Exoplanets and host stars

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RESULTS FROM AN EXTENSIVE *EINSTEIN* STELLAR SURVEY

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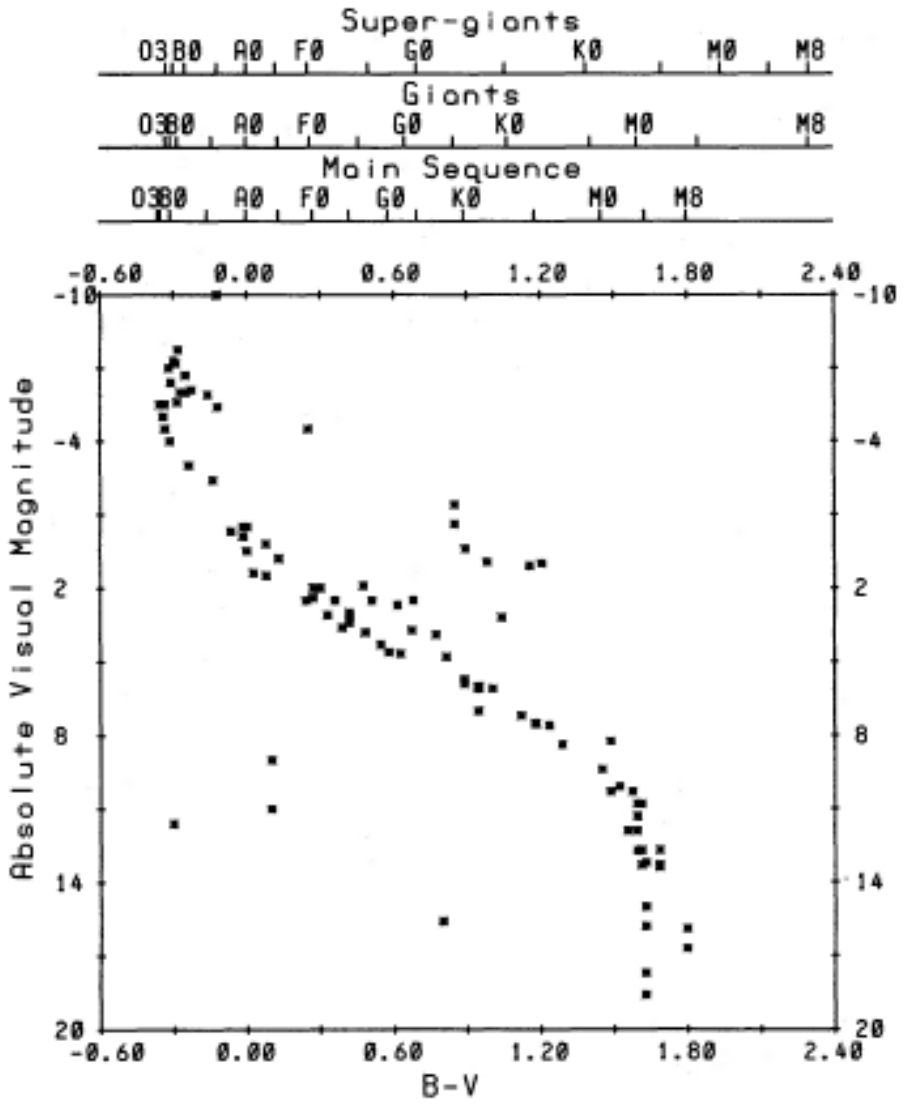
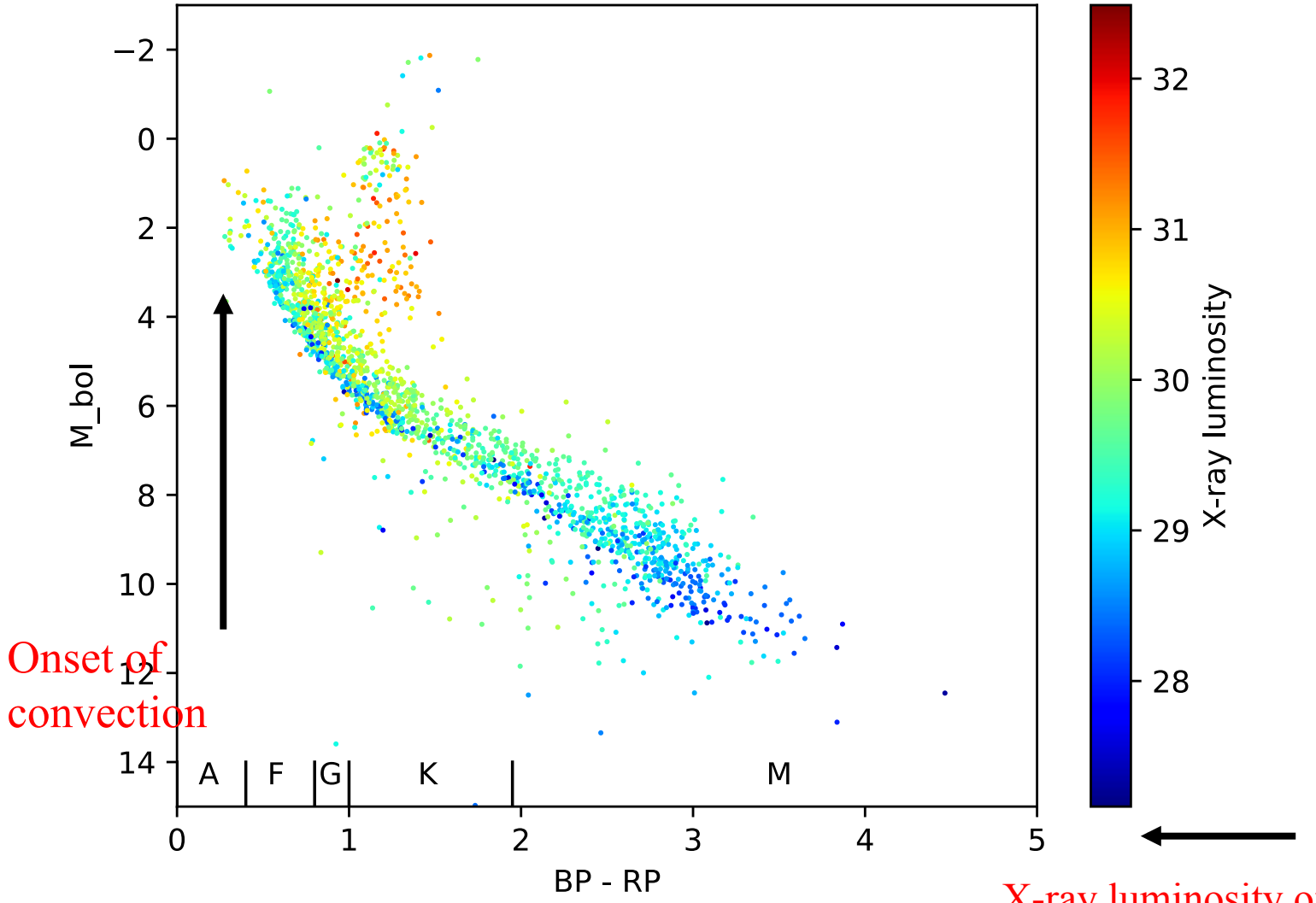


Ap.J, 244, 1981

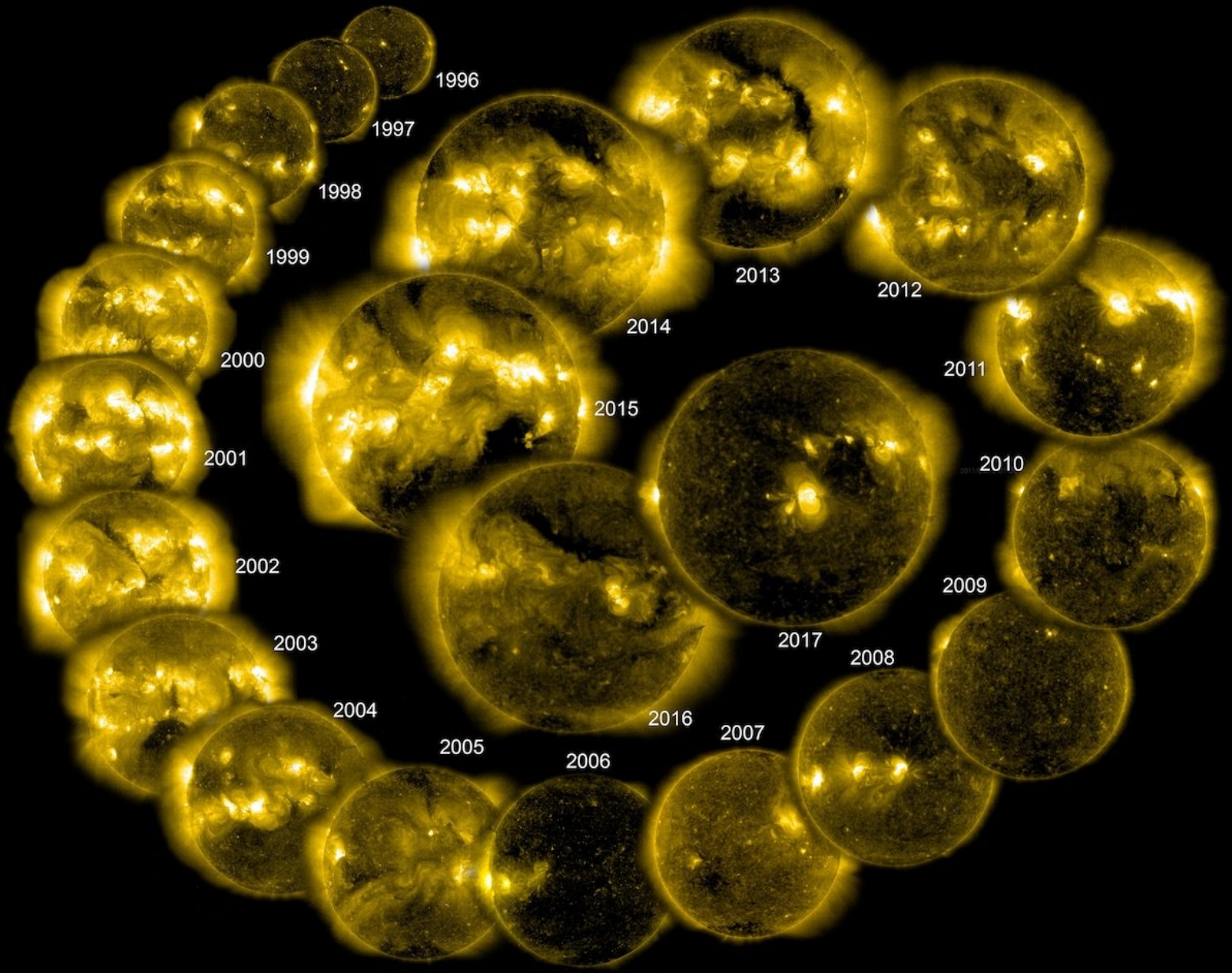
First Hertzsprung-Russell of X-ray detected stars !

38 years later .....

The first (preliminary) HR-diagram with eROSITA detected stars (from 0.4% of the sky):



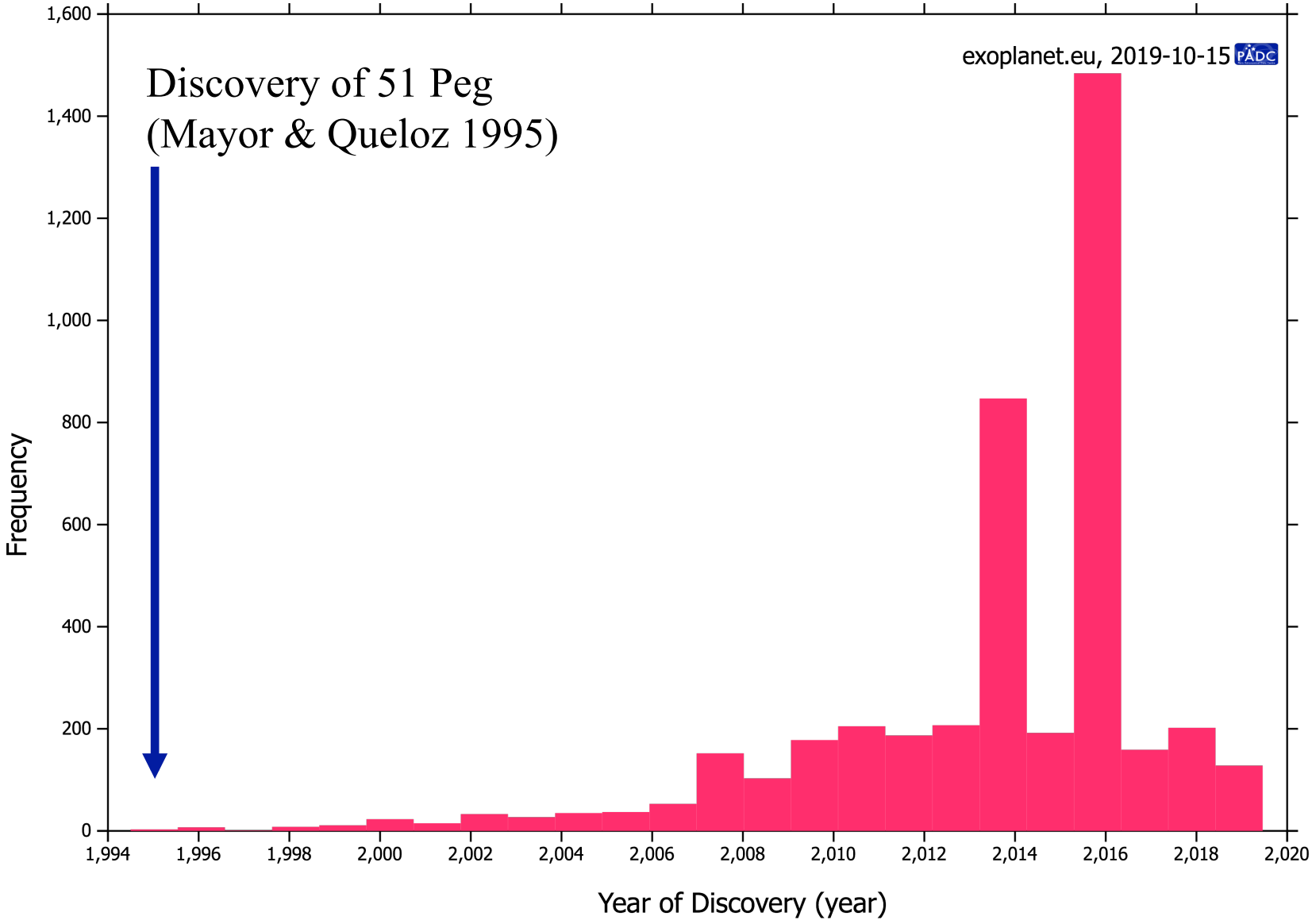
The Sun seen by SOHO



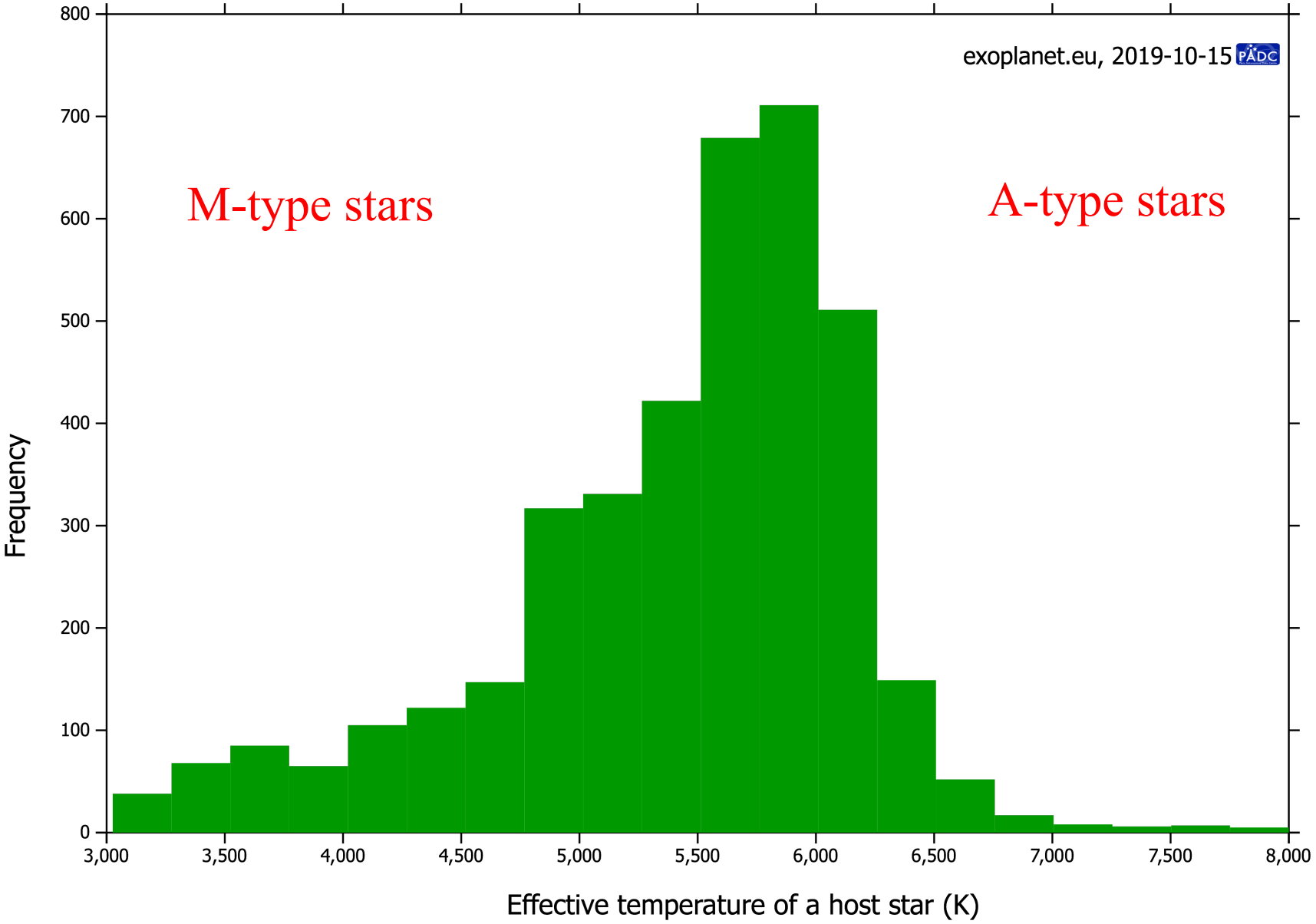
Fundamental insight:

The active Sun is NOT typical for the X-ray detected stars !

Detected number of extrasolar planets:



Spectral type distribution of host stars :



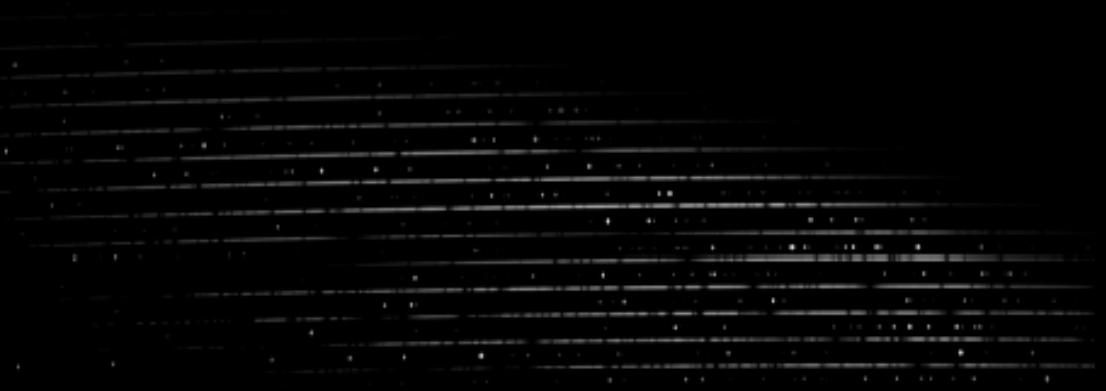
Fundamental insight:

Planet host stars are cool stars!

To understand extrasolar planets need to understand cool stars !

Nice planet you've got there.

Would be a shame if something happened to it...

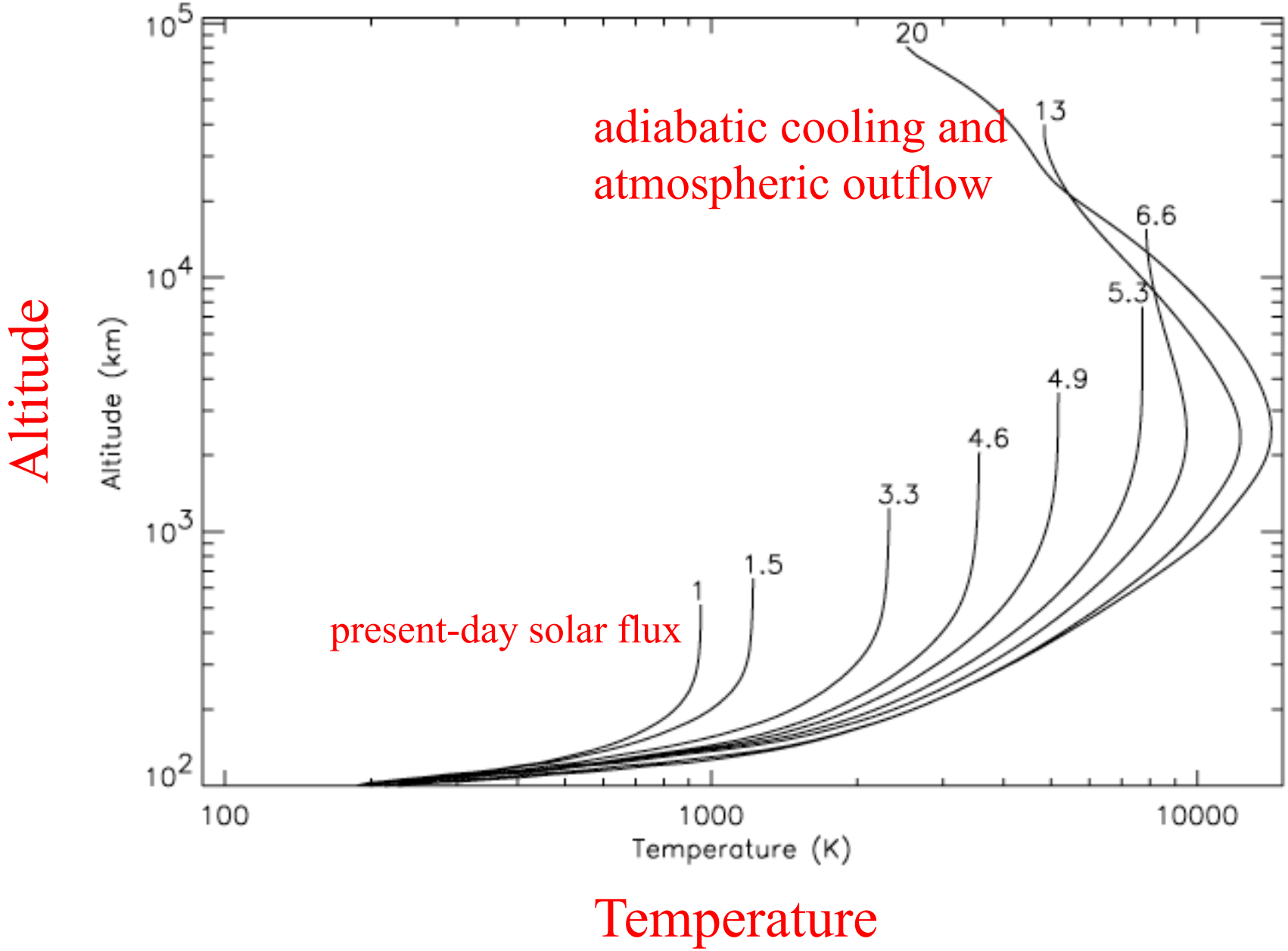


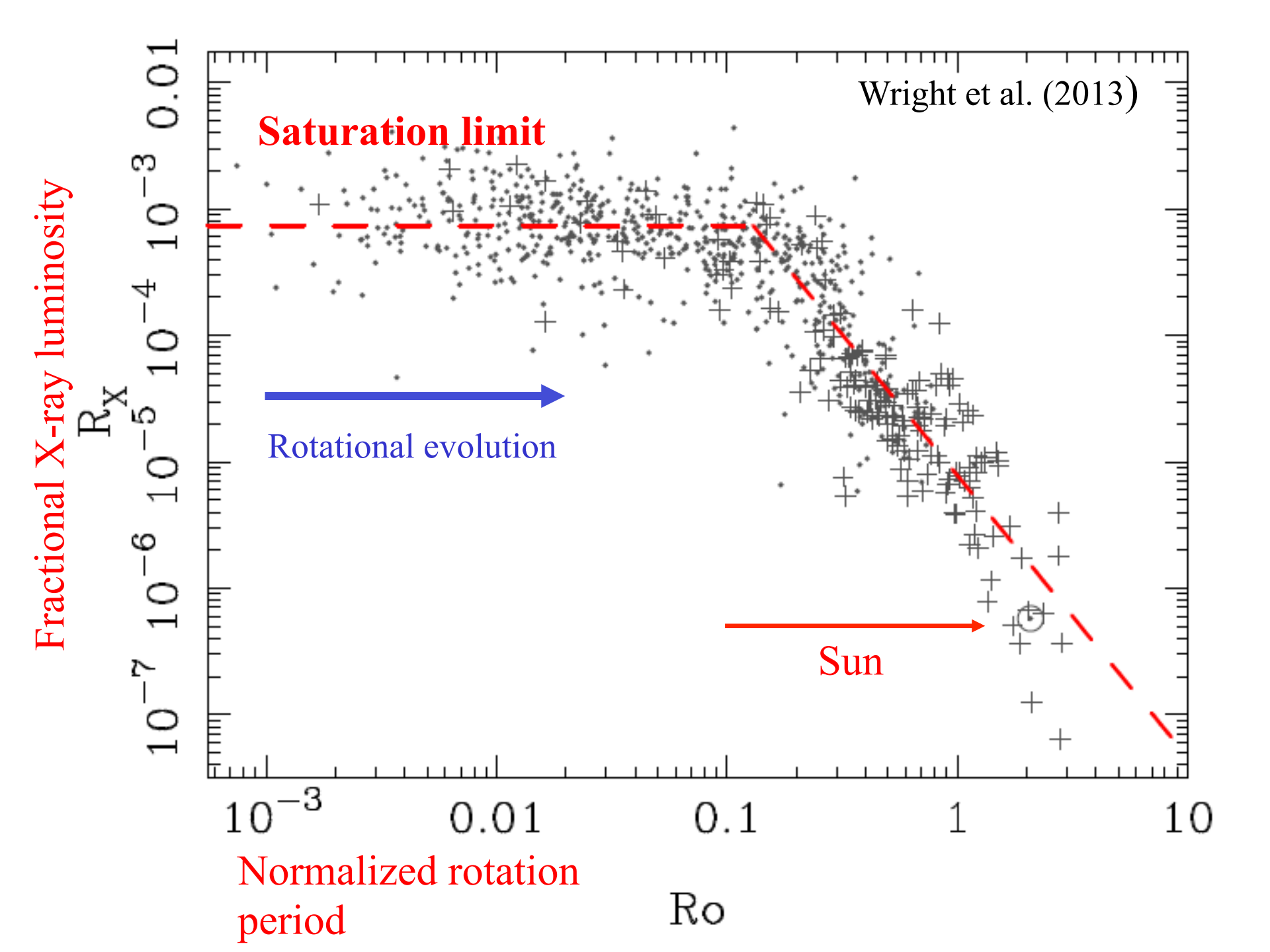
The Godfather; ©Paramount Pictures

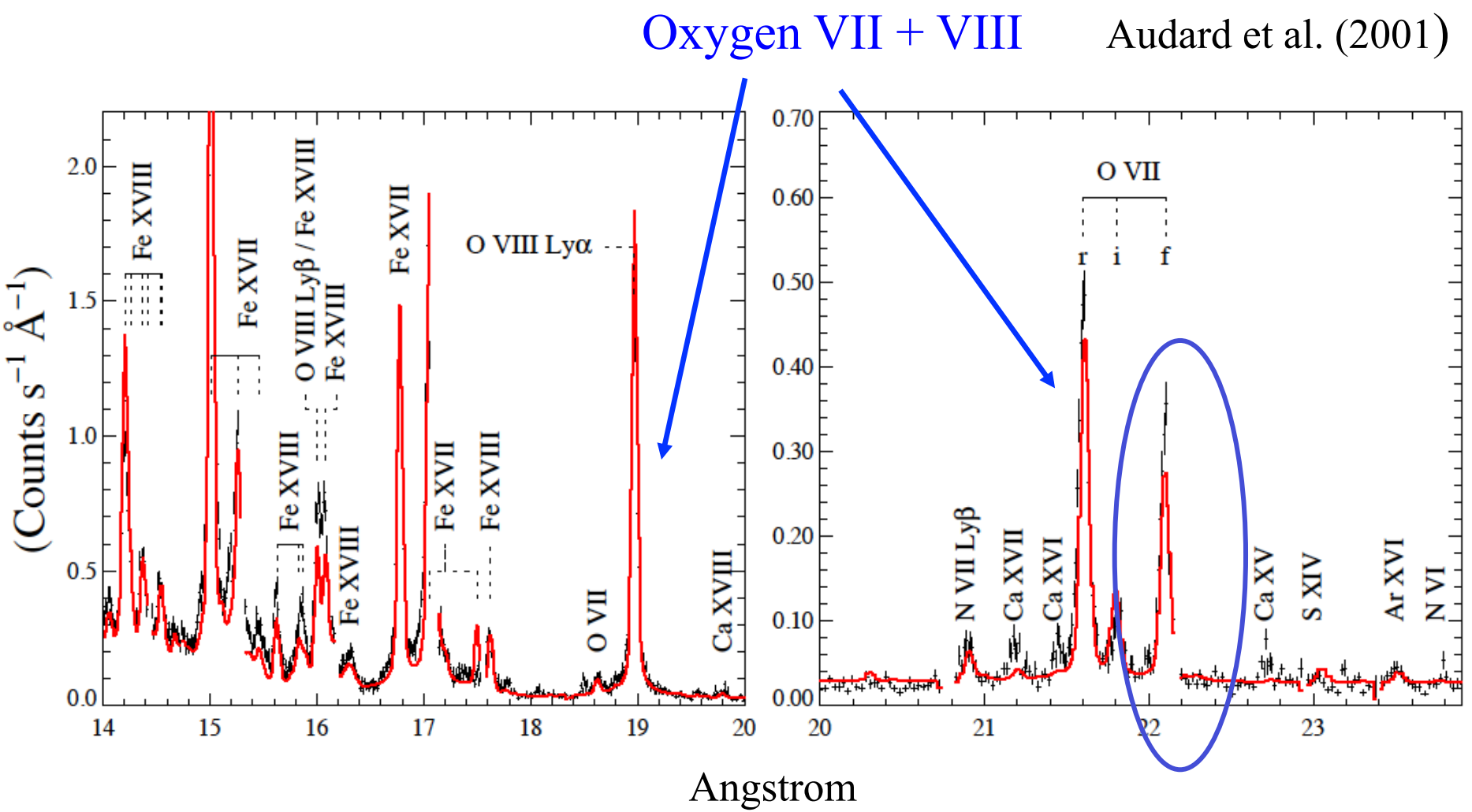
The host star is responsible for

- Planetary environment (radiation and particles)
- Planetary evaporation
- Planetary formation

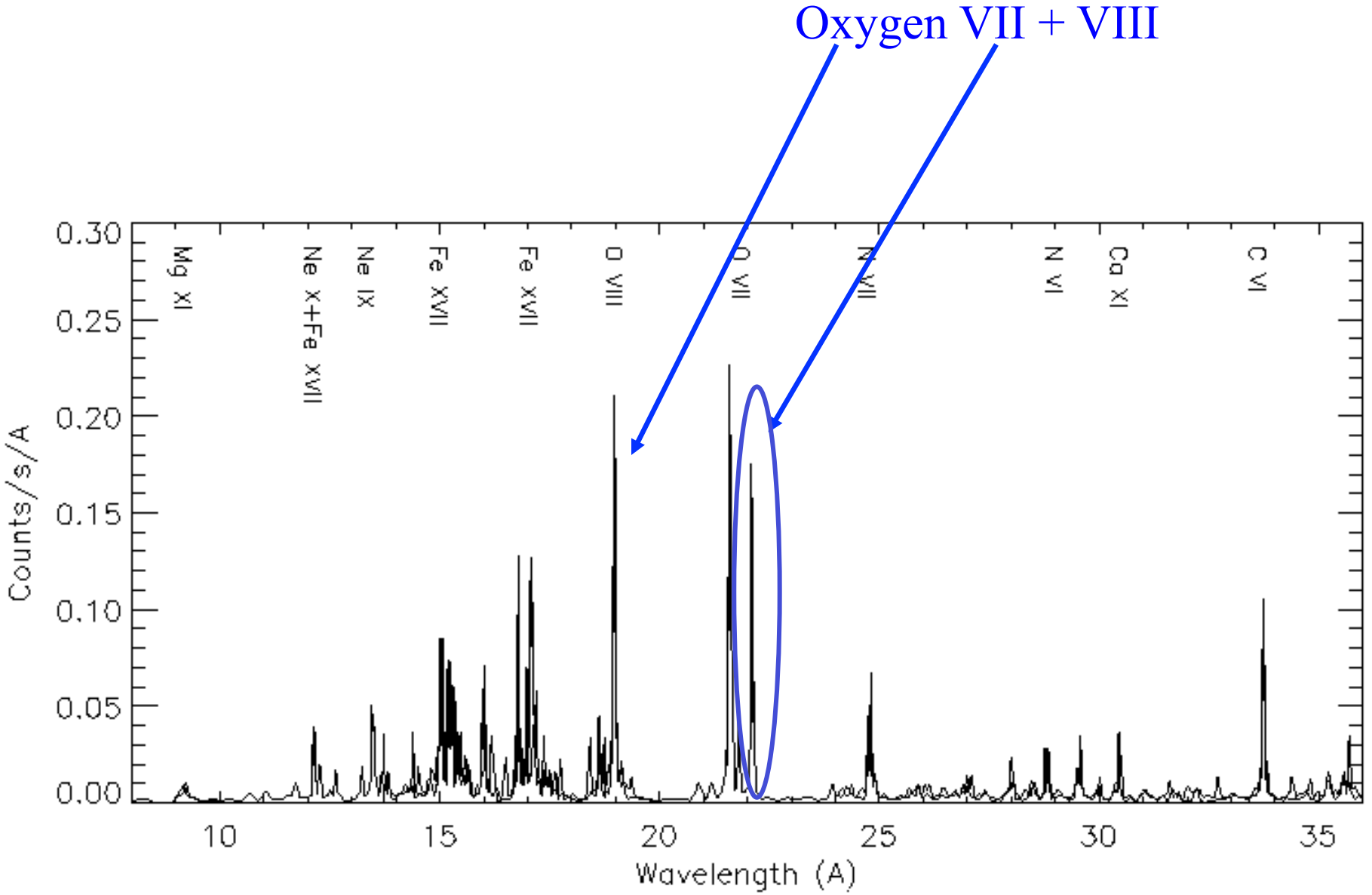
Tian et al. (2008): Response of Earth's thermosphere to solar flux




Wright et al. (2013)
Saturation limit
Rotational evolution
Sun
Fractional X-ray luminosity
R_X
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0.01
10^{-3}
0.01
0.1
1
10
Normalized rotation period
Ro

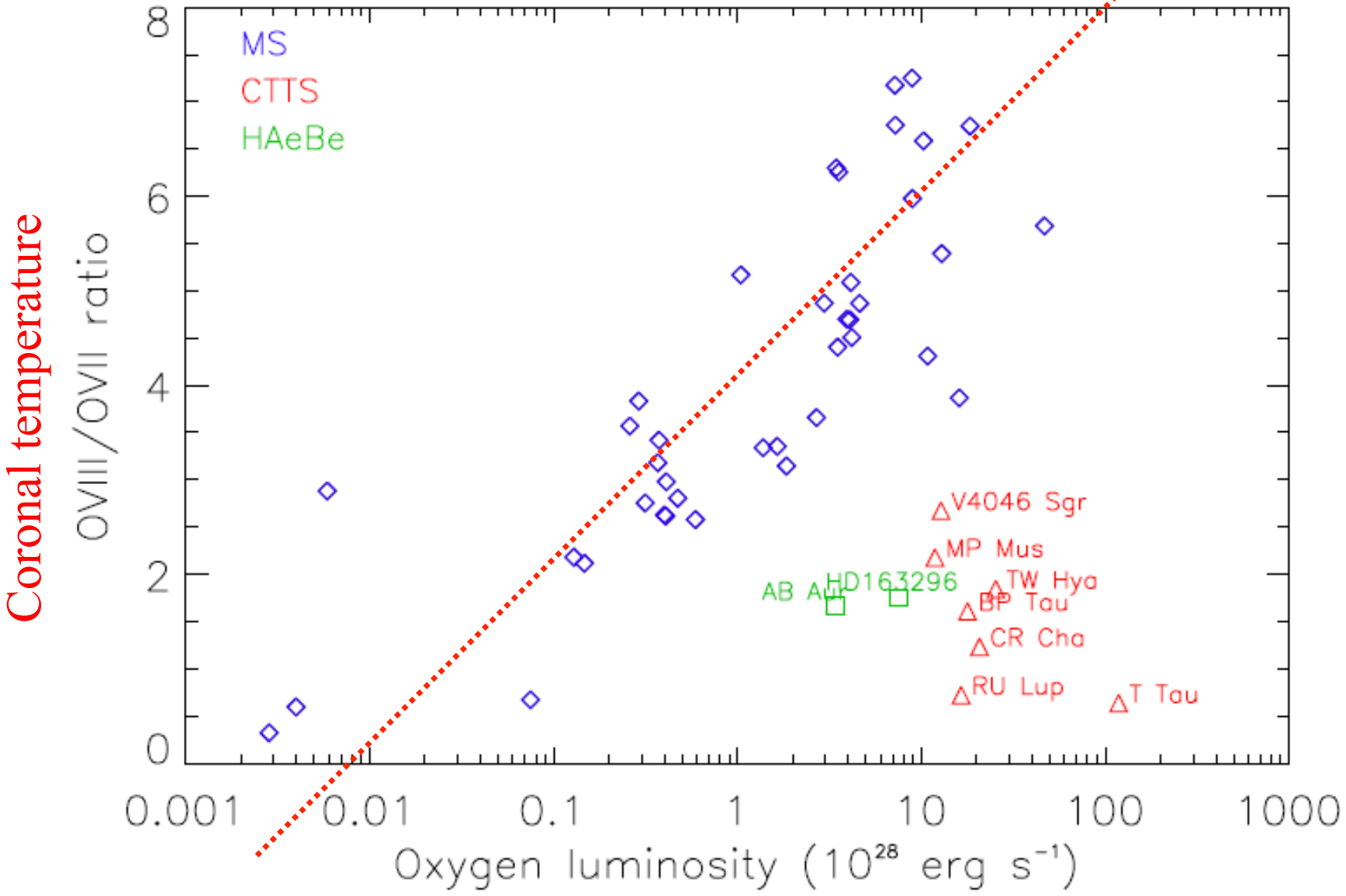


XMM-Newton spectroscopy of the RS CVn Capella



XMM-Newton RGS: α Centauri A+B (inactive star)

(Liefke & Schmitt 2006)



Courtesy: J. Robrade

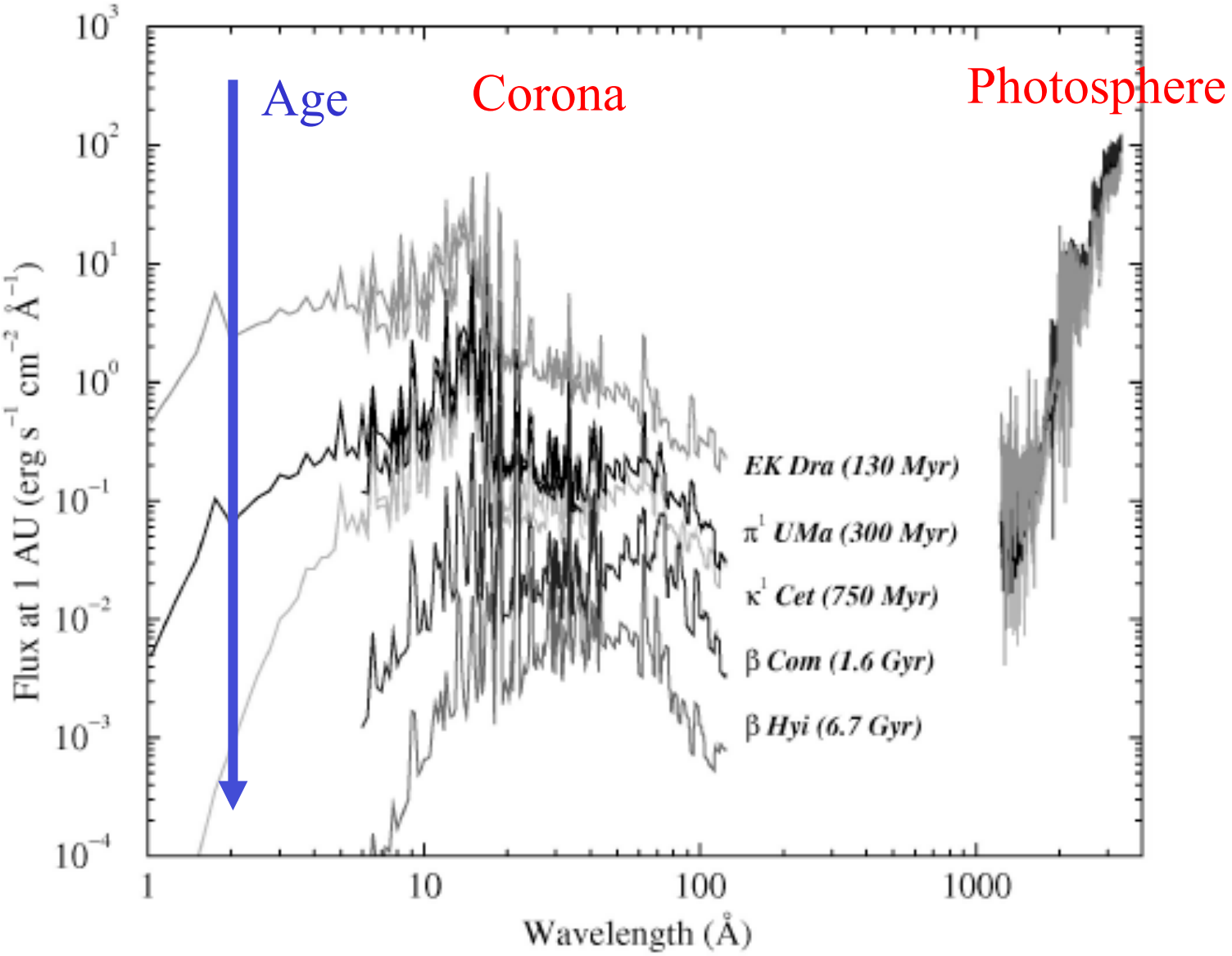
Ness et al. (2004)

Robrade & Schmitt (2007)

Fundamental insight:

The X-ray luminosities and X-ray spectra of stars change dramatically with time !

Güdel & Kasting (2009): The Sun in time



Also:

(Some) stars like to flare ....

Proxima Centauri: (Anglada-Escude et al. 2016)

Earth-like planet around Sun's neighbour

An Earth-mass planet has been discovered in orbit around Proxima Centauri, the closest star to our Sun. The planet orbits at a distance from the star such that liquid water and potentially life could exist on its surface. SEE LETTER P.437

Mass: 1.3 M_{Earth}

Period: 11.2 days

Distance: 0.05 au

Ribas et at. (2016):

The habitability of Proxima Centauri b

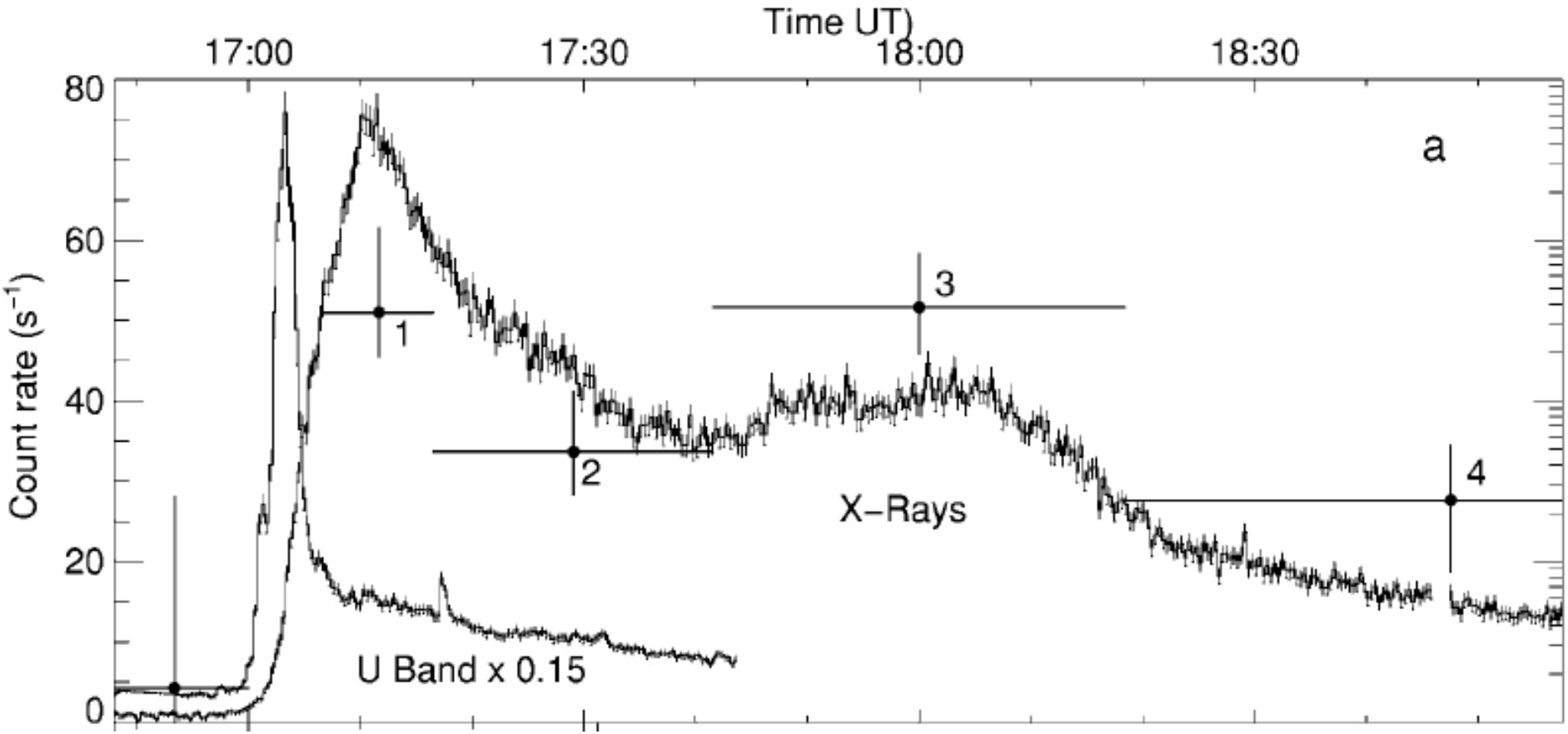
I. Irradiation, rotation and volatile inventory from formation to the present

Turbet et at. (2016):

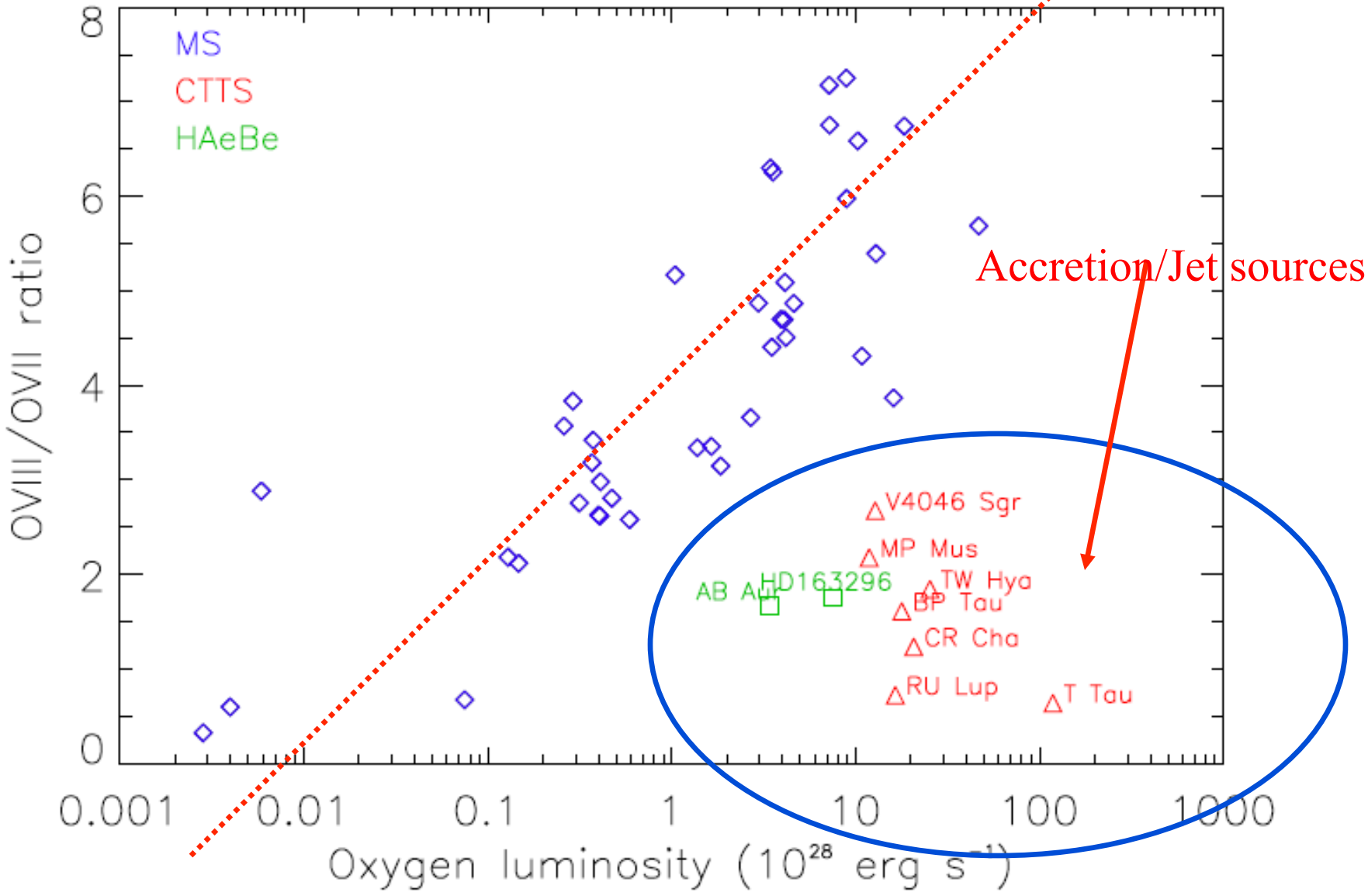
The habitability of Proxima Centauri b

II. Possible climates and observability

XMM-Newton: Flare on Proxima Centauri: Güdel et al. (2001)



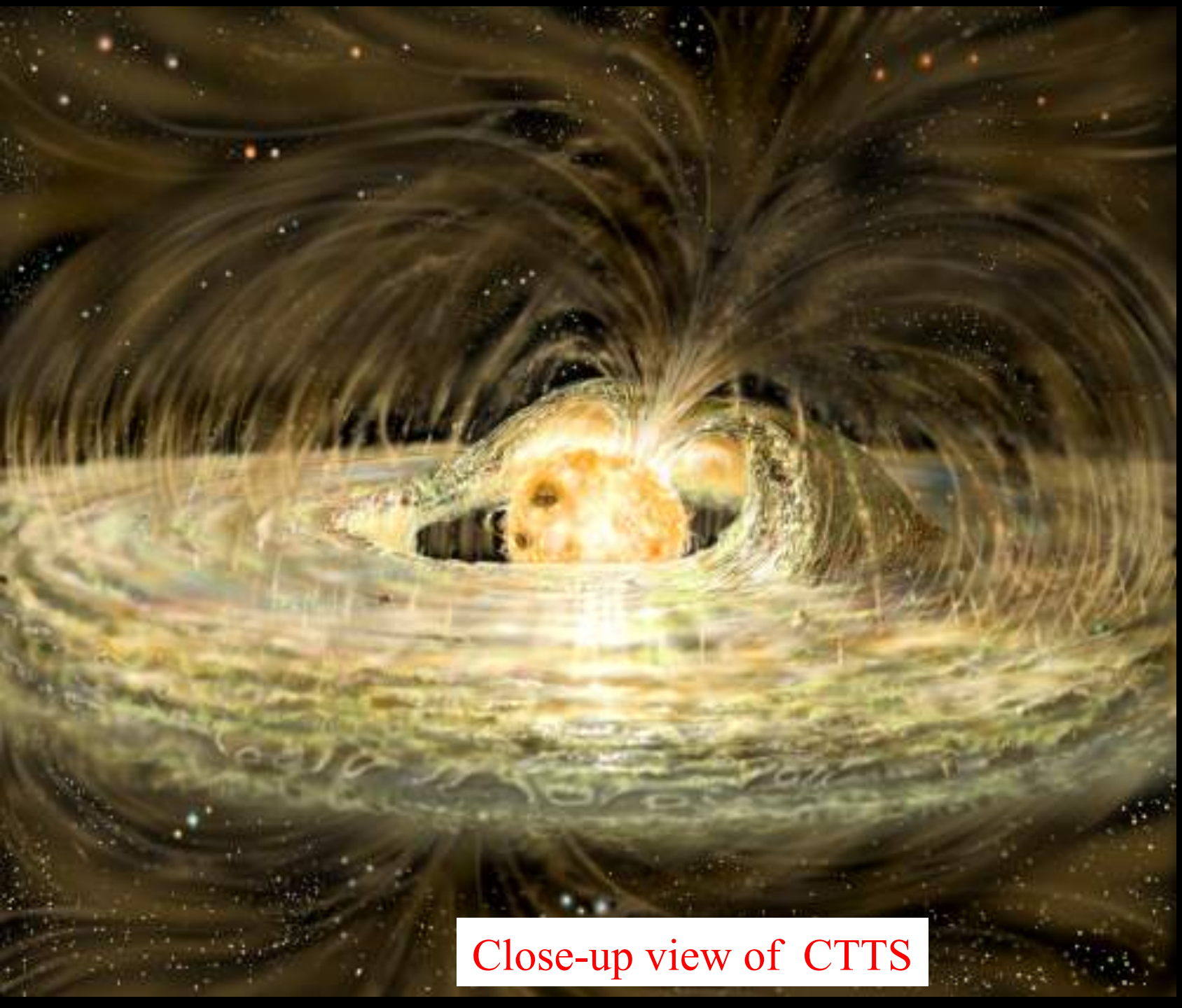
Incident X-ray flux > 10000 times larger than solar X-ray at Earth !



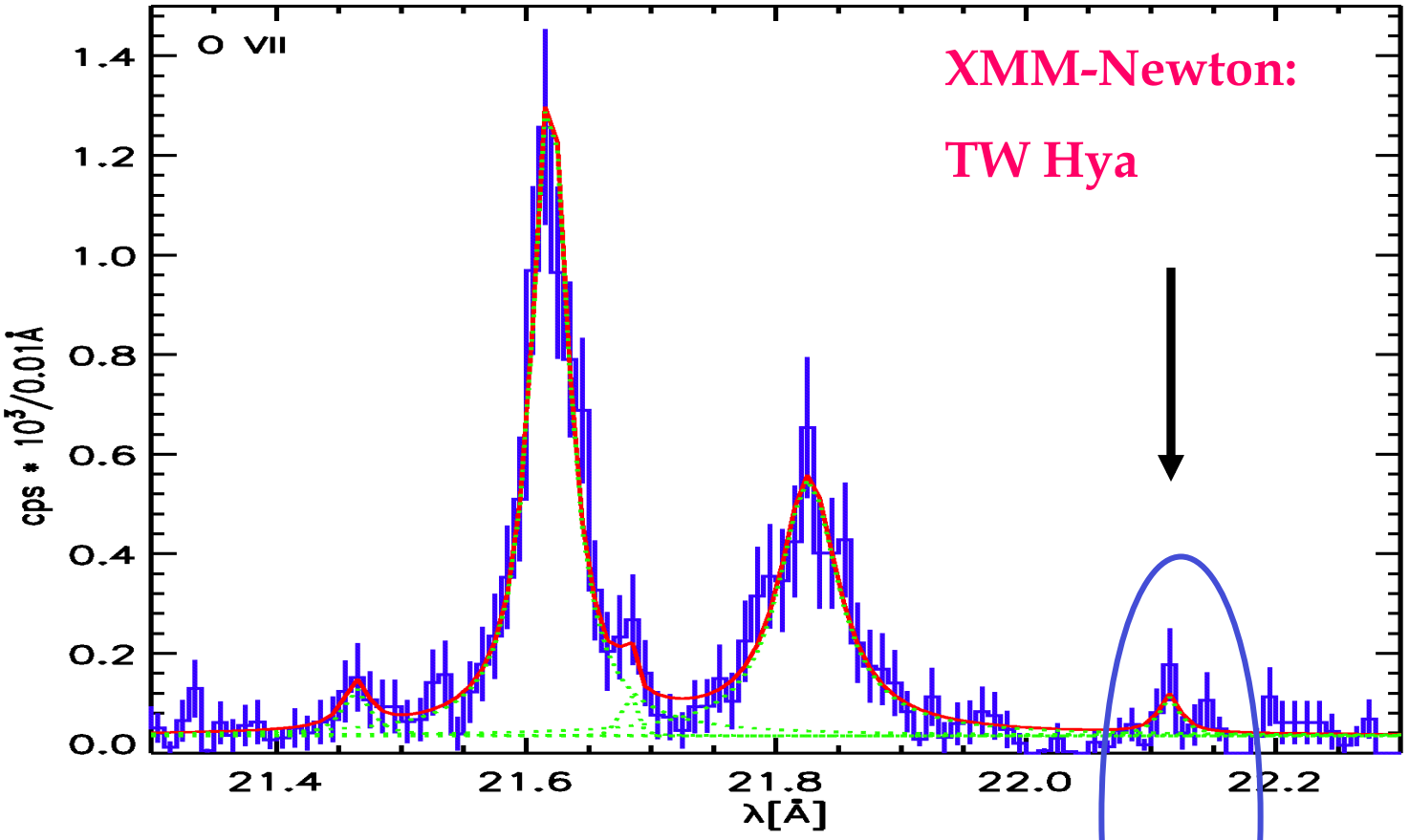
Courtesy: J. Robrade

Ness et al. (2004)

Robrade & Schmitt (2007)


Close-up view of CTTS

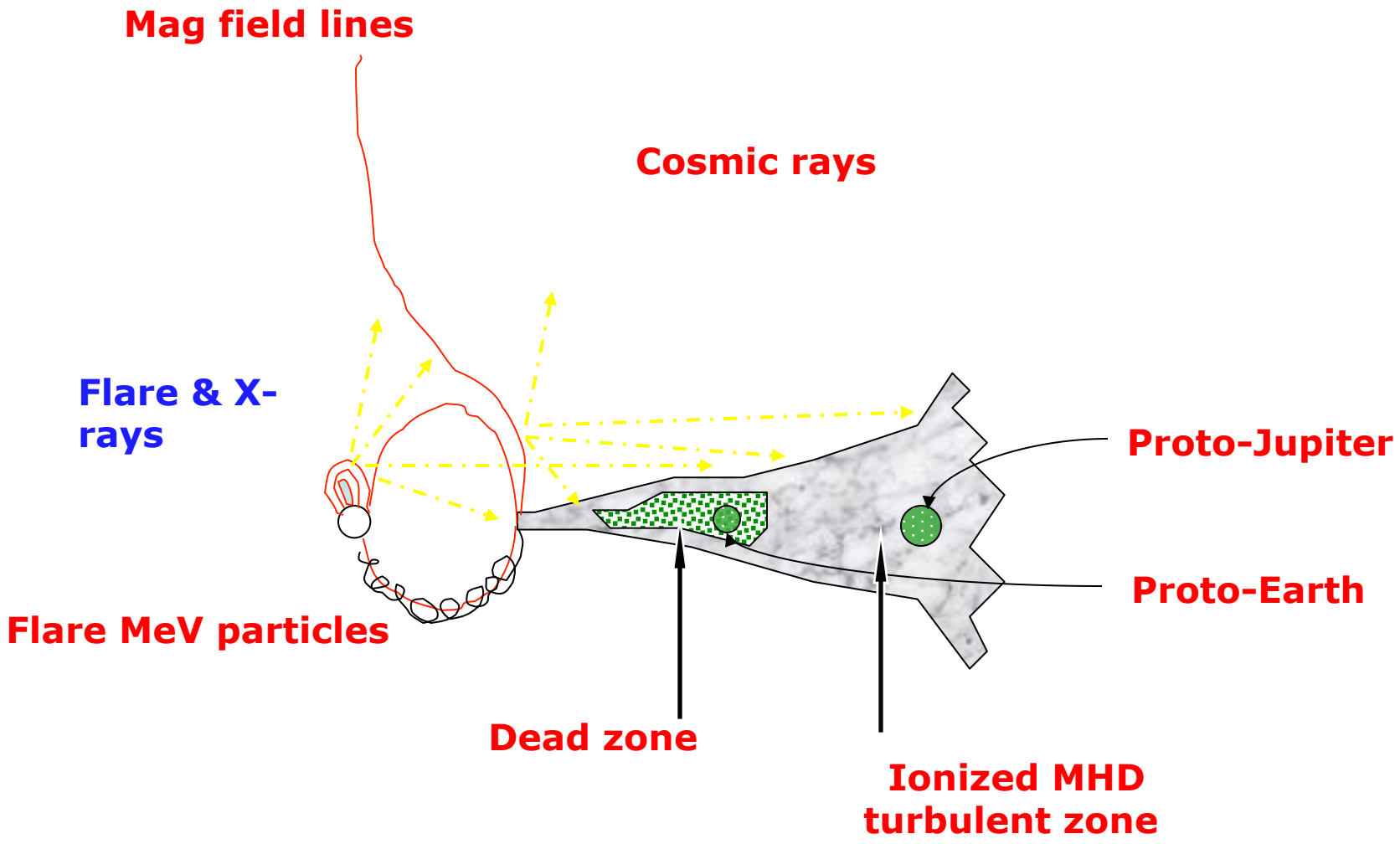
X-ray spectrum of TW Hya (CTTS): OVII triplet



forbidden line (almost) absent !

XMM-RGS: Stelzer & Schmitt (2004)

X-ray influence on planet formation



See Feigelson (2003, 2005, 2010)

Conclusions:

- (Almost) all extrasolar host stars are X-ray sources
- Need to understand the activity properities of the host stars in all respects
- Expect ionospheres and hydrodynamic blowoff for the close-in extrasolar planets
- XMM-Newton can make (still) valuable contributions to the field !!

The End !