The *XMM-Newton* view of the rich cluster Cygnus OB2

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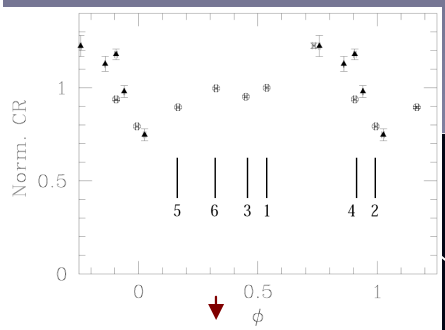
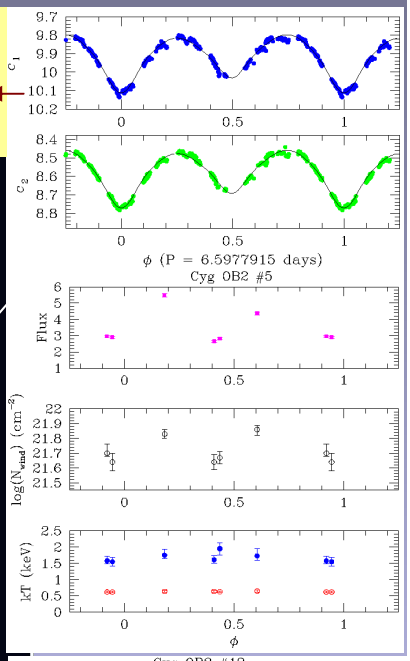
The multi-wavelength picture of Cygnus OB2:

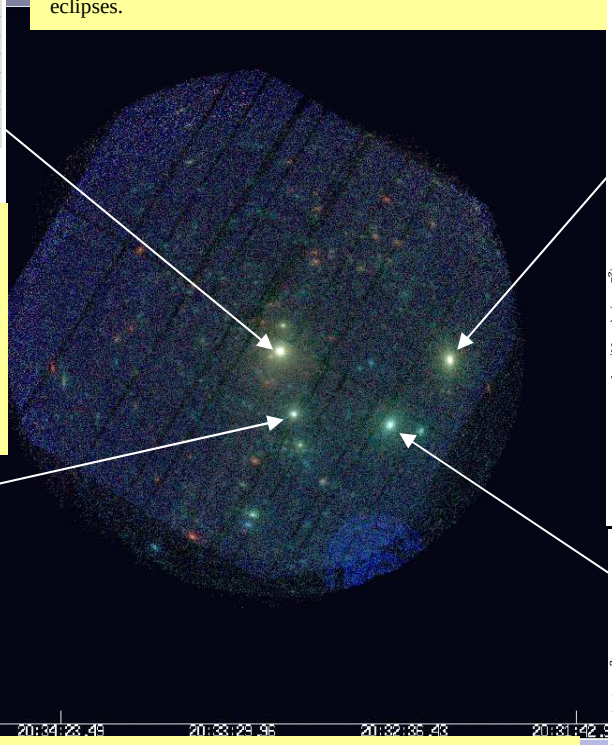
Cygnus OB2 is one of the richest and most massive young open clusters of our Galaxy. It likely harbors 120 ± 20 O-type stars (Knödlseder 2000, A&A 360 539). X-ray emission from the optically brightest O-stars of this cluster was detected serendipitously with EINSTEIN during an observation of Cyg X-3 (Harnden et al. 1979, ApJ 234, L51). Cyg OB2 contains at least three non-thermal radio emitters (Cyg OB2 #5, #8a and #9; Bieging et al. 1989, ApJ 340, 518) and has been suggested to be related to an unidentified *EGRET* source (3EG J2033+4118; Romero et al. 1999, A&A 348, 868) as well as an unidentified TeV source (TeV J2032+4130; Aharonian e al. 2002, A&A 393, L37).
We have obtained 6 observations of Cyg OB2 with *XMM-Newton* (4 in October-November 2004 and 2 in April-May 2007). Each observation has an exposure time of 20 – 30 ks. The spectra of massive stars were fitted with an absorbed (neutral ISM material + ionized wind material) two-temperature *mekal* model.

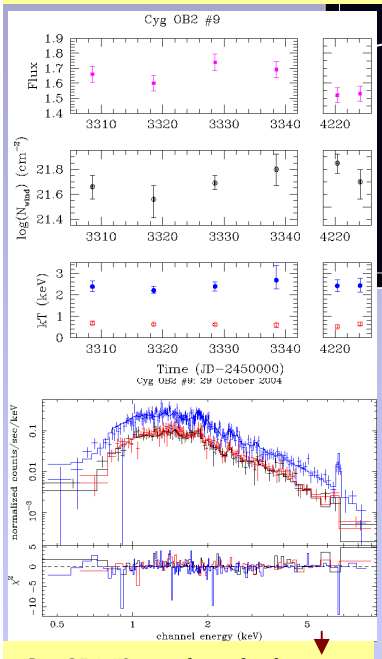


Cyg OB2 #8a: this non-thermal radio emitter is an eccentric O6If + O5.5III(f) binary system with a period of 21.9 days (De Becker et al. 2004, A&A 424, L39). The X-ray flux is modulated as a function of orbital phase as can be seen from the light curve built from our XMM-Newton data along with archive ROSAT and ASCA data (see De Becker et al. 2006, MNRAS 371, 1280).

Cyg OB2 #5: non-thermal radio emitter consisting of an O6-7Ia + Ofpe/WN9 eclipsing binary (Rauw et al. 1999 ApJ 517, 416; Linder et al. 2008, in prep.) with a third more distant companion. X-ray flux likely modulated by the photometric eclipses.

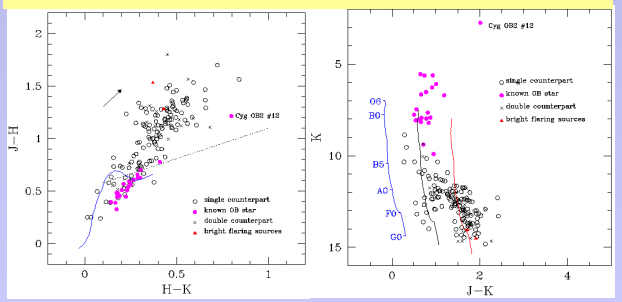


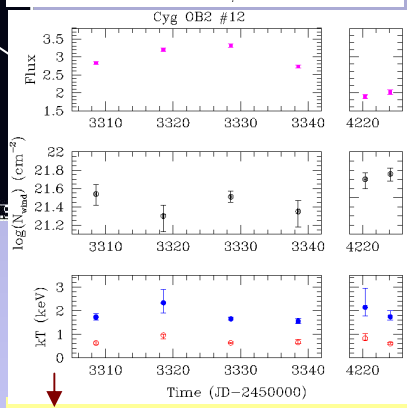




Cyg OB2 #9: non-thermal radio emitter of spectral-type O5If. This is a long-period binary system (Nazé et al. 2008, A&A 483, 543) and the hard emission (kT2 > 2 keV) is likely produced in the wind-wind interaction region.

Several hundred secondary sources showing flares and rather hard X-ray spectra are detected. Near-IR counterparts indicate that these are low-mass pre-main sequence stars belonging to Cyg OB2 (see also Albacete Colombo 2007, A&A 464, 211).





Cyg OB2 #12: B5Ia+ LBV candidate that shows long-term variability of its X-ray flux and displays an unusually hard X-ray spectrum.

Summary: The XMM-Newton data of Cyg OB2 reveal unusually hard (thermal) X-ray spectra for the three non-thermal radio emitters consistent with these objects being colliding wind binary systems. Phase-locked modulations are detected for at least two of them. A wealth of PMS objects are detected that provide constraints on the star formation history of the cluster.