High-Resolution Spectroscopy of Ultracompact Binaries

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Outline

- What are Ultracompact Binaries?

  Why are they interesting?

- Evidence for C-O WD Donors

- Caveats/Weak Points

- Remaining Questions

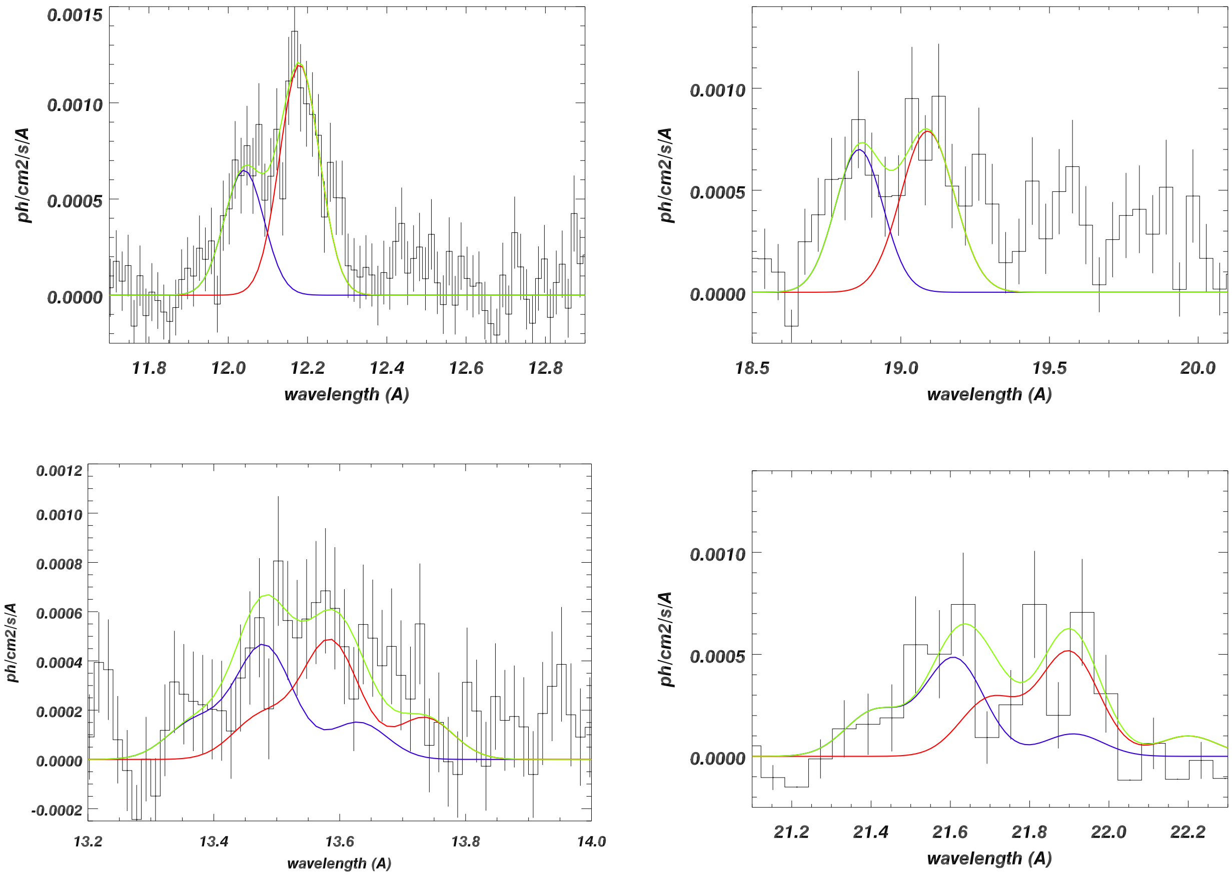
Ultracompact Binaries

- $P_{\mathrm{orb}} \lesssim 80$ min
  - Require Hydrogen-deficient or degenerate companions
- 6 ultracompact LMXBs (out of 49)
- 2 of 3 X-ray MSPs
- 2 of 5 Globular Cluster binaries
- 9 additional candidate UC binaries with low $L_{\mathrm{opt}}/L_{\mathrm{X}}$

  (van Paradijs & McClintock 1994)

Line Emission from 4U 1626−67 with *Chandra*

(Schulz et al. 2001)



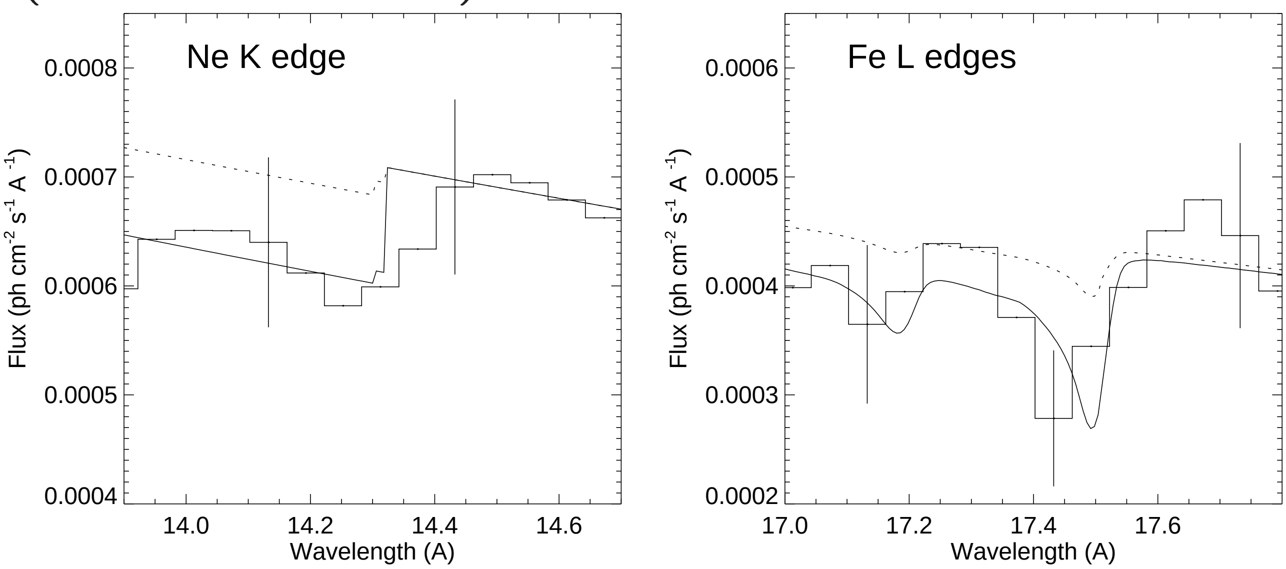
Ne & O rich material

Hot (10^6 K), dense ($\approx 10^{12}$ cm^{-3}) material,

from outer Keplerian accretion disk or disk wind

4U 1626−67 Absorption Edges

(Schulz et al. 2001)



Damped Lyman α: $N_{\mathrm{H}} = 5{\times}10^{20}$ cm^{-2}

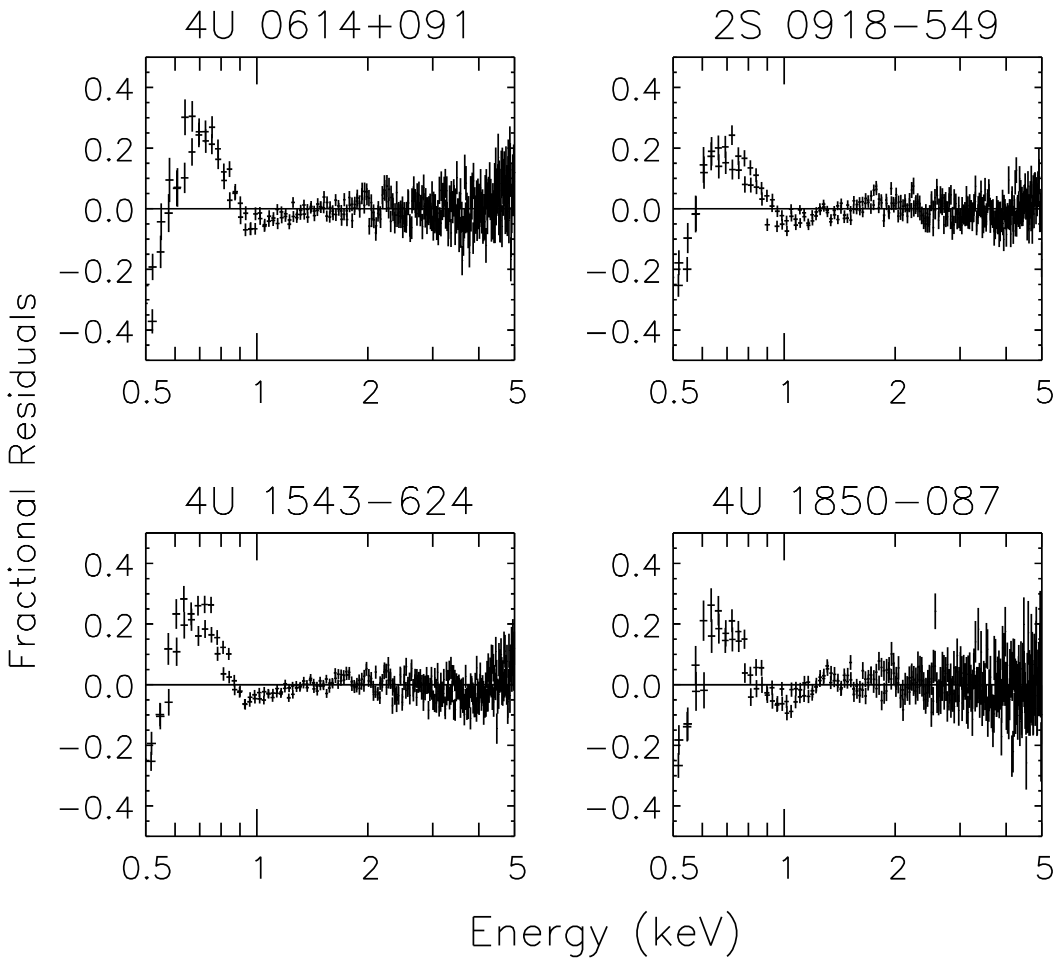
Ne edge: $N_{\mathrm{H}} = 3.7 \times 10^{21}$ cm^{-2}

O edge: $N_{\mathrm{H}} = 3.3 \times 10^{21}$ cm^{-2}

Local material has Ne/O ratio = 0.22

– much larger than expected

ASCA spectra of UC binaries

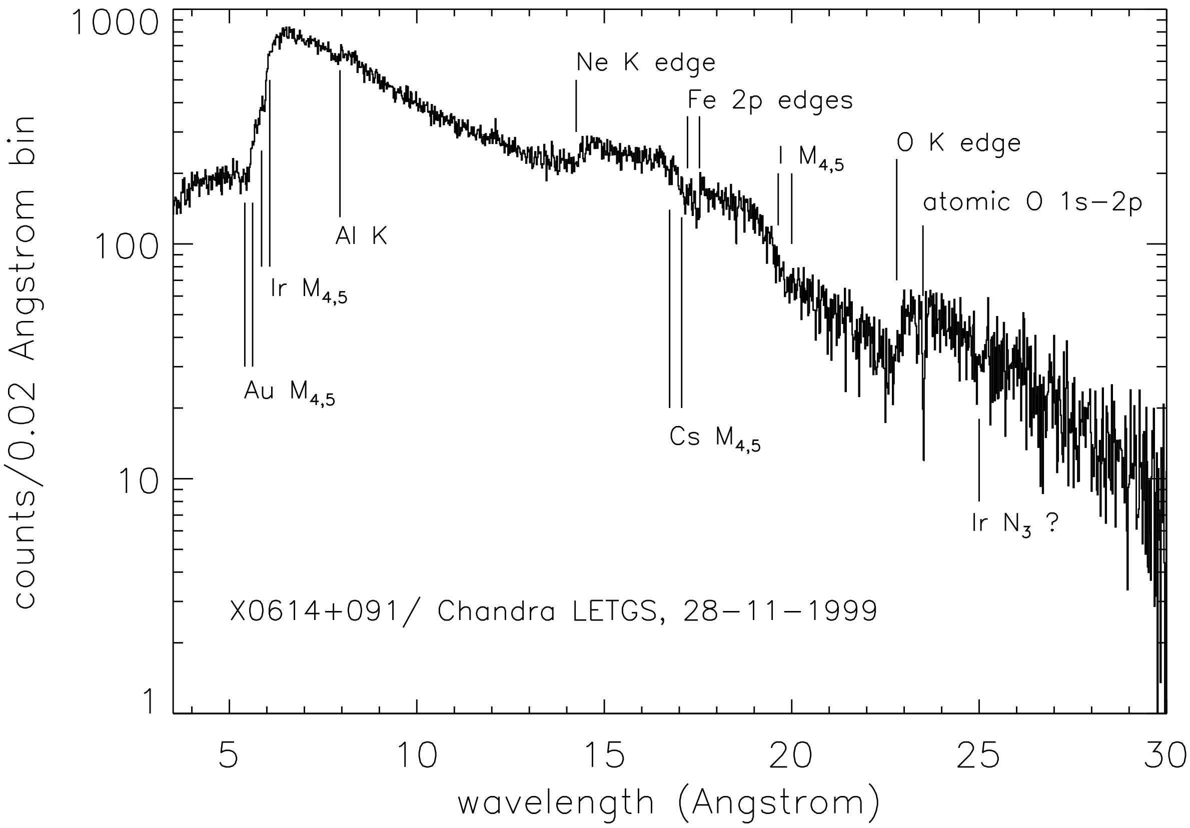


Residuals from absorbed PL + BB model

Feature at 0.7 keV attributed to unresolved Fe/O emission lines

Chandra spectrum of 4U 0614+091

(Paerels et al. 2001)

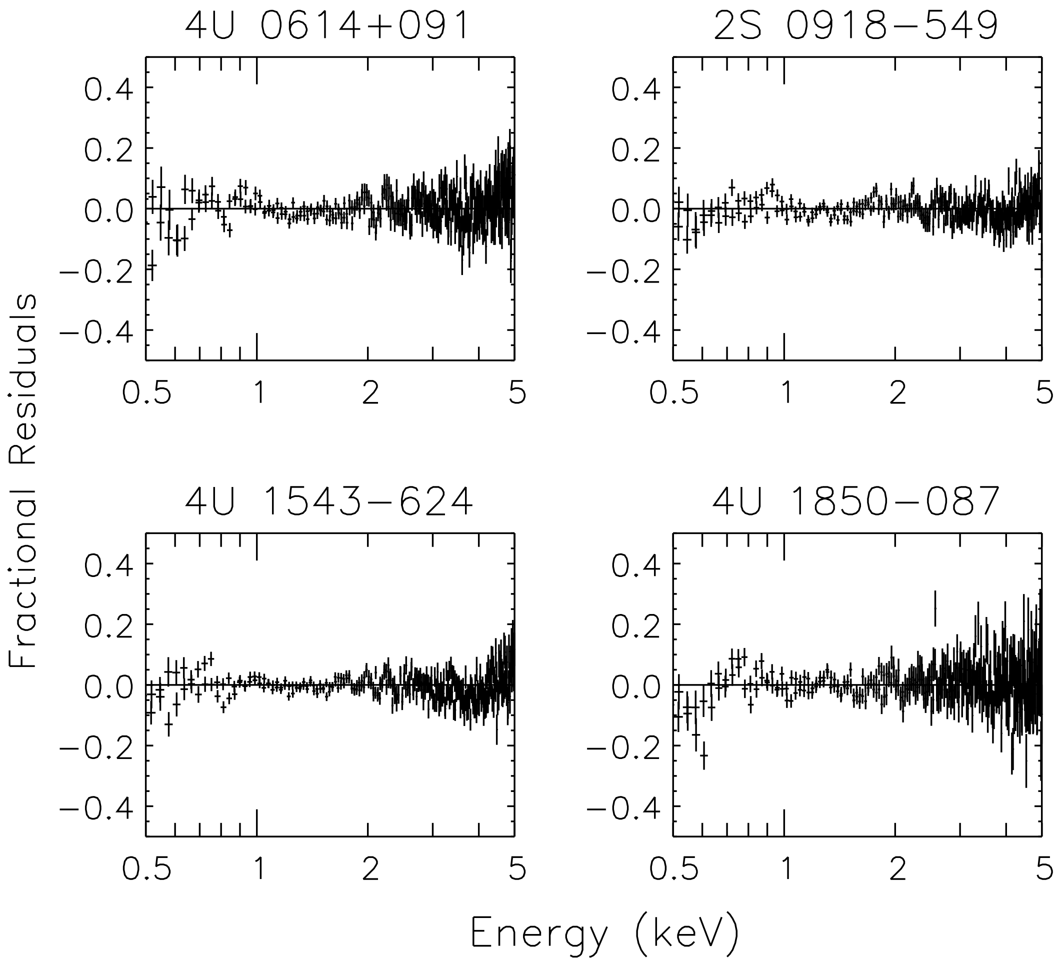


No emission lines

Ne/O ratio ≈ 1.25

(Ne/O in ISM $= 0.18$)

Alternative explanation for the 0.7 keV feature

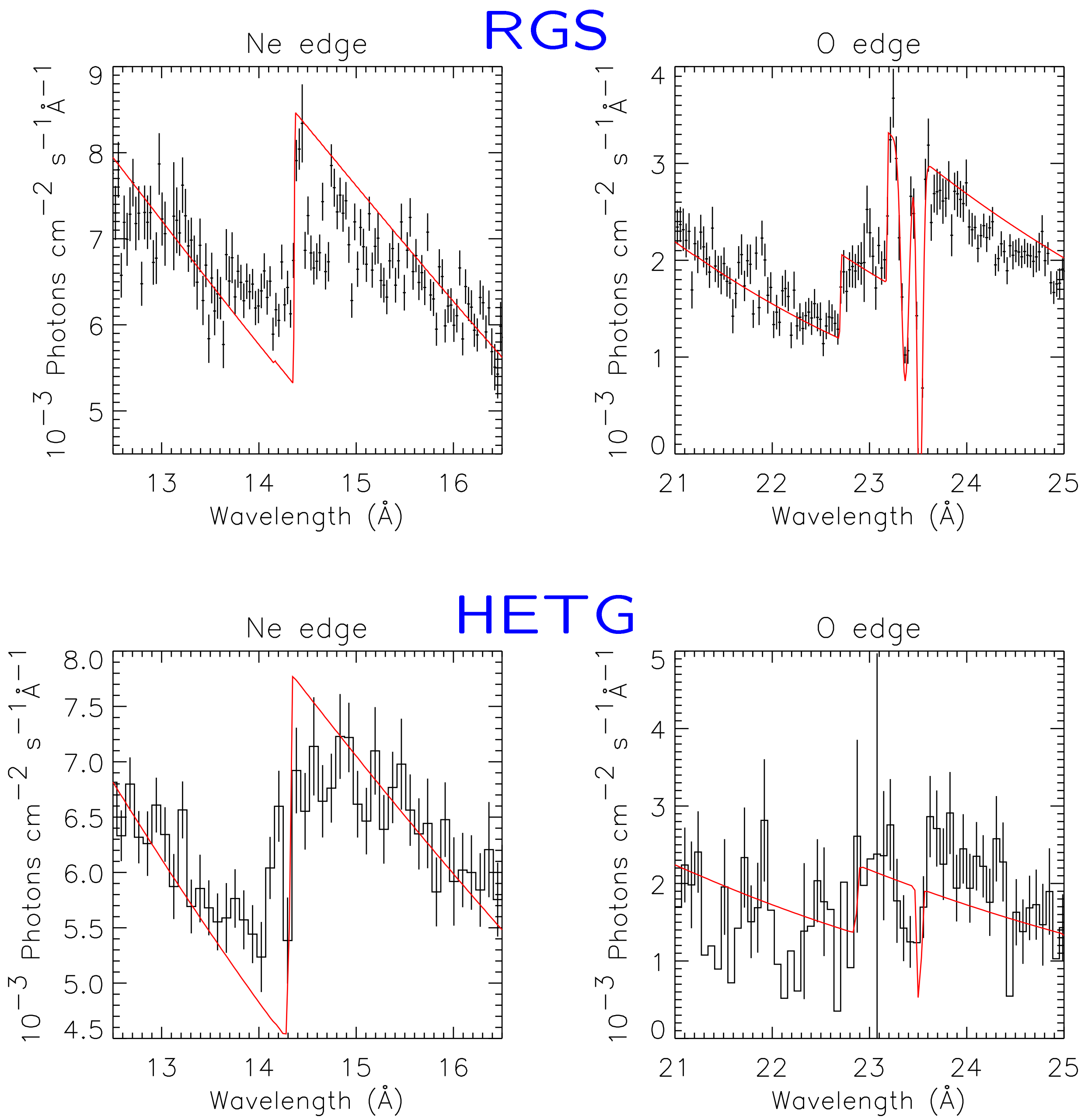


Variable O and Ne absorption

Ne/O ratios 0.9–1.1

(Ne/O in ISM = 0.18)

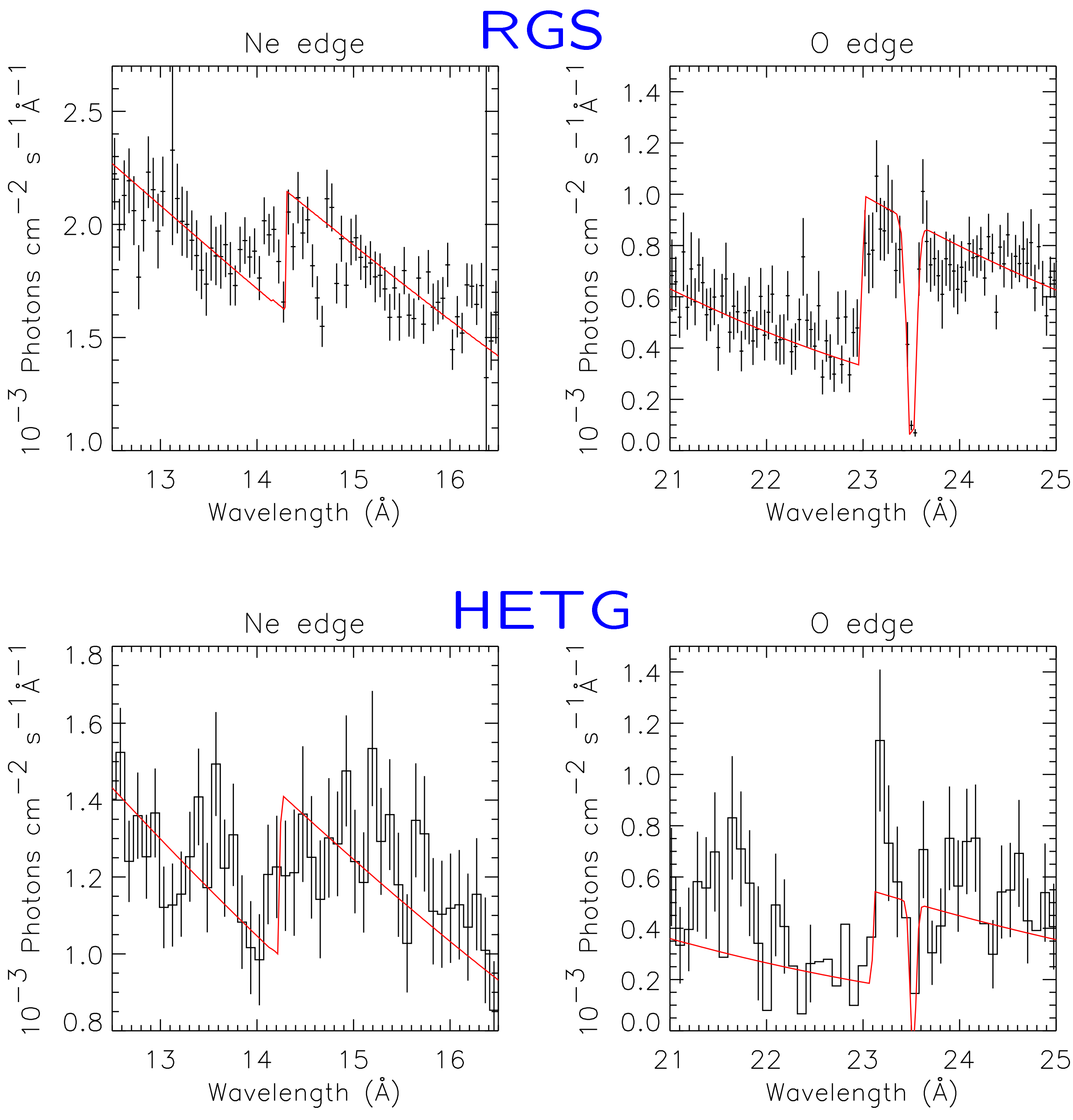
Grating Spectra of 4U 1543−624



XMM: Ne/O ratio 0.617±0.012

Chandra: Ne/O ratio 1.7±0.3

Grating Spectra of 2S 0918−549



XMM: Ne/O ratio 0.40±0.02

Chandra: Ne/O ratio 0.5±0.3

Caveats/Weak Points

- Is the material local?
- ISM Properties
  - Ne abundance not well known
  - Effect of dust grains
- Shape of Ne edge

Questions to Answer

- Where is this local material?
  Where does it come from?

- What are the properties of a C-O accretion disk?

- Why do they have "normal" X-ray bursts?

- How do such binaries form?