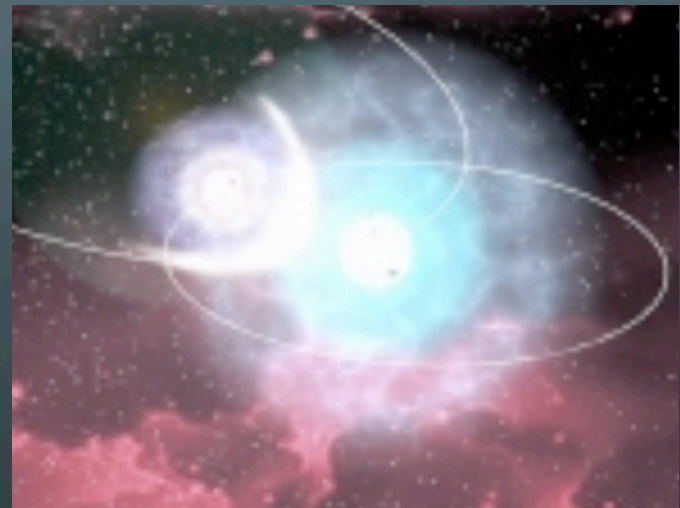


# Suzaku Observations of Massive Binary Systems

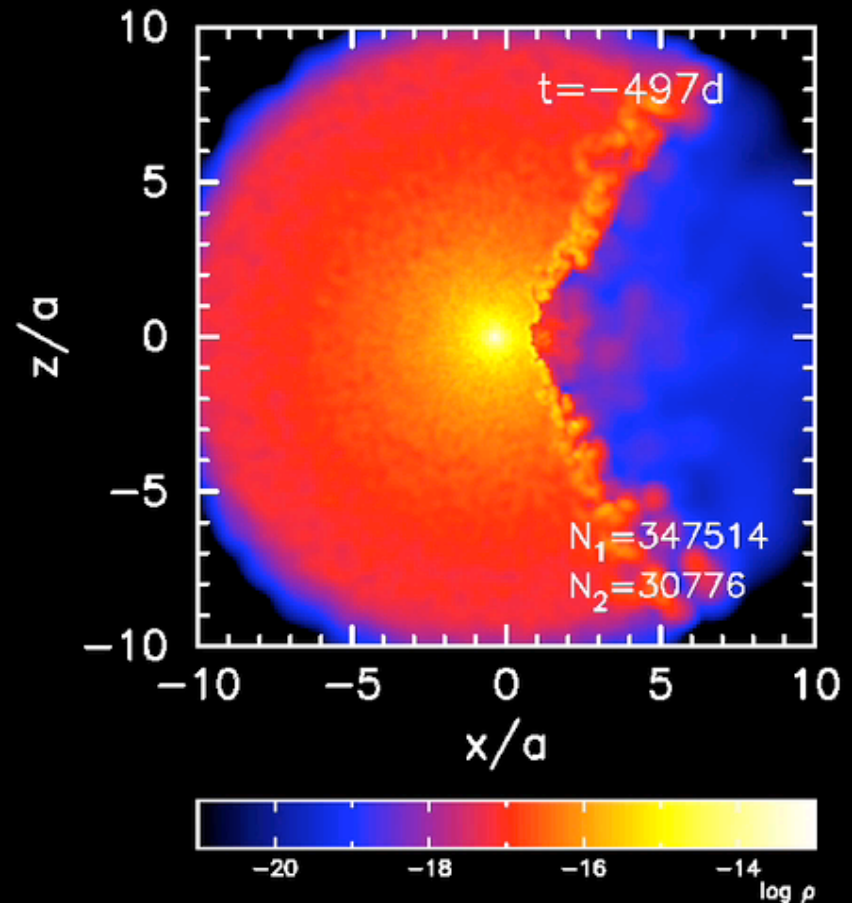
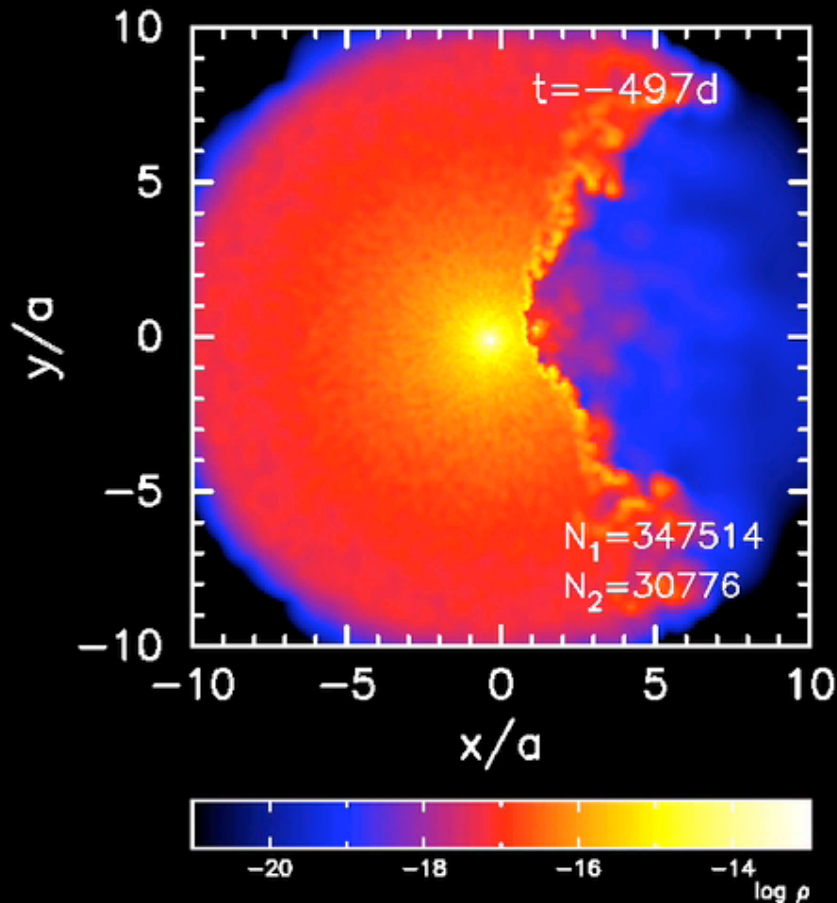
K. Hamaguchi (CRESST NASA/GSFC & UMBC)  
Michael F. Corcoran (CRESST NASA/GSFC & USRA)  
Suzaku  $\eta$  Car, WR140, and WR25 teams,

# X-ray Emission from Massive Binary Systems

- Evolved massive stars have strong winds
  - The winds eject CNO materials
  - $\dot{M}_{\text{dot}} \sim 10^{-3} \sim 10^{-5} M_{\text{solar}} \text{ yr}^{-1}$
  - $v_{\text{wind}} \sim 500 - 3000 \text{ km s}^{-1}$
- Collision of winds from a binary pair produces hot plasma
  - $kT \sim 2-4 \text{ keV}$
  - $L_x$  up to  $\sim 10^{35} \text{ ergs s}^{-1}$






# Simulation of the Wind-wind Collision





Assuming parameters of  $\eta$  Car (Okazaki et al.)

# New Science w/Suzaku

## XIS + HXD

-  Good sensitivity between 5 – 40 keV (0.25-2 angstrom)
-  well constrains Fe K line/edge and hard slope profiles
-  Detection of hard components

## Science on colliding wind plasma

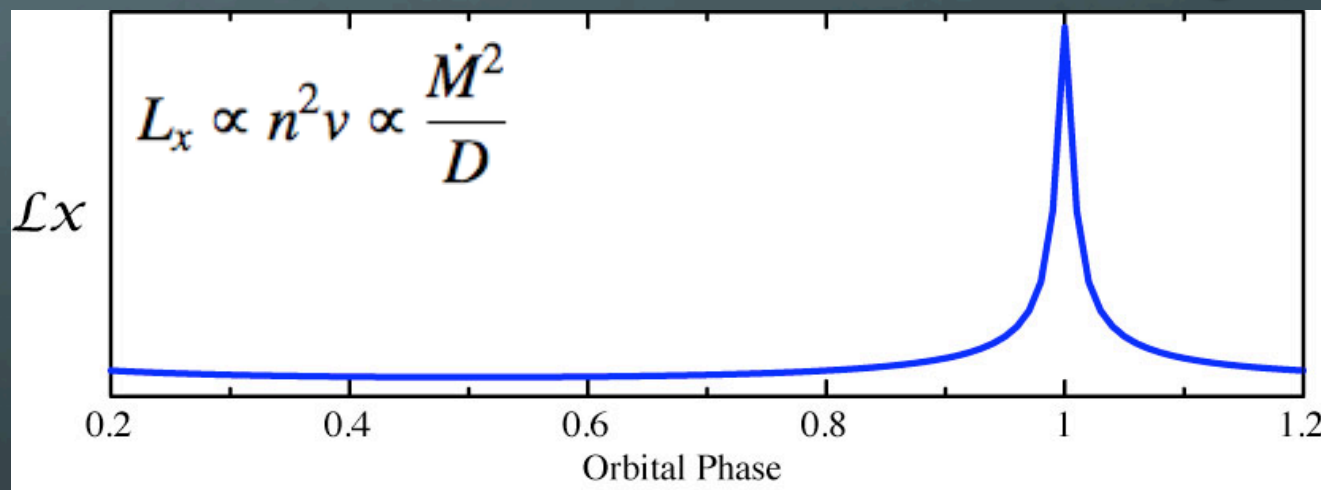
-  Plasma thermal equilibrium/non-equilibrium
-  particle acceleration at the wind colliding surface

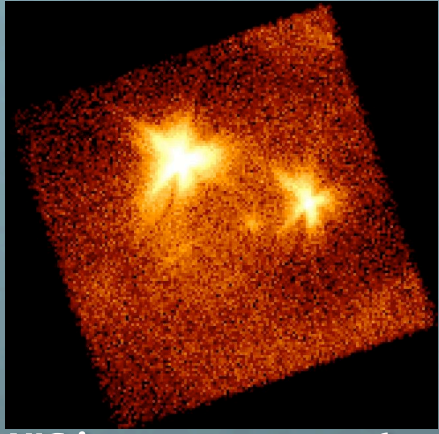


# MBSs seen with Suzaku

	Spectrum	$P$ (year)	$e$	$i$ (degree)	$L_x$ ( $10^{34}$ ergs $s^{-1}$ )
$\eta$ Car	LBV+O3?	5.54	$\sim 0.9$	45?	6-25
WR 25	WN6ha+O	0.57	0.56	37	$\sim 0.8$
WR 140	WC7pd+O5I	7.94	0.88	32	0.5-2

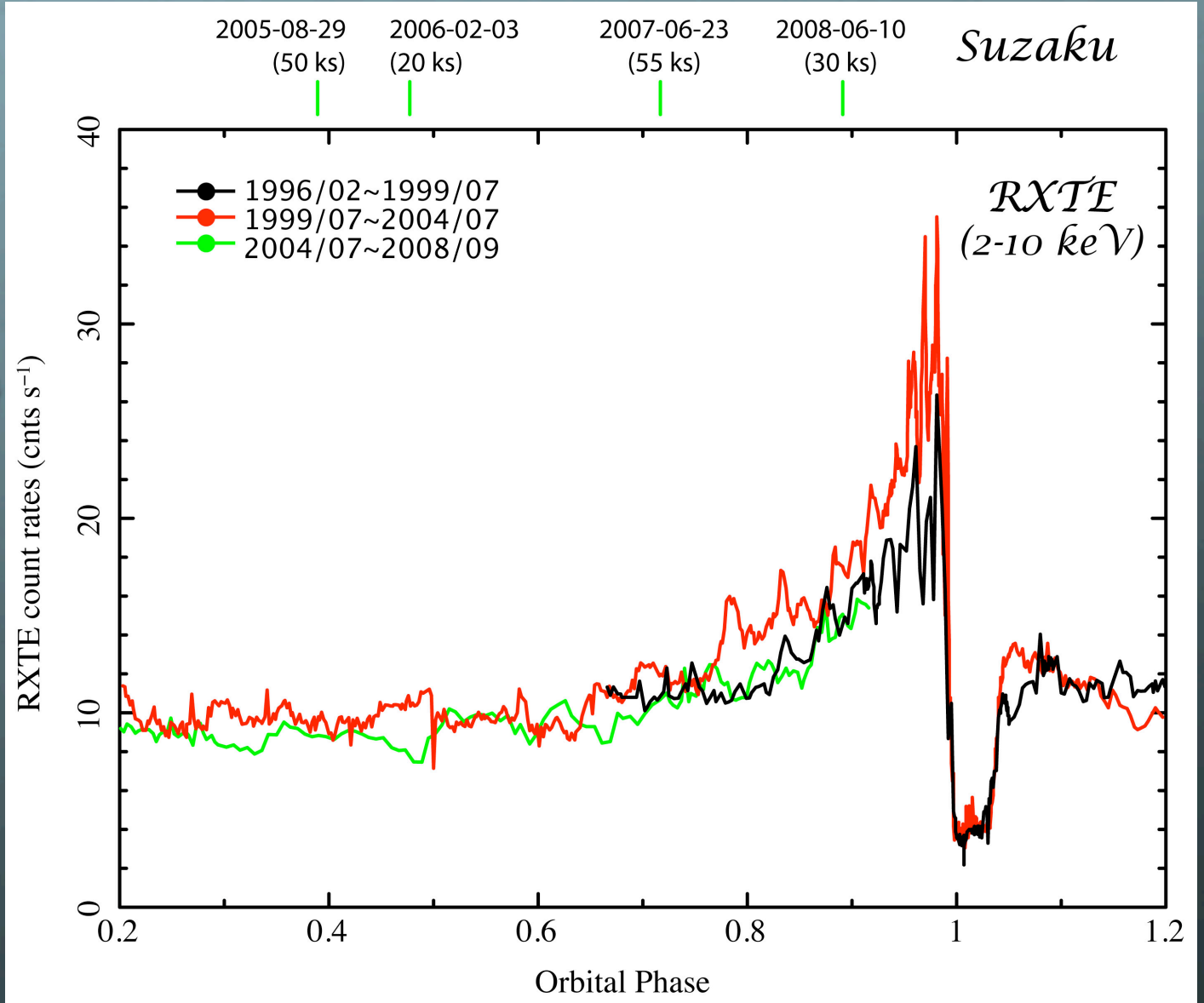
X-ray luminosity variation of a wind-wind colliding system





XIS image on 2007-06-23

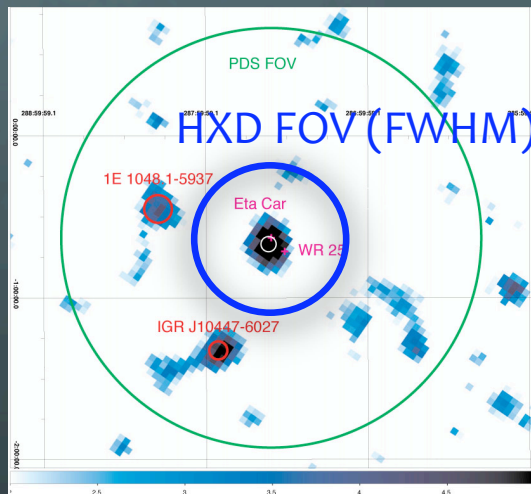
# $\eta$ Carinae ( $P=5.54\text{yr}$ )



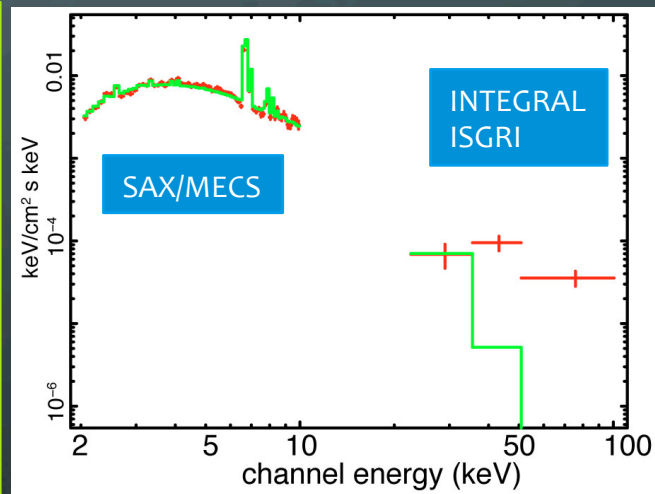
# Early Results on Very Hard X-rays

- Beppo-SAX measured fluxes above 15 keV (Viotti et al.)
  - severe contamination by 1E1048.1-5937, IGR J10447-6027
- INTEGRAL resolved hard emission from  $\eta$  Car (Leyder et al.)
  - another hard component above 22 keV
  - It was interpreted as an inverse Compton component.

INTEGRAL image



INTEGRAL + Beppo-SAX spectrum

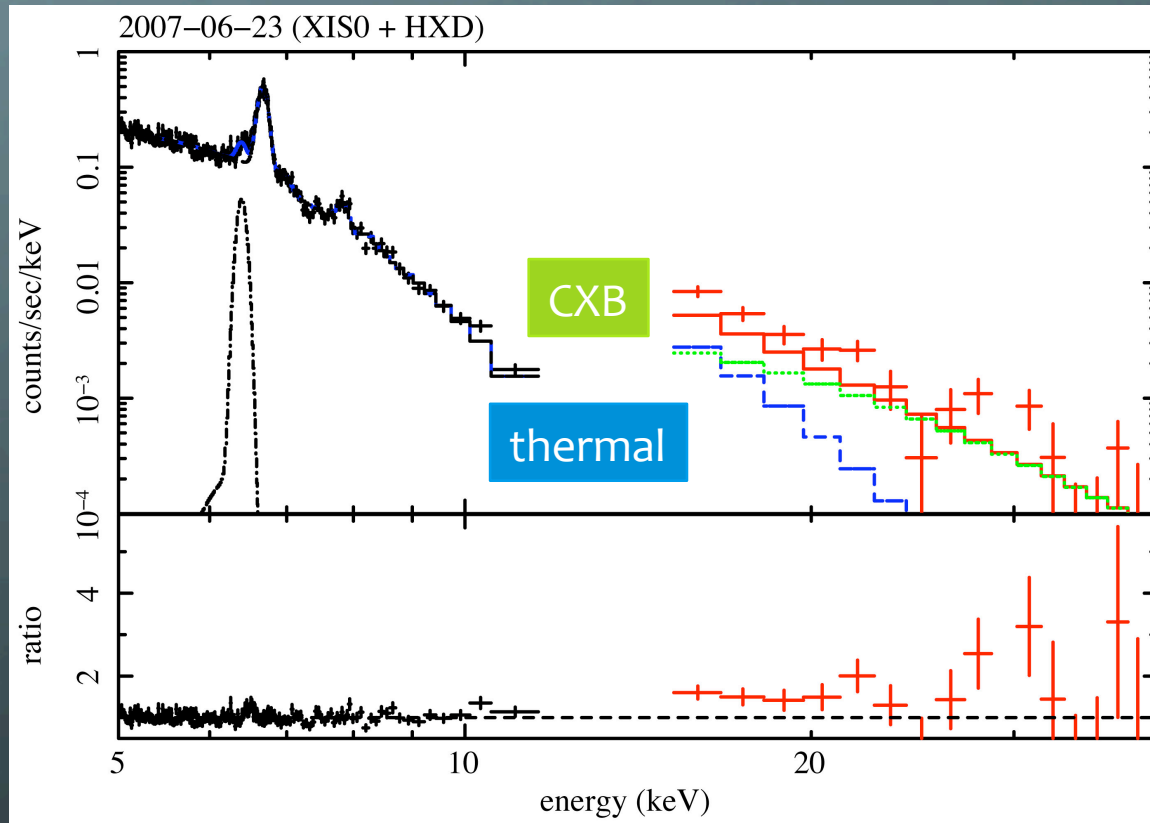


# XIS+HXD spectra

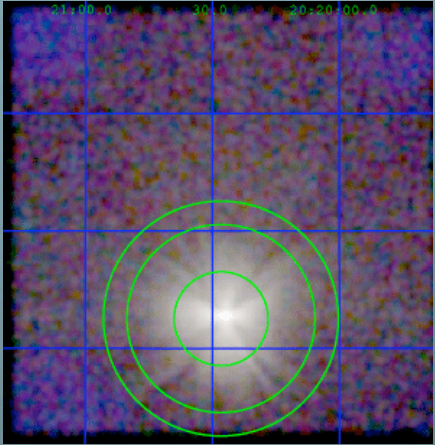
- 🌐 Excess component above 10 keV
  - 🌐 No apparent flux variation between observations
  - 🌐 Inverse Compton, additional thermal comp, or external hard source?

Sekiguchi, Hamaguchiet al.

(PI: SWG, Hamaguchi)

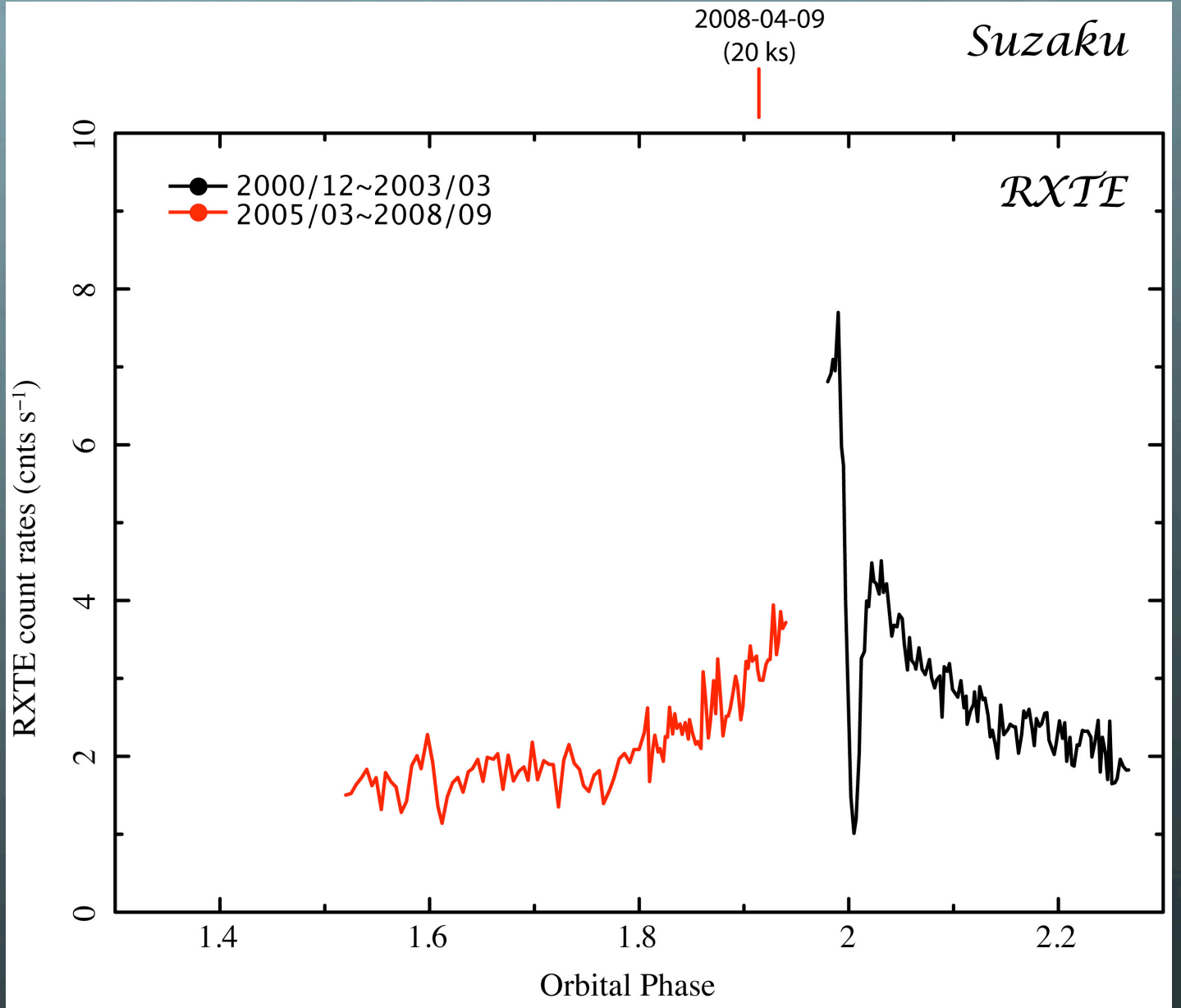






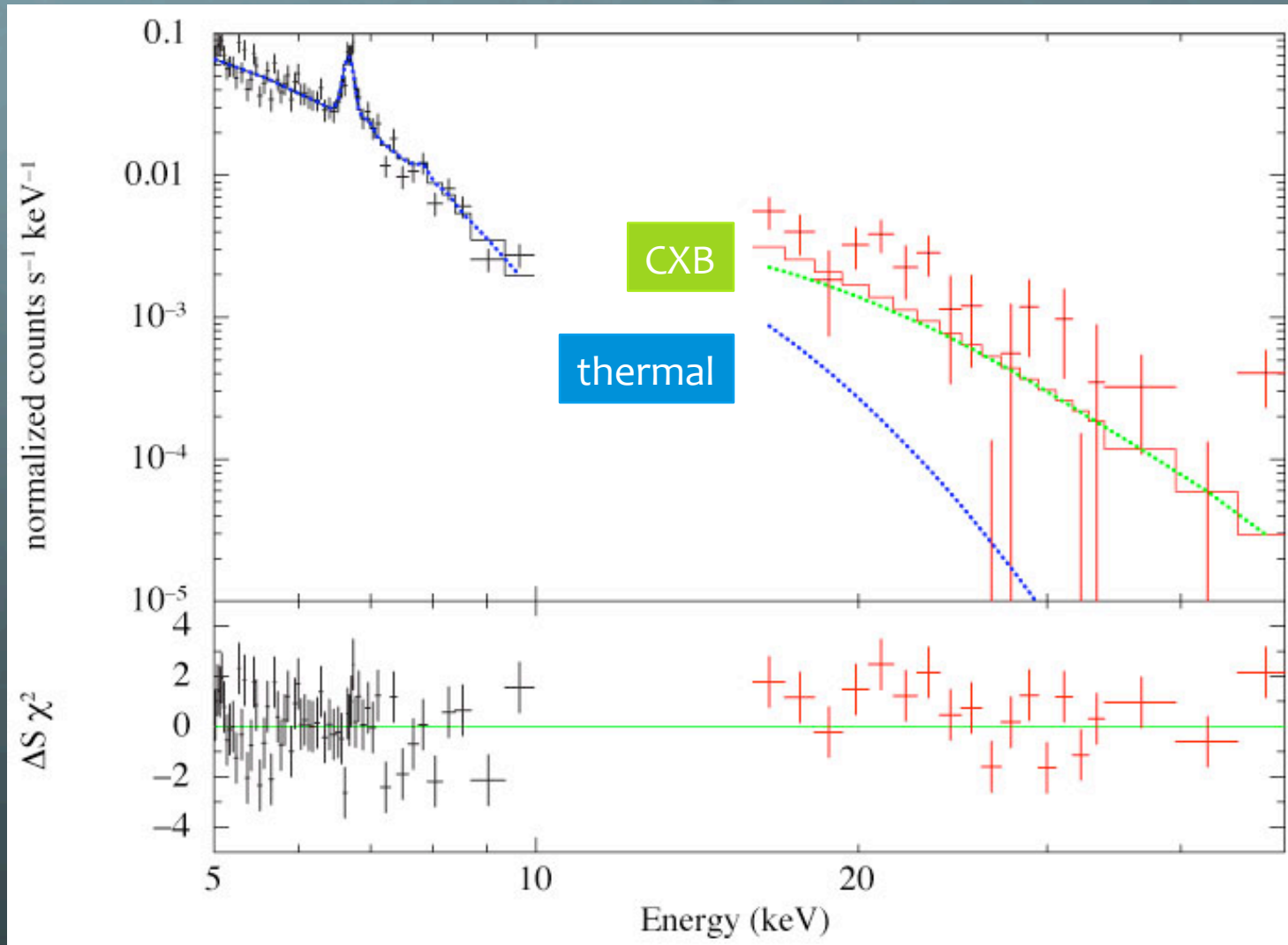
XIS image on 2008-04-09

**WR140**  
( $P=7.94\text{yr}$ )

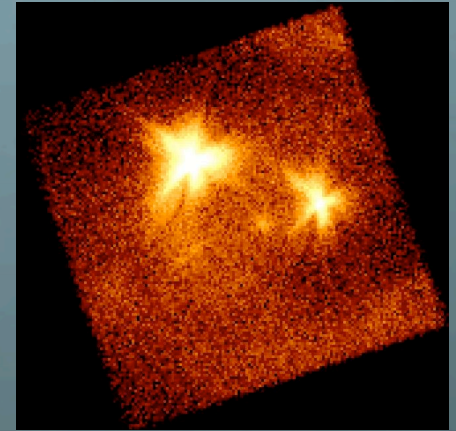


# XIS+HXD spectrum

Sugawara et al. (PI: Y Maeda)

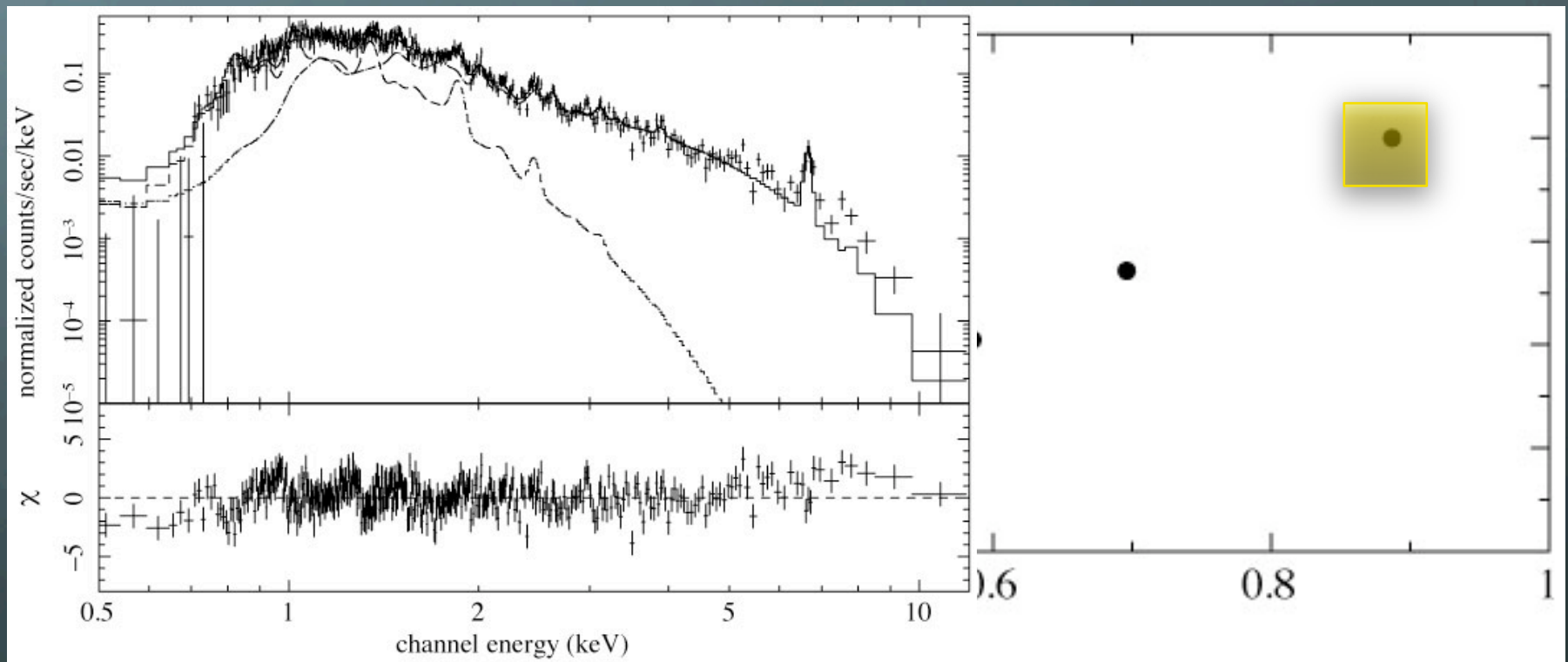


# WR25 ( $P=0.57\text{yr}$ )

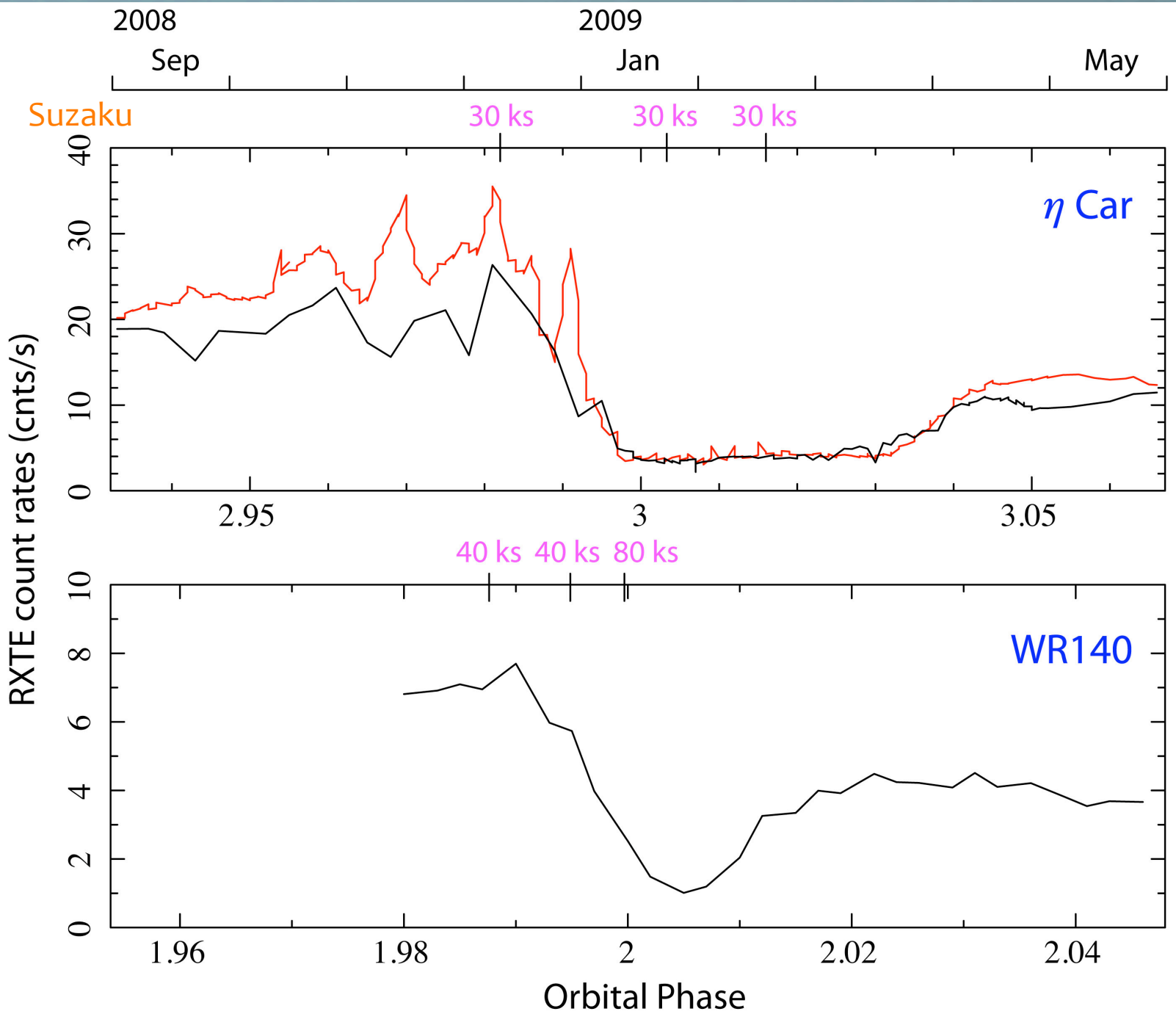


XIS image on 2007-06-23

- 🌐 No detailed phase resolved spectra
- 🌐 Some spectra show hot  $kT \sim 4\text{-}5\text{ keV}$  (XMM:  $kT \sim 0.6, 2.8\text{ keV}$ )



# Big Events in 2009!





# Summary

- 🌐 Suzaku observed evolved massive binary systems,  $\eta$  Car, WR140 and WR25.
- 🌐 The XIS + HXD spectra of  $\eta$  Car showed excess from the thermal emission that dominates below  $\sim 10$  keV.
- 🌐 The HXD spectrum of WR140 was consistent with thermal emission with CXB background.
- 🌐 X-ray spectra of WR25 showed very hot components.
- 🌐 Big events are coming in early 2009. Stay tuned!