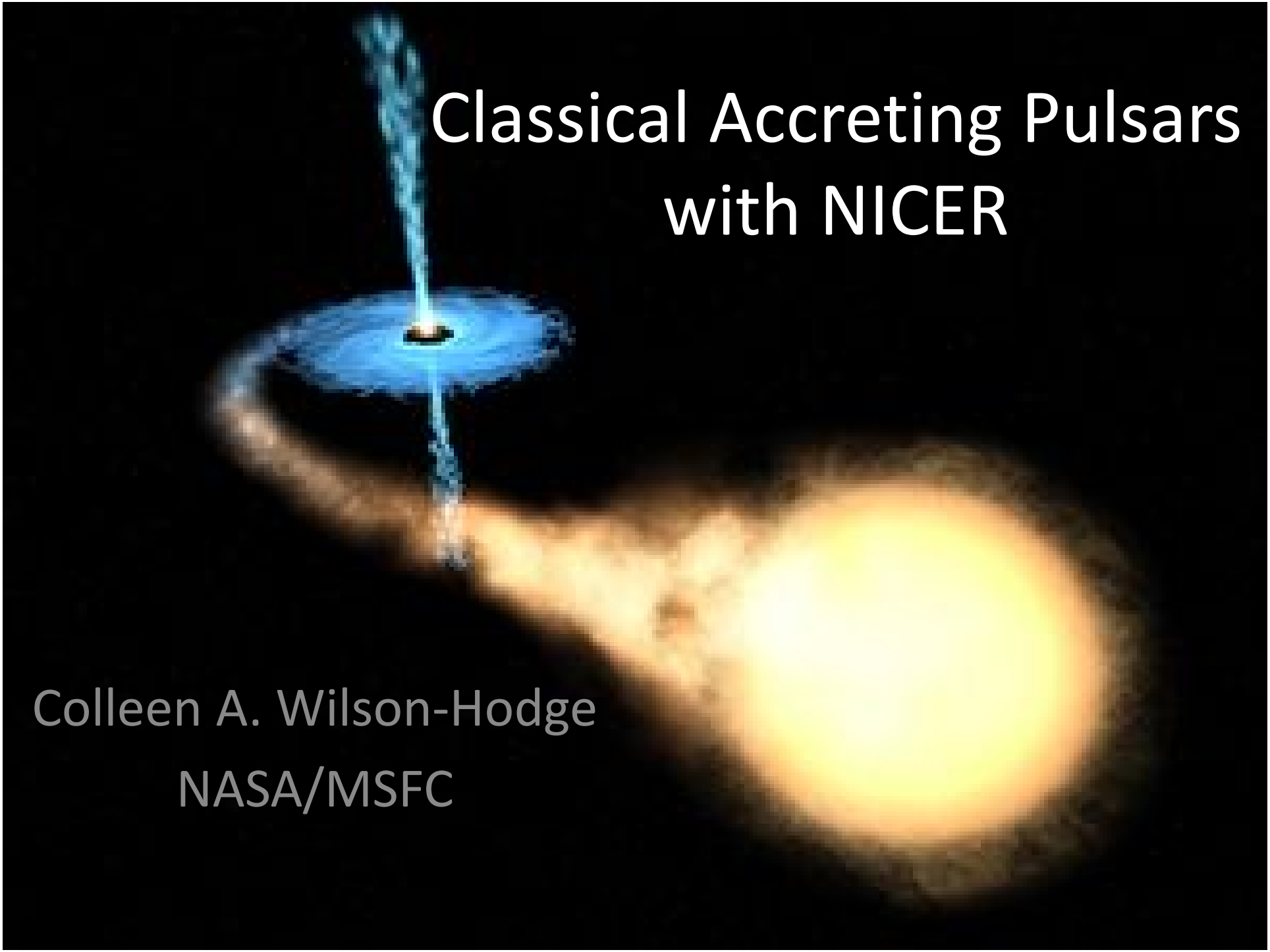
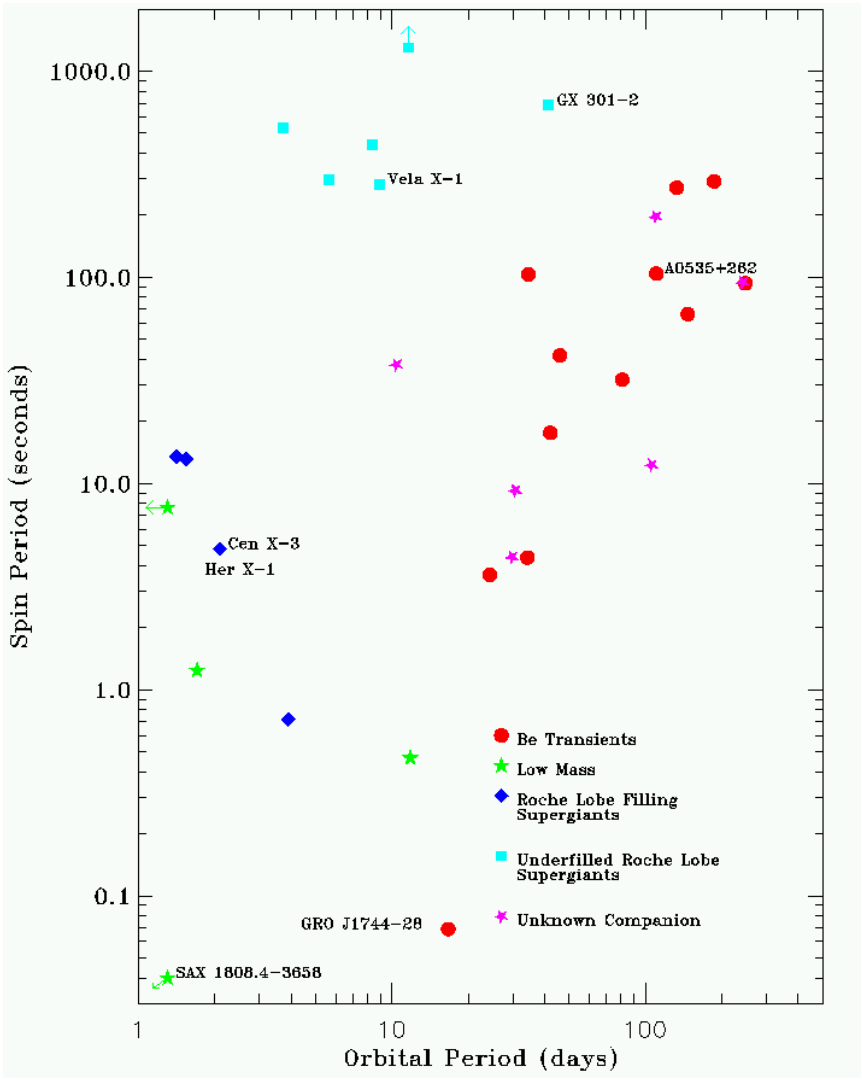
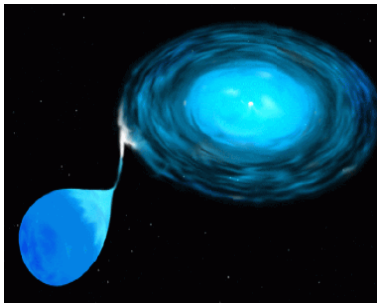


Classical Accreting Pulsars with NICER

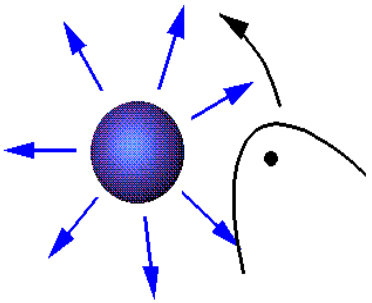
Colleen A. Wilson-Hodge
NASA/MSFC

Classical Accreting X-ray Pulsars

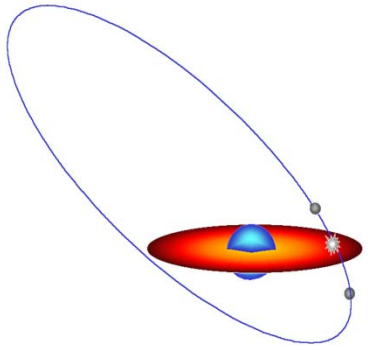




Roche lobe overflow



Wind accretion



Be star's circumstellar disk

Soft X-ray Excesses

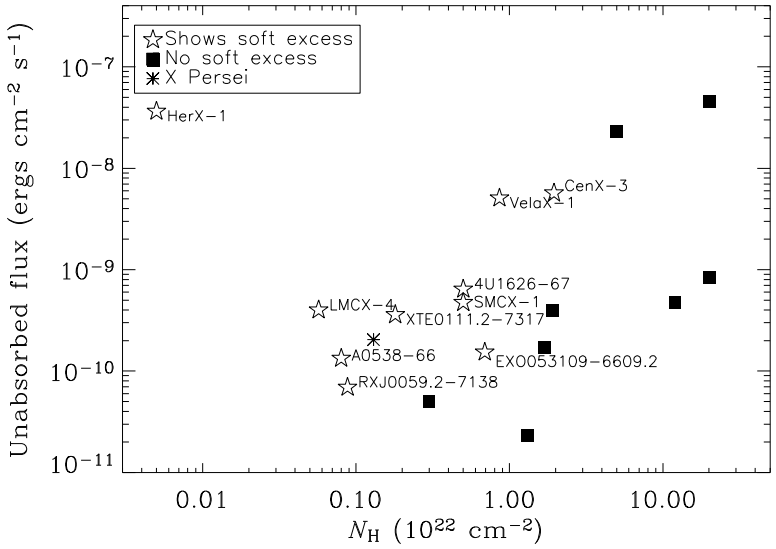


FIG. 1.—Observed N_H and unabsorbed fluxes for the XBPs in Table 1 of Bildsten et al. (1997) plus EXO 053109−6609.2. Sources with a known soft excess are shown as stars, while those without are shown as squares. The low-luminosity source X Per is shown as an asterisk (see text for details).

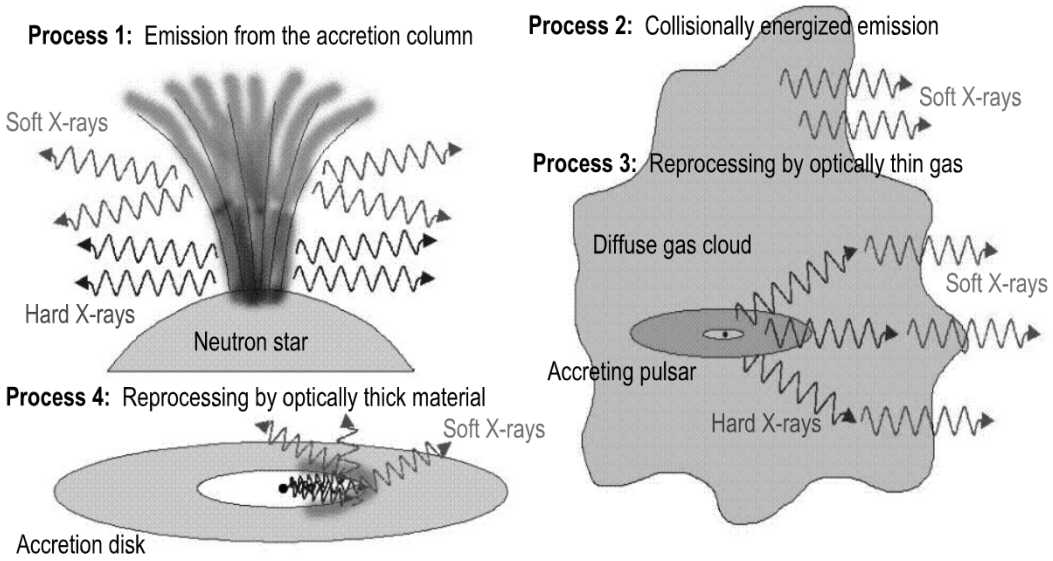


FIG. 3.—Four soft excess emission processes considered in this paper.

Hickox, Narayan, and Kallman 2004, ApJ, 614, 881

- Soft excesses are very common
- $L_x > 10^{38}$ erg/s – reprocessing by optically thick material at the inner edge of the accretion disk
- $L_x < 10^{36}$ erg/s – photoionized or collisionally heated diffuse gas or thermal emission from the NS surface
- $L_x \sim 10^{37}$ erg/s – either or both types of emission
- NICER observations of soft excesses in bright X-ray pulsars combined with reflection modeling will constrain the ionization state, metalicity and dynamics of the inner edge of the magnetically truncated accretion disk

Torque Reversal in 4U 1626-26

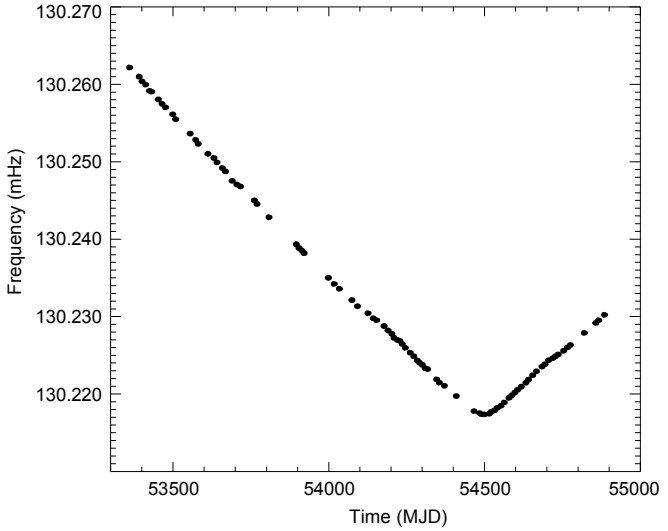
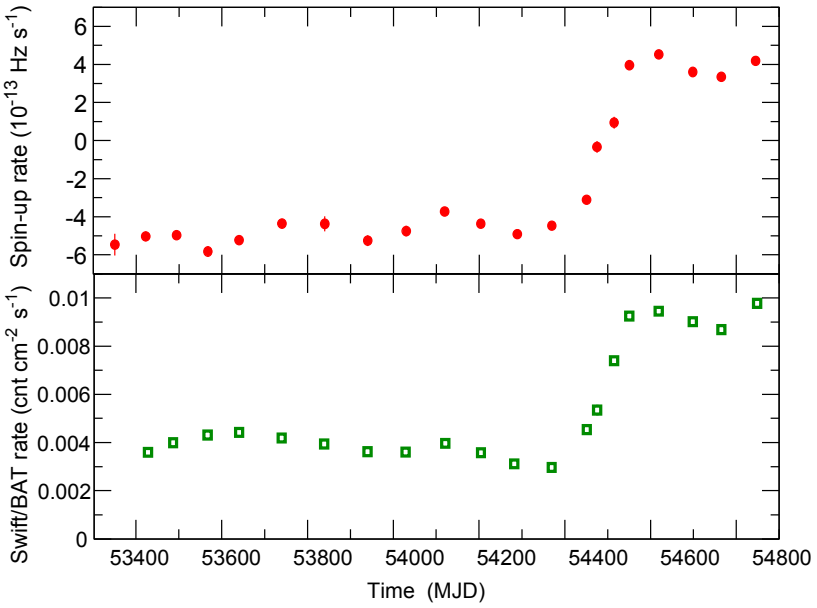


Figure 3. *Swift*/BAT pulse frequency history covering this second reversal torque (from 2004 October to the present time). Error bars are smaller than the plotted symbols.



Camero-Arranz et al 2010

Low Energy Lines

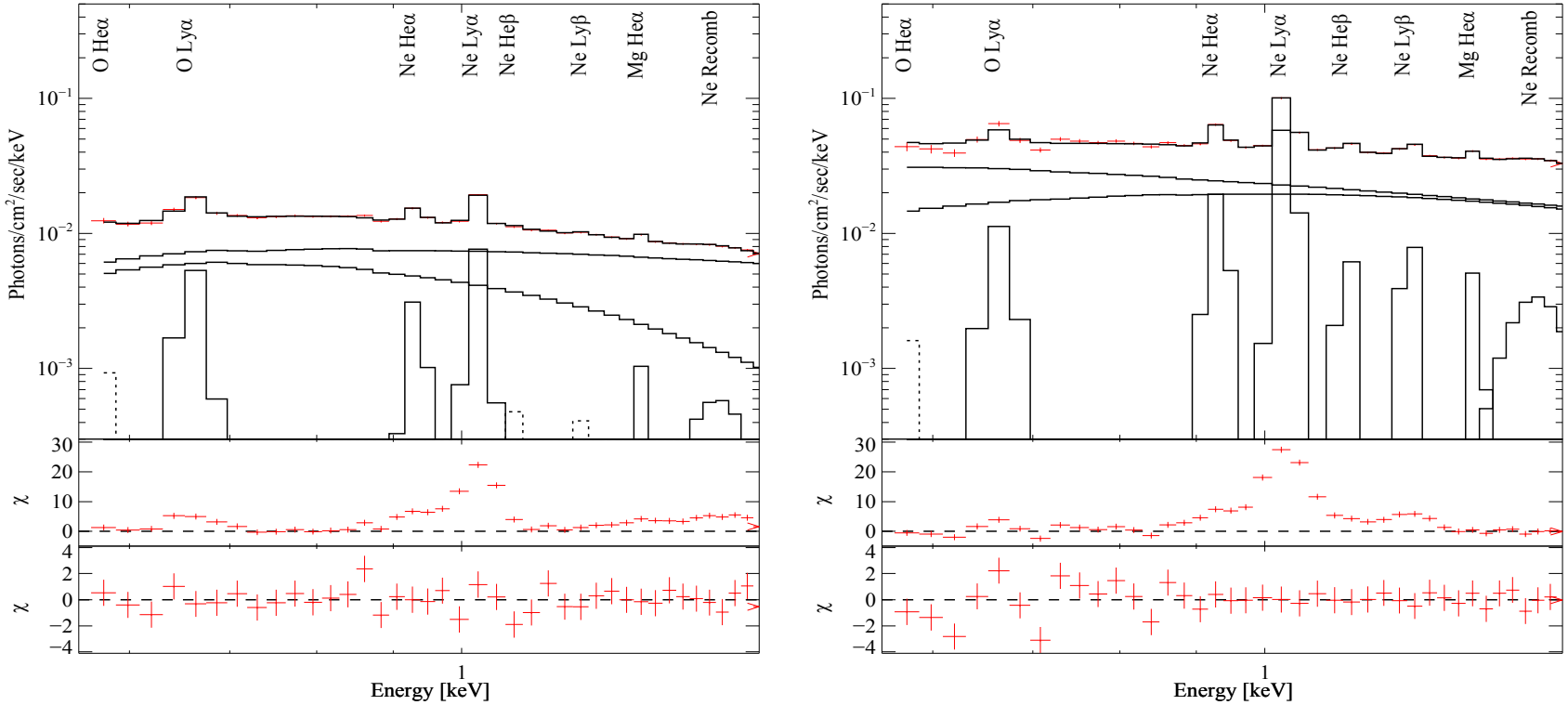


Fig. 2. *Top panels*: Eight Gaussian lines from the □1 keV complex detected by *Suzaku*, before (*left panel*) and after (*right panel*) the 2008 torque reversal. Here the dotted lines in the model denote the components that were fixed. The residuals after fitting only the continuum model are shown in *the middle panel*, with no line emission included. *The bottom panel* shows the residuals after fitting the line complex with those 8 lines (see Table 2 for more information about these lines).

Camero-Arranz et al. 2012, A&A, 546, A40

Possible Changes in Disk Ionization?

Ballanyne et al 2012

THE ASTROPHYSICAL JOURNAL LETTERS, 747:L35 (5pp), 2012 March 10

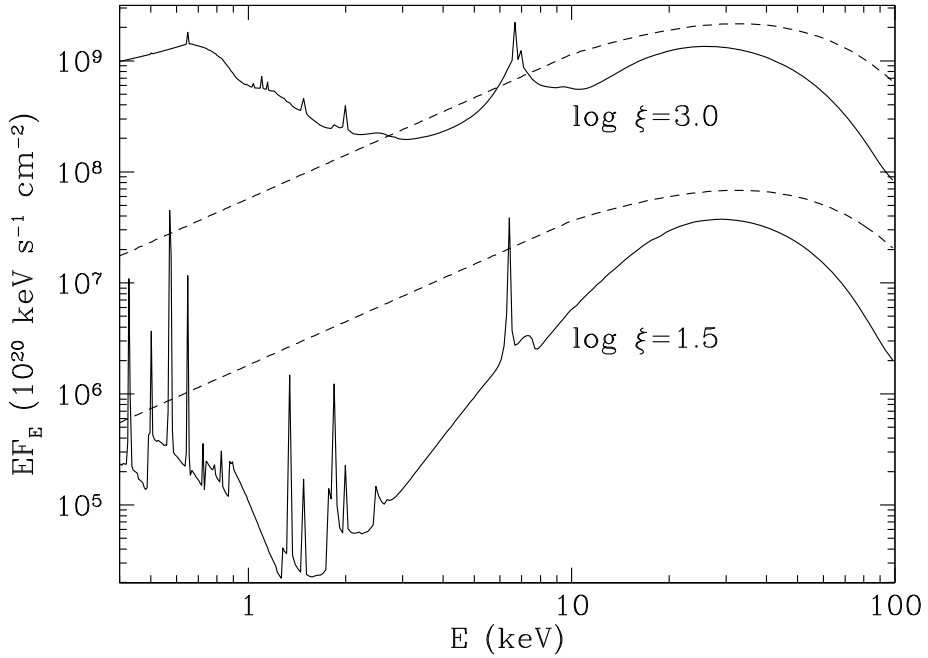


Figure 1. Reflection spectra from a constant density slab irradiated by a power law with a high-energy cutoff (Equation (2)) with $\Gamma = 0.7$, $E_{\rm cut} = 10$ keV, and $E_{\rm fold} = 25$ keV (dashed lines). The solid lines plot the reflection spectra for both a weakly ionized slab ($\log \xi = 1.5$) and a strongly ionized one ($\log \xi = 3.0$). The highly irradiated slab produces a strong bremsstrahlung-dominated soft excess at energies $\lesssim 3$ keV.

- Reflection models of an accretion disk for a hard power law
  - Strong soft excess below 3 keV from hot X-ray heated disk
  - For weakly ionized case: strong recombination lines
  - Are we seeing changes in the disk ionization in 4U1626-26?

SMC Pulsars

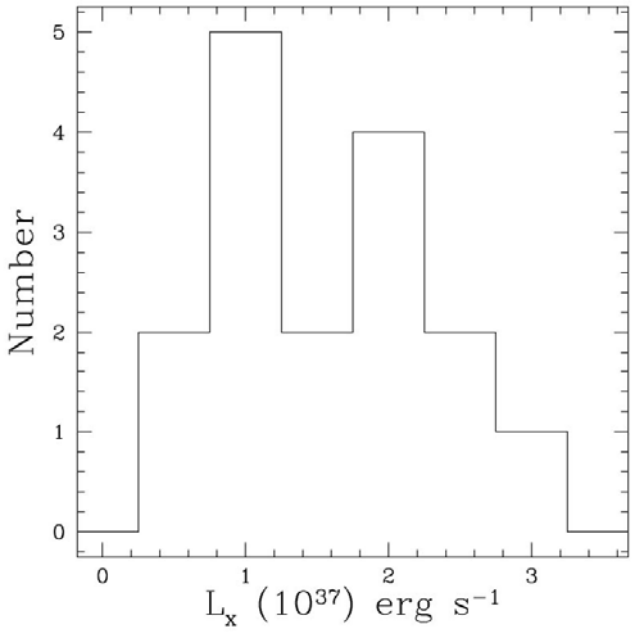


Figure 4. The histogram of the estimated peak X-ray luminosities for the outbursts discussed in this work. The exceptionally large outburst from SXP2.37 is excluded from this plot.

Coe, McBride, & Corbet, 2010, MNRAS, 401,252

- 13 years of weekly monitoring with RXTE PCA
- Revealed an unexpectedly large population of Be/X-ray binaries compared to the Milky Way
- Plotted luminosities are typical of “normal” outbursts (once per orbit)
- The SMC provides an excellent opportunity to study a homogenous population of HMXBs with low interstellar absorption for accretion disk studies.

Summary and Future Work

- Monitoring with NICER will enable studies of accretion disk physics in X-ray pulsars
- The SMC provides a potential homogeneous low-absorption population for this study
- NICER monitoring and TOO observations will also provide measurements of spin-frequencies, QPOs, pulsed fluxes, and energy spectra.