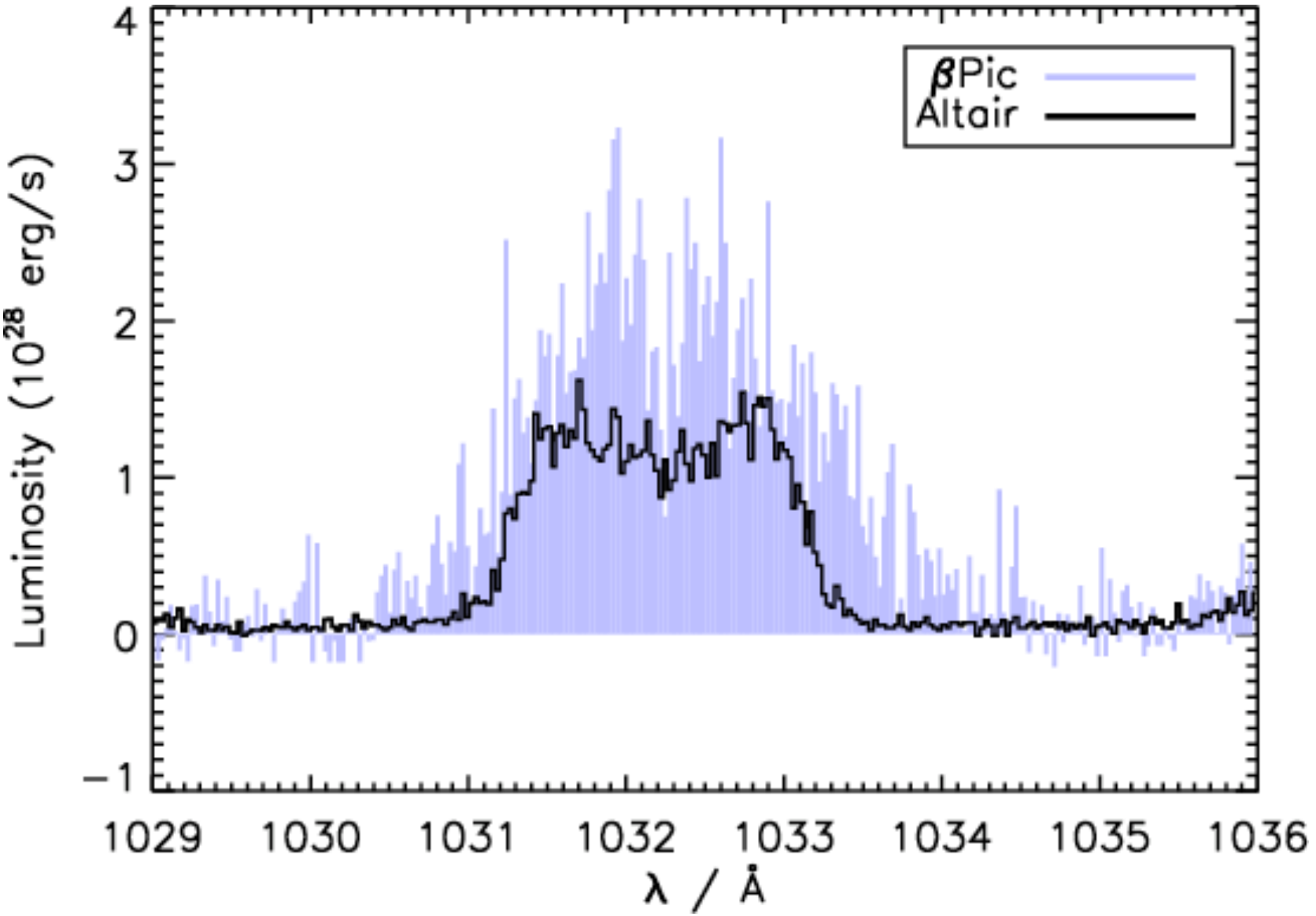




Monnier et al. (2007)



Redfield et al. (2005)



Hempel et al. (2005)

X-rays from β Pic

	Source region			Scaled background			SRC/BG	Probabi	
Energy (keV)	MOS1	MOS2	Σ	MOS1	MOS2	Σ	Ratio	PPM1	PPM2
0.2–0.465	4	7	11	3.9	7.0	10.9	1.0	0.55	0.55
0.465–0.665	7	10	17	2.5	3.6	6.1	2.8	0.014	0.004
0.665–1.0	6	2	8	3.5	3.7	7.2	1.1	0.14	0.88
1.0–2.0	19	11	30	14.3	15.2	29.5	1.0	0.13	0.89
2.0–5.0	15	9	24	11.9	11.4	23.3	1.0	0.22	0.80
5.0–12.0	13	16	29	19.1	18.3	37.4	0.8	0.94	0.74

In energy band 465-665 eV: 17 counts with 6.1
expected from background ! (Hempel et al. (2005))

Young stars

Classical T Tauri Stars (CTTS)

- Spectral type M-F
- Age < 30 Myr
- IR excess
- Ha EW > 10 Å
- Cool stars
- X-rays from active corona
- X-rays from accretion and jets

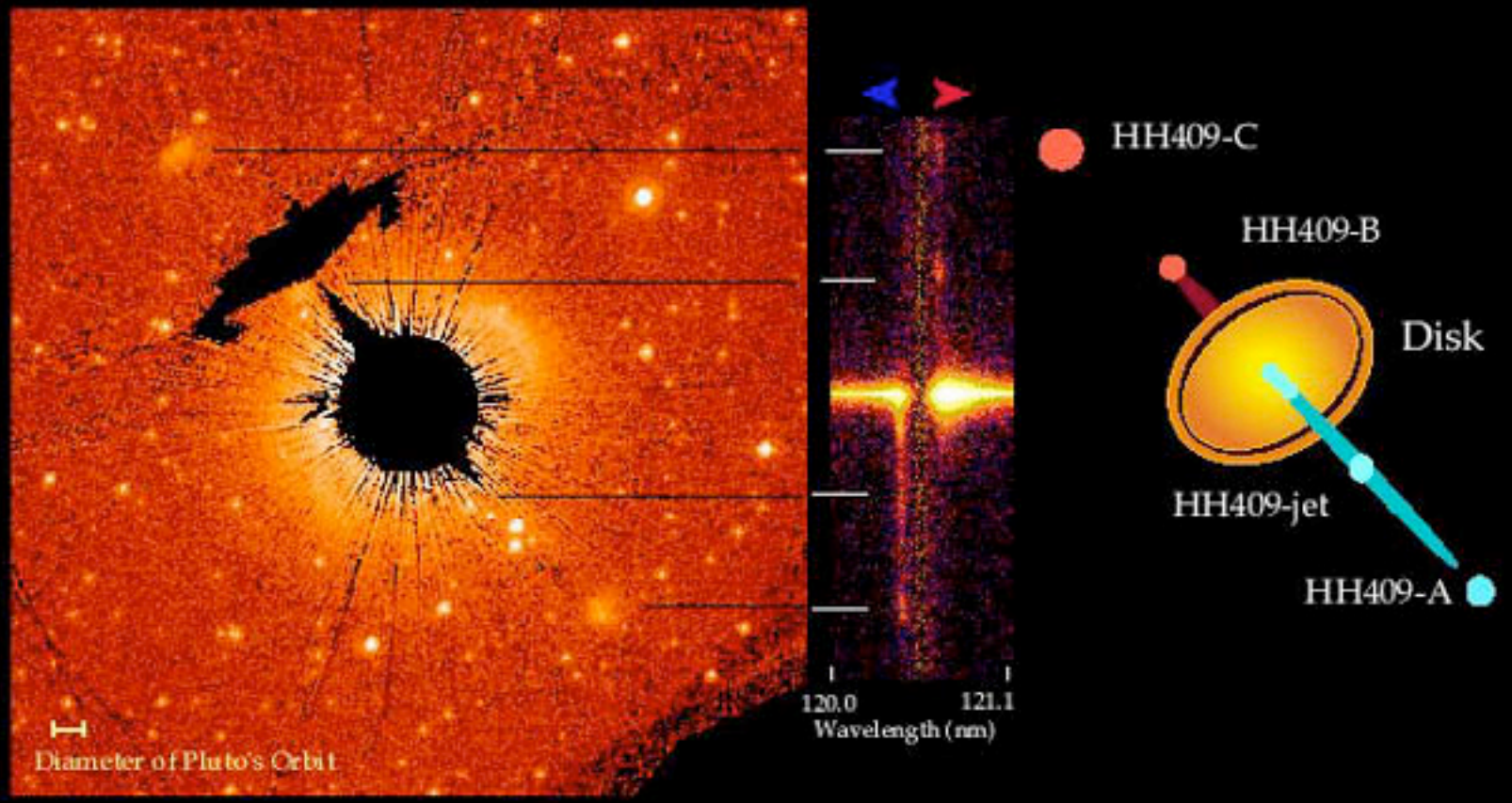
Herbig Ae/Be Stars (HAeBe)

- Spectral type A-B
- Age < a few Myr
- IR excess
- No convective envelope
- Often unresolved companions
- Very high fraction of X-ray emitters

HAeBes: X-ray generation

X-ray production emission mechanism unknown:

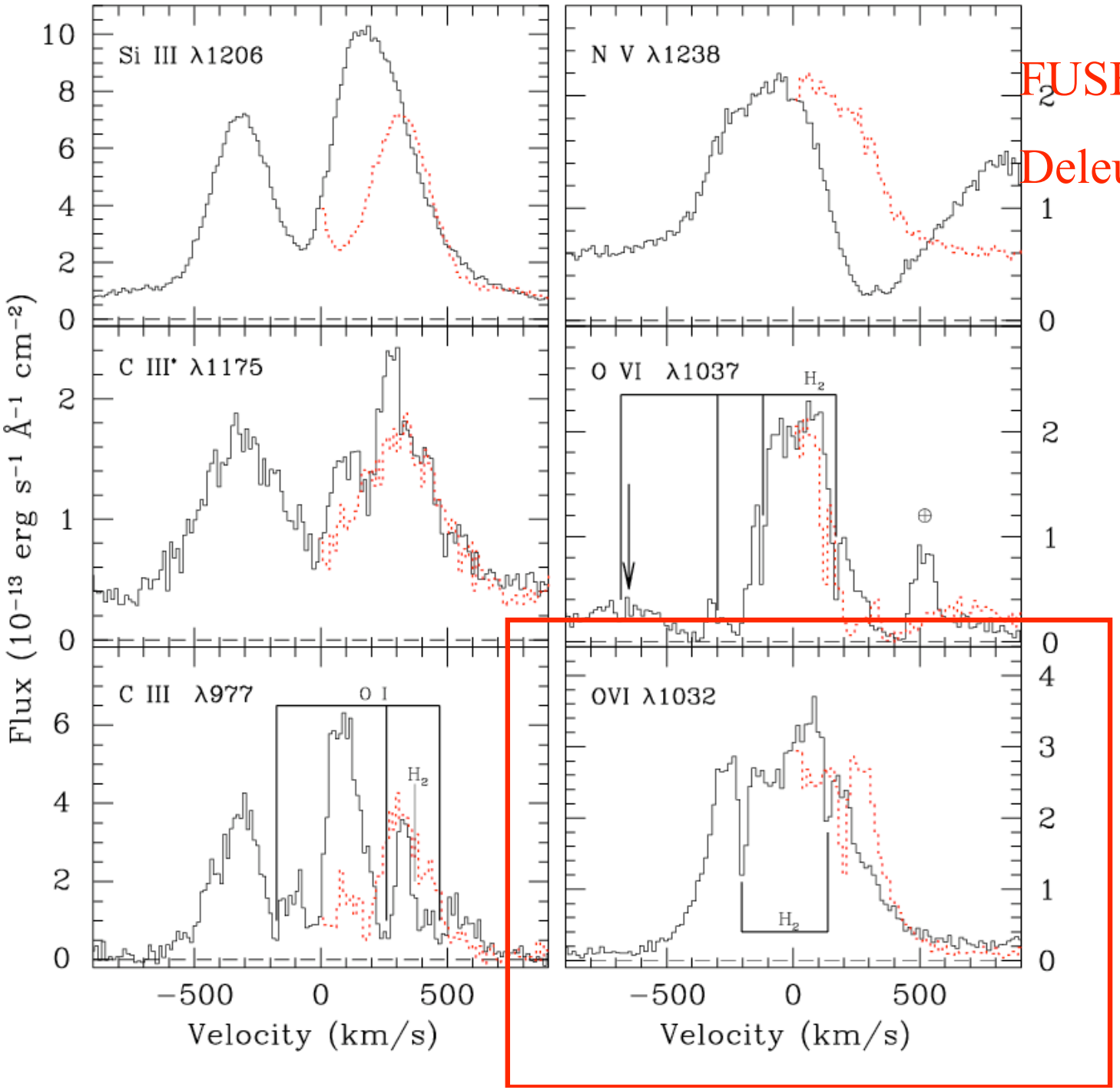
- late-type companion (T Tauri star) ?
- own corona (HAeBes as Ap progenitors) ?
- stellar accretion ?
- shocks in outflows ?



A Young Planetary System: HD 163296

HST • STIS

NASA Goddard Space Flight Center
and C.A. Grady, D. Devine (NOAO at GSFC)

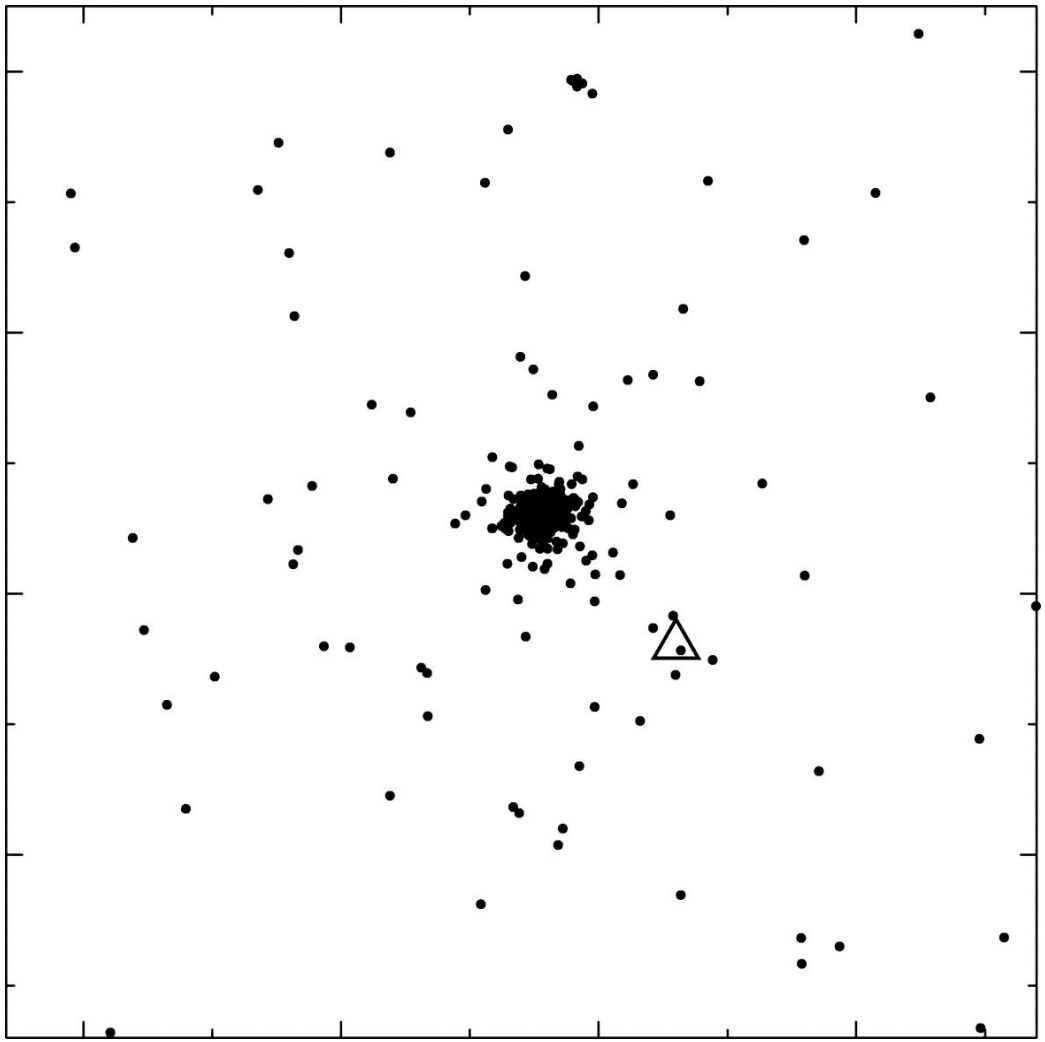


FUSE:

Deleuil et al. (2005)

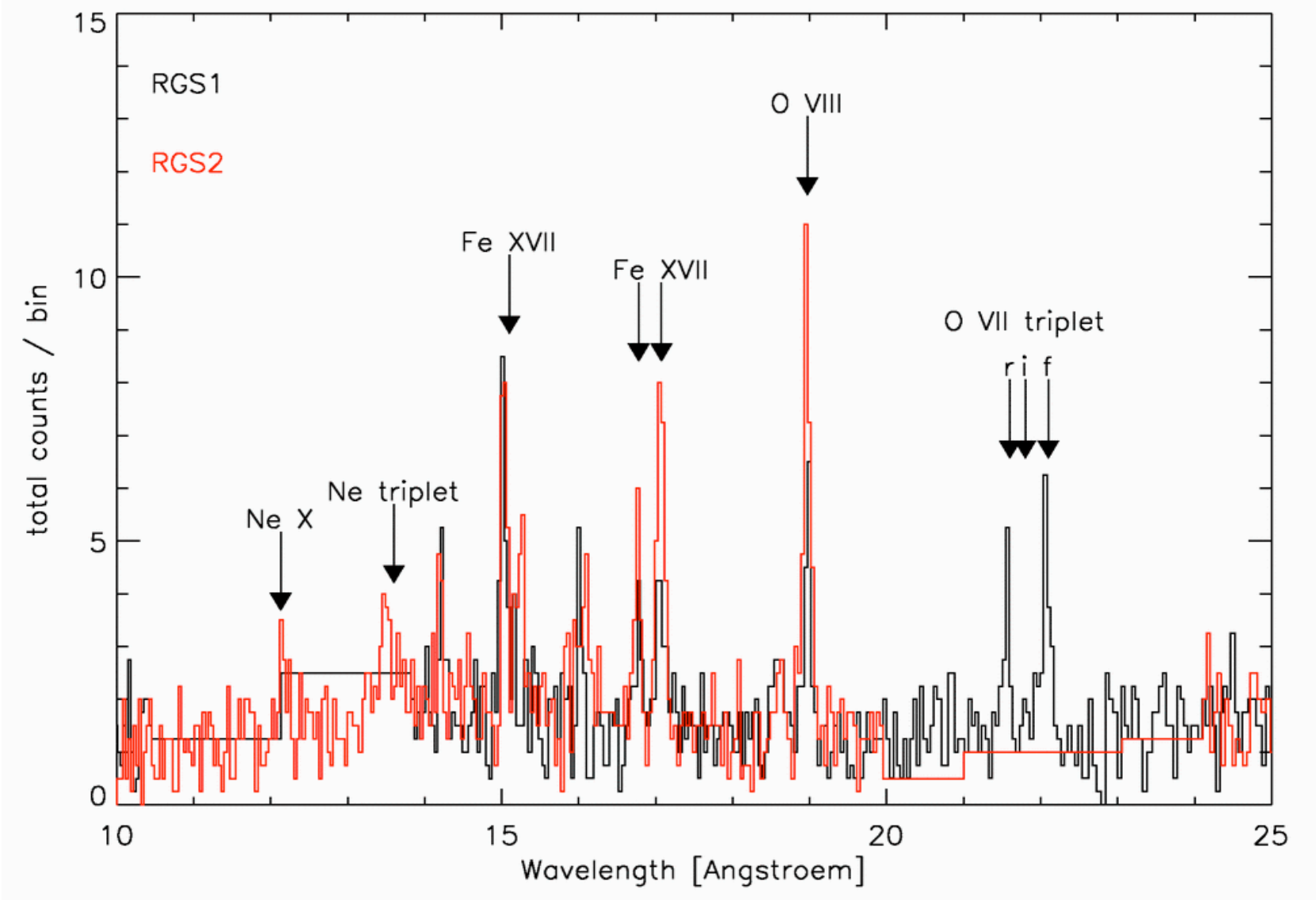
HAeBe stars

Chandra (20 ks)



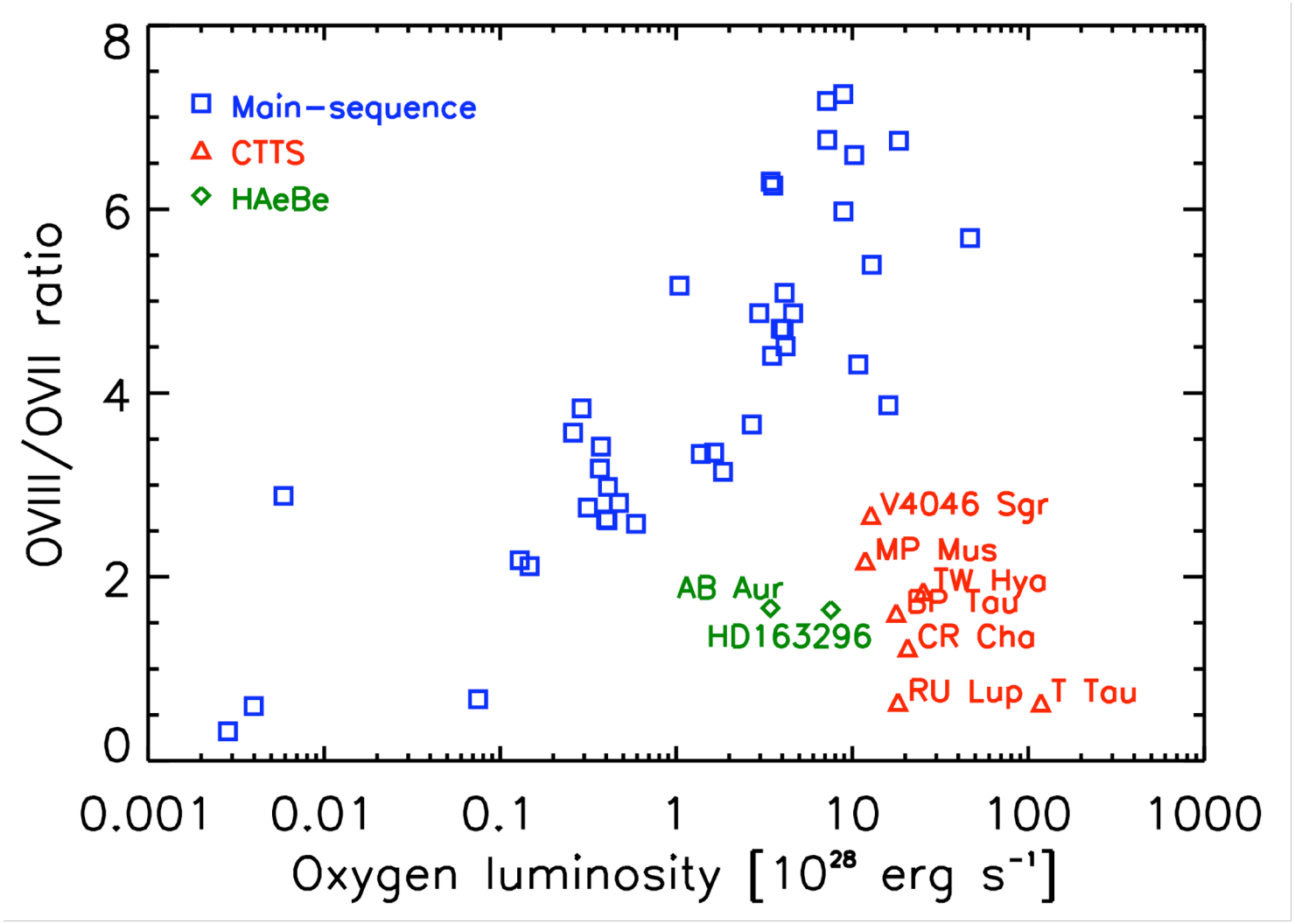
Swartz et al., ApJ (2005)

HD 163296: XMM-RGS



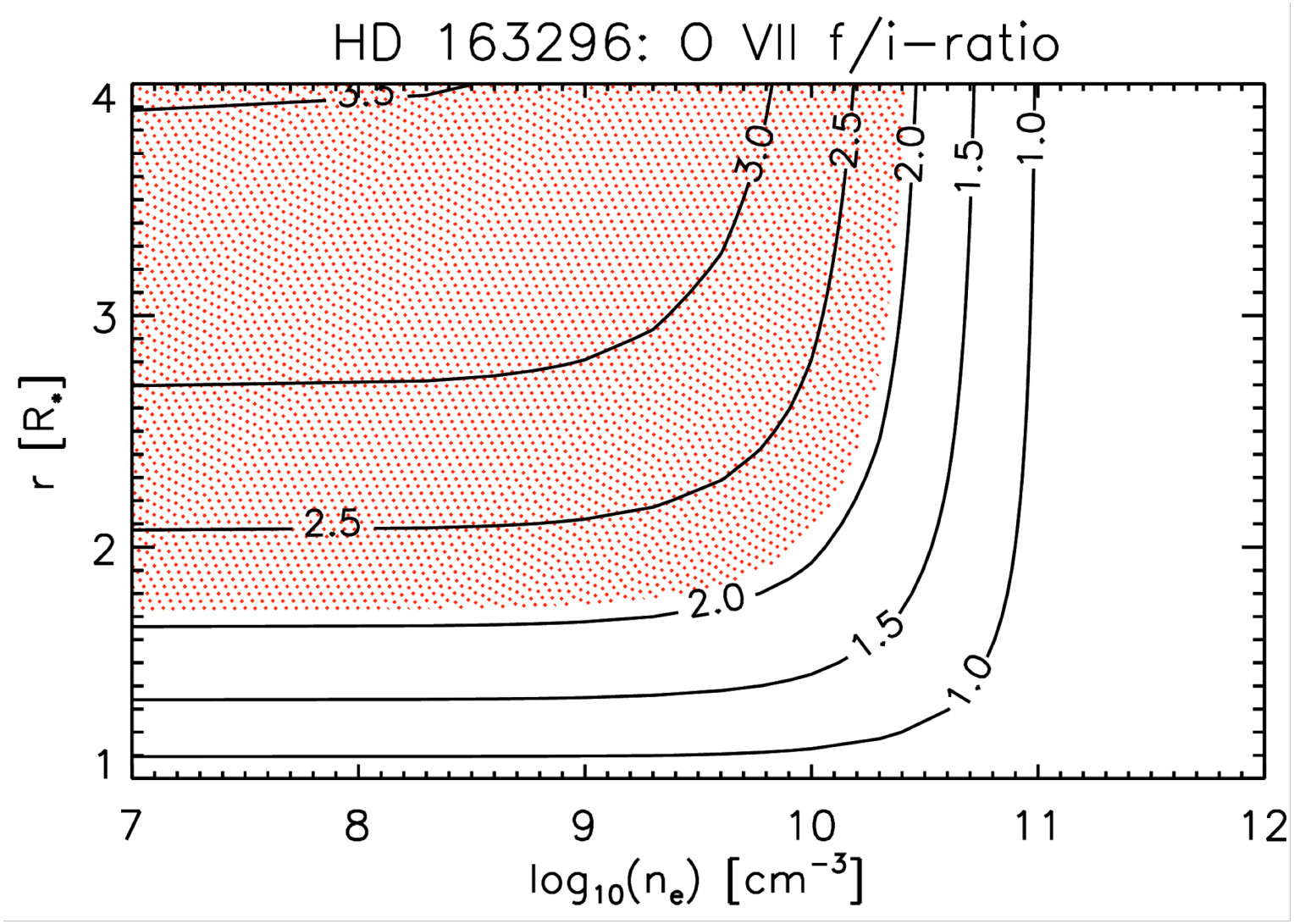
Günther & Schmitt, A&A (2009)

Cool excess



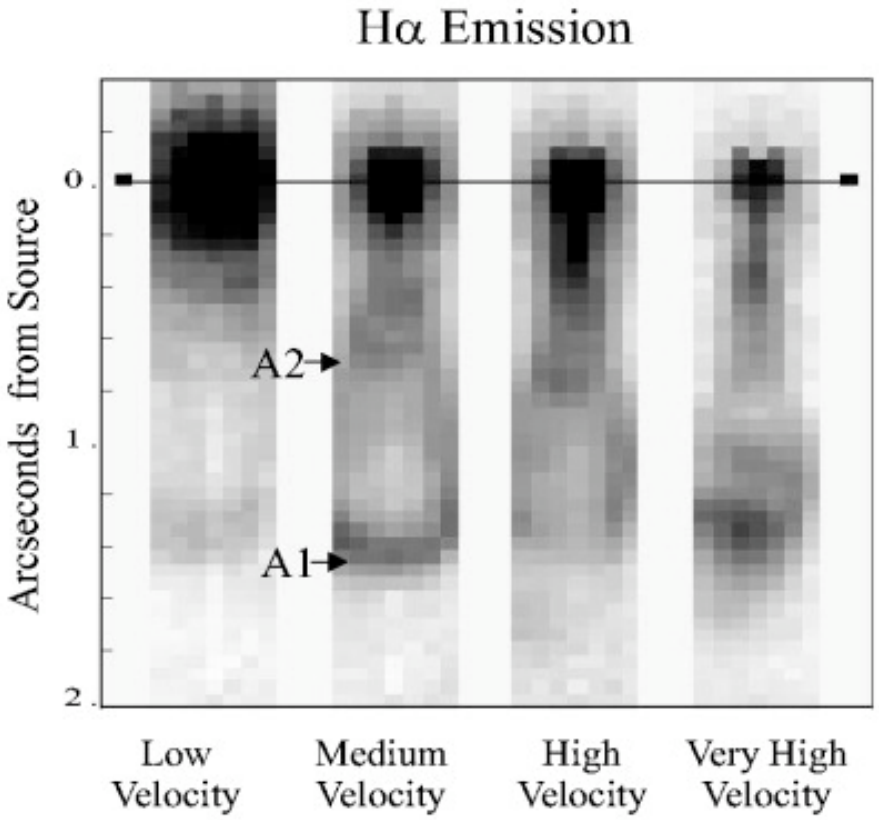
Robrade & Schmitt, A&A (2007), Günther & Schmitt, A&A (2008)

HD 163296: OVII f/i ratio

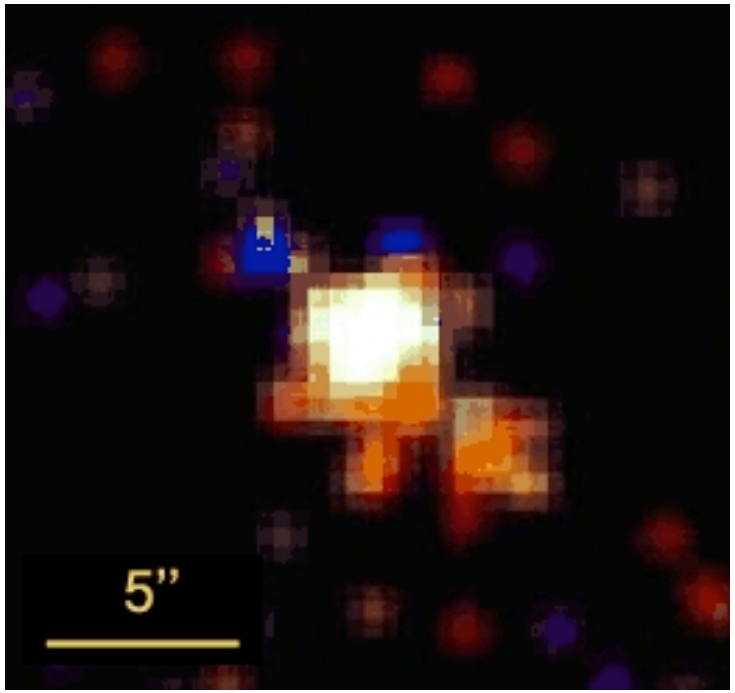


Günther & Schmitt, A&A (2009)

Collimated outflows

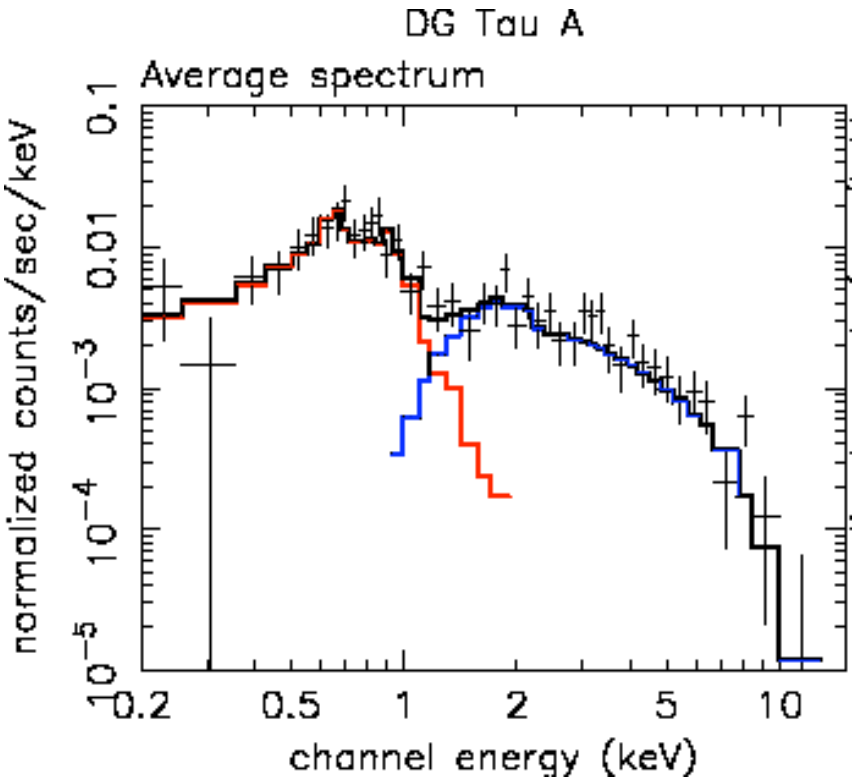


HST/STIS:
Bacciotti et al., ApJ (2000)

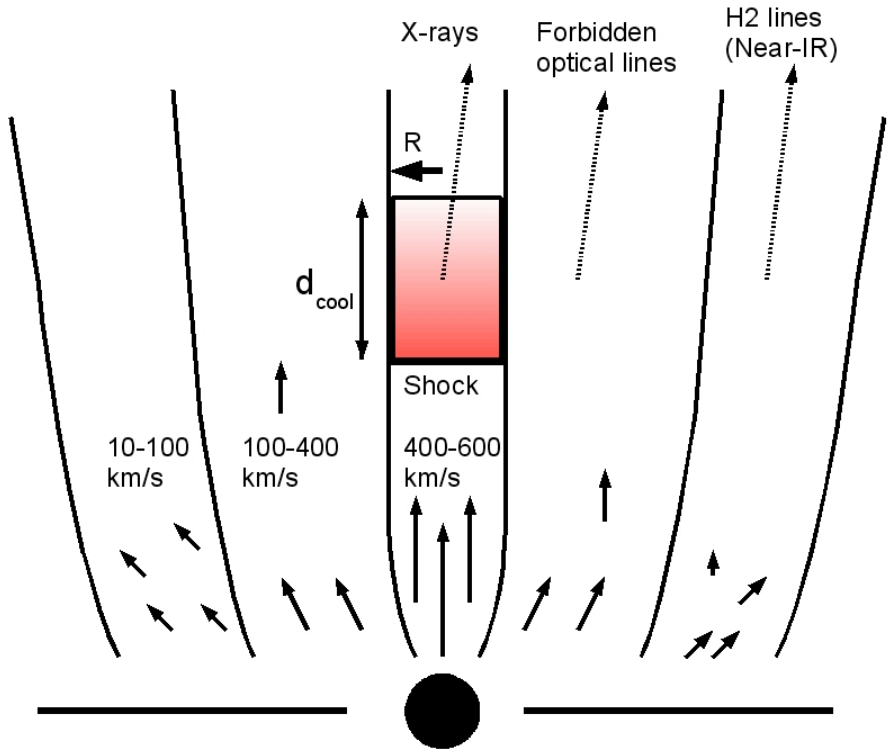


Chandra:
Güdel et al., A&A (2008)

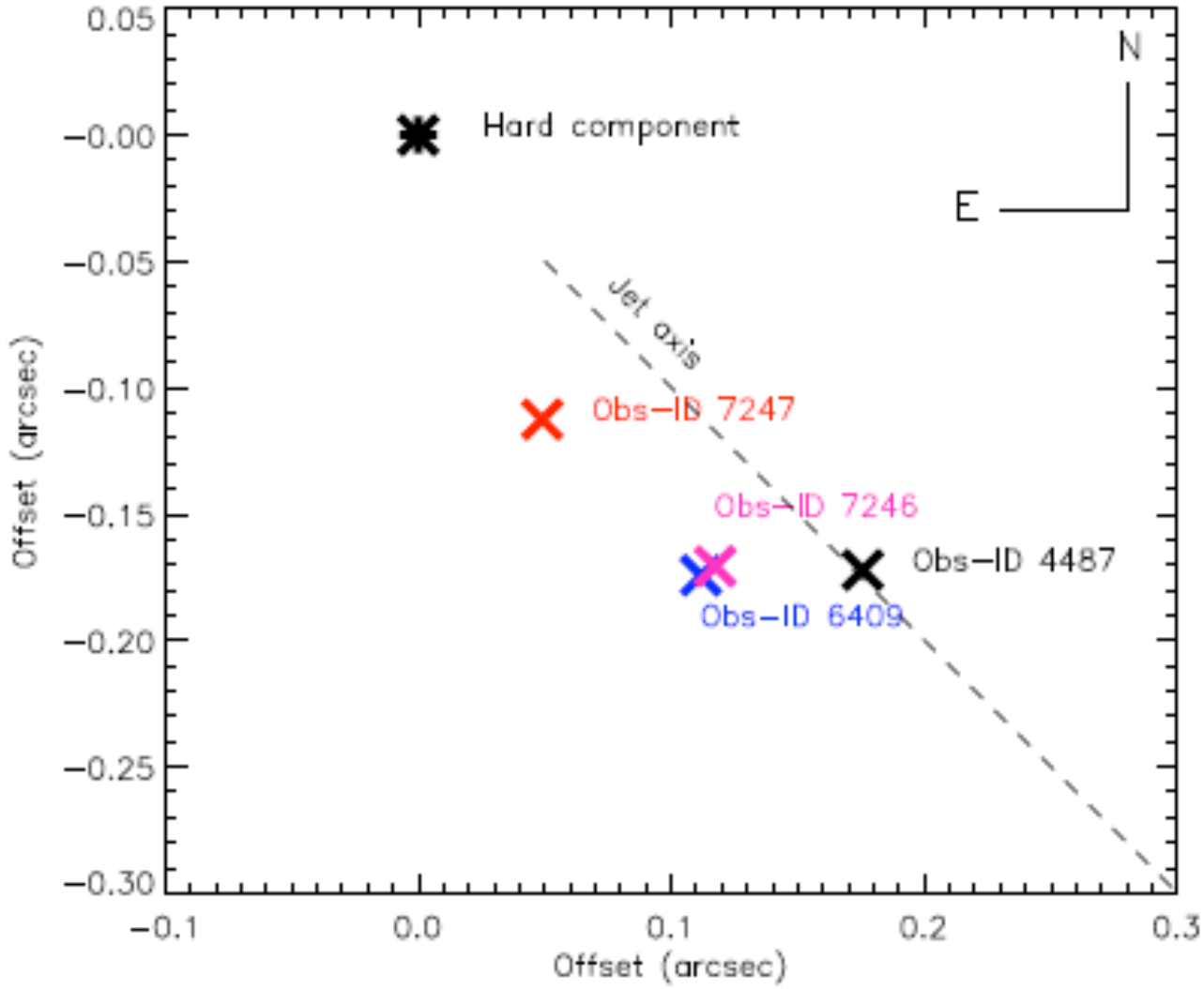
X-rays from jets



Güdel et al., ApJ (2007)



Model:
Günther, Matt & Li, A&A (2009)



Schneider & Schmitt (2008)

Summary: Three different beasts !

Star	Spectral type	OVI luminosity (erg/sec)	OVII luminosity (erg/sec)	Mechanism
Altair	A7V	$3.3\ 10^{27}$	$3.3\ 10^{26}$	Corona
β Pic	A6V	$2.5\ 10^{27}$	(<)2.710^{25}	??
HD163296	A1Ve	$1.1\ 10^{30}$	$1.0\ 10^{29}$	Jet/Wind

The End !