Comparing X-ray Properties of Eta Carinae and WR 140

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Introduction:
Massive stars in binary systems generate X-ray emission in the region between the two stars where the radiatively-driven winds from the primary collides with the radiatively-driven wind of the companion.

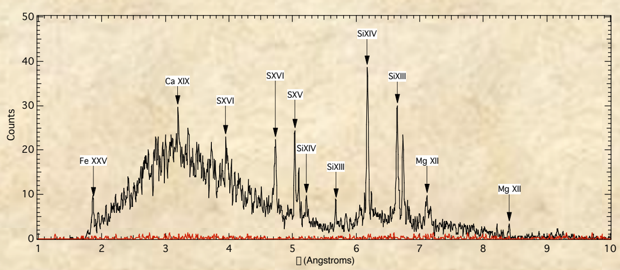
In these systems X-ray emission acts as an in-situ probe of important stellar and system parameters like **mass-loss rates**, **chemical abundances**, **wind velocities,** and **magnetic field strengths**.

In addition, X-ray variability can be produced in these colliding wind binaries by 2 effects: 1) the changing line-of-sight to the colliding wind region as the stars move in orbit around the center of mass and 2) the changing emission measure of the shocked gas in the wind collision zone produced if the separations between the two stars change due to non-zero orbital eccentricity. X-ray variability depends on the wind and orbital parameters and so can in principal allow the direct measurement of mass functions and the connection between the stellar and wind parameters.

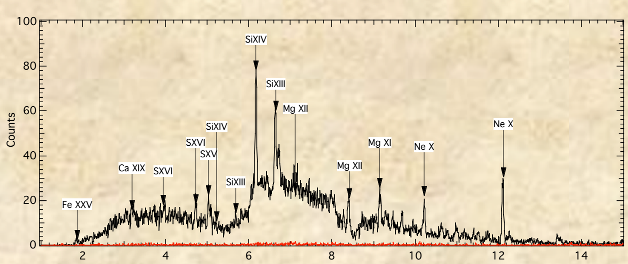
X-ray emission from colliding wind systems can thus be used to refine the evolutionary state of massive stars and to help test models of single and binary massive stars.

High Resolution X-ray Spectra

Eta Car: The HETGS spectrum (obtained near **apastron**) shows the presence of strong, narrow, symmetric line emission. The presence of both He-like and H-like lines of S and Si implies a mult-temperature plasma (Corcoran et al, 2001). Recent colliding wind hydro modeling (Pittard & Corcoran 2002, submitted) has shown that synthetic colliding wind spectra can describe well the ion distribution.The spectrum is cut off beyond 8 angstroms by absorption in the wind and the homunculus.

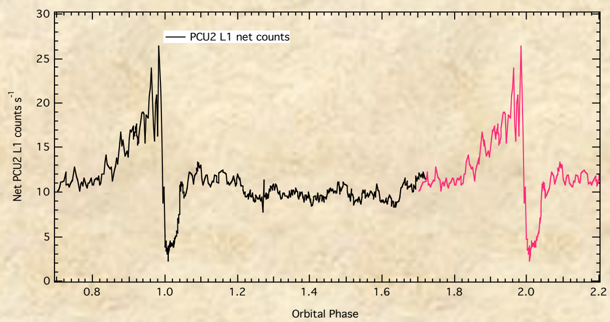


WR 140: The HETGS spectrum (obtained just prior to **periastron**) also shows the presence of strong, narrow, symmetric line emission. The presence of both He-like and H-like lines of S and Si implies a mult-temperature plasma. The strong Ne line near 12 A is presumably due to dredge-up of Ne to the surface (and wind) of the WC7 star.

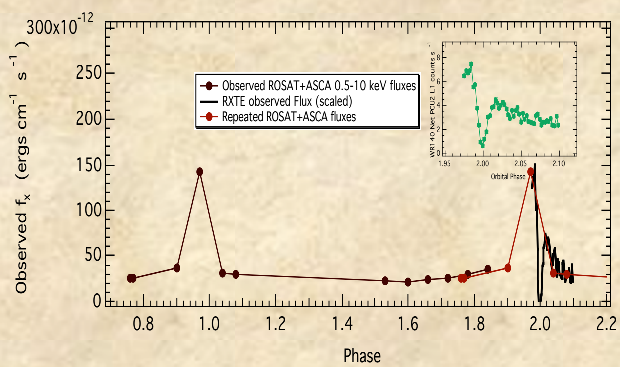


Broad-band X-ray Variability:

Eta Car: The 2 -10 keV X-ray lightcurve of Eta Car has been monitored in detail using the Rossi X-ray Timing Explorer (RXTE). The lightcurve is characterized by a gradual rise to a maximum followed by an abrupt decline to minimum which lasts about 3 months, followed by a recovery.



WR140: WR 140 has been monitored most extensively by ROSAT and ASCA. We have obtained RXTE monitoring of WR 140 since the time of the last periastron passage. The 0.5 -10 keV X-ray lightcurve of WR 140 Eta Car is shown below.



X-ray Similarities between WR 140 and Eta Car:

- Both are anomalously bright X-ray sources (compared to other WR stars)
- Both show similar X-ray lightcurve morphologies
- Both show strong line emission which is rather symmetric and originates far from either star
- Both reach maximum X-ray intrinsic luminosity near time of maximum absorbing column