The X-ray emission of the massive star population in Cyg OB2

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Introduction :

Cygnus OB2 is a rich star forming region containing a wealth of massive stars (Wright 2014). The full association was observed with the ACIS-I instrument in a 6 × 6 raster mosaic of 30 ksec exposures with an 8 arcmin pointing offset (Drake et al. 2014, Wright et al. 2014). In the framework of this Chandra Cygnus OB2 Legacy Survey, **49 O-stars, 54 B-stars and 3 Wolf-Rayet stars** were detected.

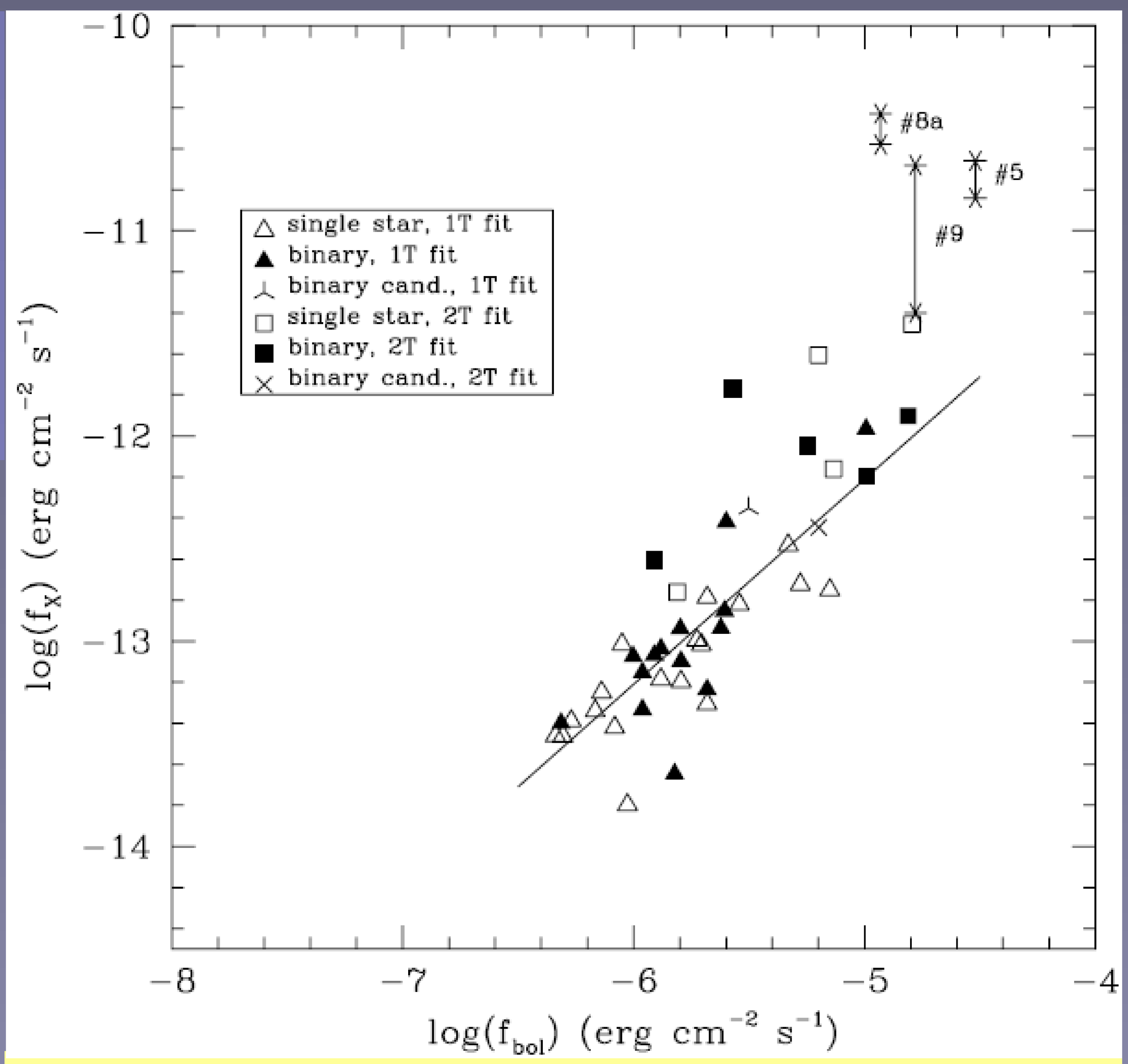

Fig.1: L_X/L_{bol} relation for the O-type stars in Cyg OB2. For comparison, the ranges of fluxes of the 3 overluminous colliding wind binaries (#5, #8a and #9) measured with XMM-Newton is also shown.

O-type stars:

The O-stars in our sample cover a range of spectral types from O3 I to O9.5 V. The X-ray spectra were fitted with thermal plasma models accounting for the interstellar absorption and (when needed) for the circumstellar absorption by the stellar wind. The resulting X-ray fluxes (corrected for ISM absorption only) were used to build the L_X/L_{bol} relation of O-stars in Cyg OB2 (Fig. 1). Excluding some overluminous stars, **L_X/L_{bol} can be represented by a simple scaling relation**:

$$\log L_X/L_{bol} = -7.21 \pm 0.24$$

This result is **in excellent agreement with the relation** found by Nazé et al. (2011) **for the O-stars of the Carina OB1 association**. There is **no need for a more complex power-law relation** as advocated by Albacete-Colombo et al. (2008). Except for a handful of very bright systems (see poster by Nazé, Cazorla & Rauw), binary systems are generally not overluminous in X-rays. For details, we refer to Rauw et al. (2014).

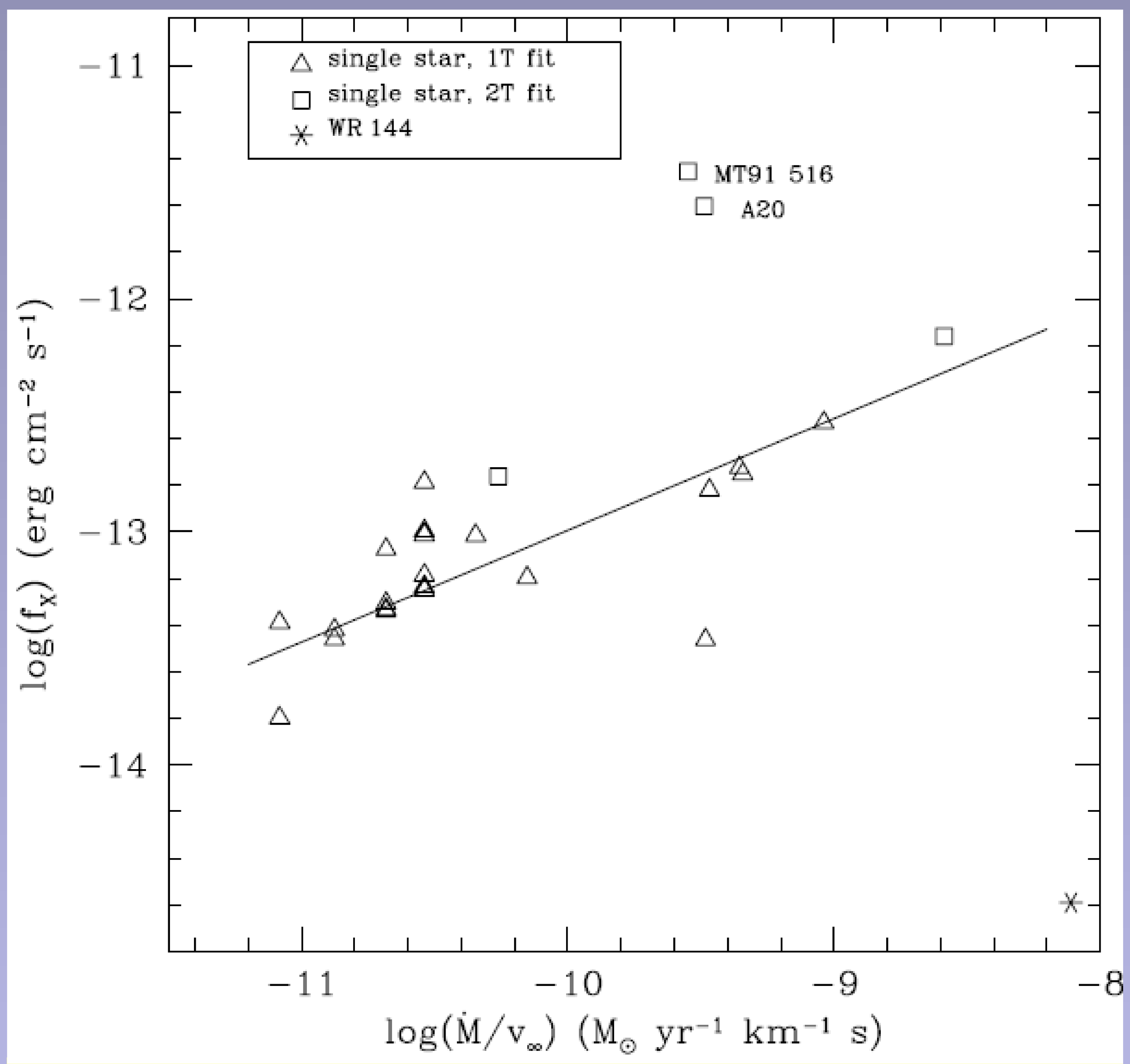

Fig.2: f_X function of $(\dot{M}/v_\infty)$ for single O-stars. The asterisk corresponds to the WC4 star WR144.

Owocki et al. (2013) proposed that L_X of O-stars should scale as $(\dot{M}/v_\infty)^{1-m}$ where theory predicts m ~ 0.2 – 0.4. We have tested this relation on our data (see Fig. 2), finding

$$\log f_X = (0.48 \pm 0.10)\,\log\frac{\dot{M}}{v_\infty} - 8.19 \pm 0.97$$

i.e. a slightly shallower relation than expected theoretically.

B-type stars:

50% of the known B-type stars in the FoV are detected. Their X-ray emission is generally harder than for O-stars. There is **no clear L_X/L_{bol} relation** for $\log(f_{bol}) < -5.9$ (see Fig. 3).

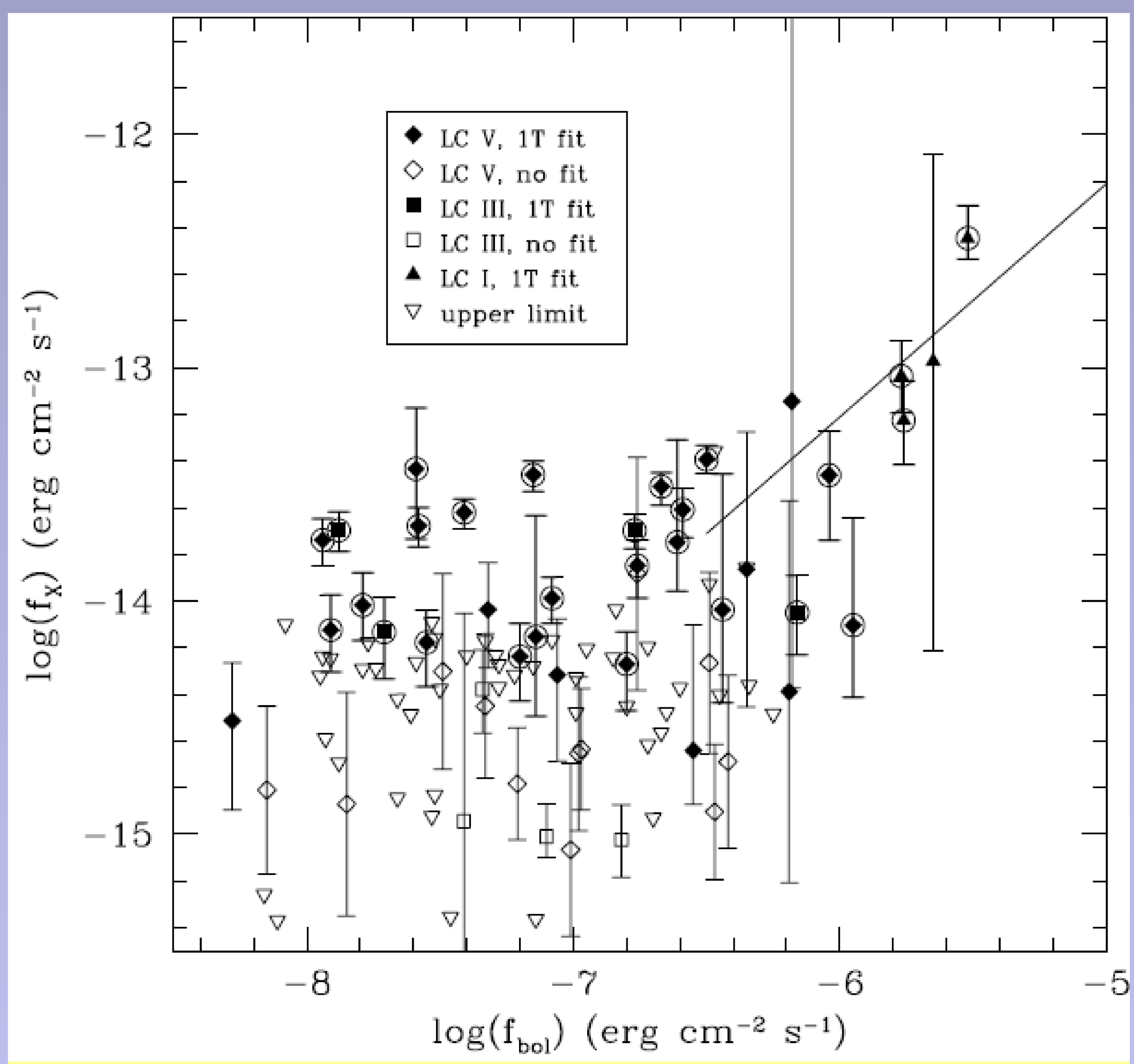

Fig.3: ISM corrected X-ray fluxes of the B-type stars as a function of their bolometric fluxes.

Wolf-Rayet stars:

The FoV contains 3 WR stars: WR 144 (WC4), WR145 (WN7/CE + O7 V) and WR146 (WC6 + O8 I-IIf). The first two have strong X-ray emission probably due to colliding winds (see Fig. 4).

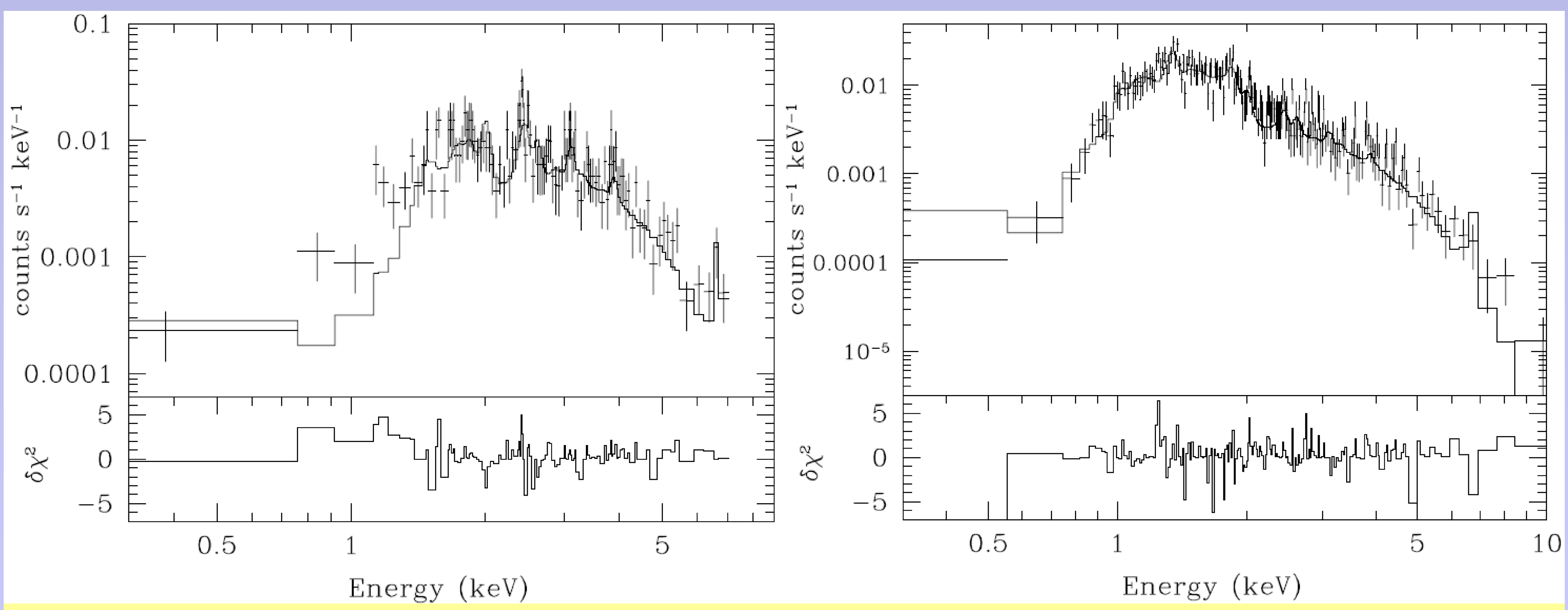

Fig.4: ACIS-I spectra of WR 145 (left) and WR 146 (right).

Although WR 144 is detected with only 6 net counts, we can estimate **$\log(L_X/L_{bol}) = -8.8 \pm 0.2$. To our knowledge, this is the first detection of X-ray emission from a single WC star.**

References:

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