

Update on the White Dwarf (+ iNS) Working Group



Vadim Burwitz

International Astronomical Consortium
for High Energy Calibration
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WG Members

- White Dwarfs (Chair: Vadim Burwitz).

Current members:

- J.Drake (Chandra),
- F.Haberl (XMM-Newton/EPIC-pn),
- J.Kaastra (Chandra/LETG and XMM-Newton/RGS),
- H.Marshall (Chandra/HETG),
- N.Schultz (Chandra/HETG).

- Isolated Neutron Stars (Chair: Frank Haberl).

Current members:

- A.Beardmore (Swift/XRT),
- V.Burwitz (XMM-Newton/EPIC-pn, Chandra/LETGS),
- J.Cottam (XMM-Newton/RGS),
- C.de Vries (XMM-Newton/RGS),
- T.Dotani (Suzaku),
- E.Miller (Suzaku/XIS),
- S.Sembay (XMM-Newton/EPIC-MOS).

Overview

- Why White Dwarfs and iNS
- Isolated Neutron Stars
 - WG little activity since last 2 IACHECs
- White Dwarfs
 - in full action, busy completing analysis of reprocessed and new data HZ 43, Sirius B and GD153 using CIAO 4.3 CALDB 4.4.3
- Status of home work from IACHEC 2010!

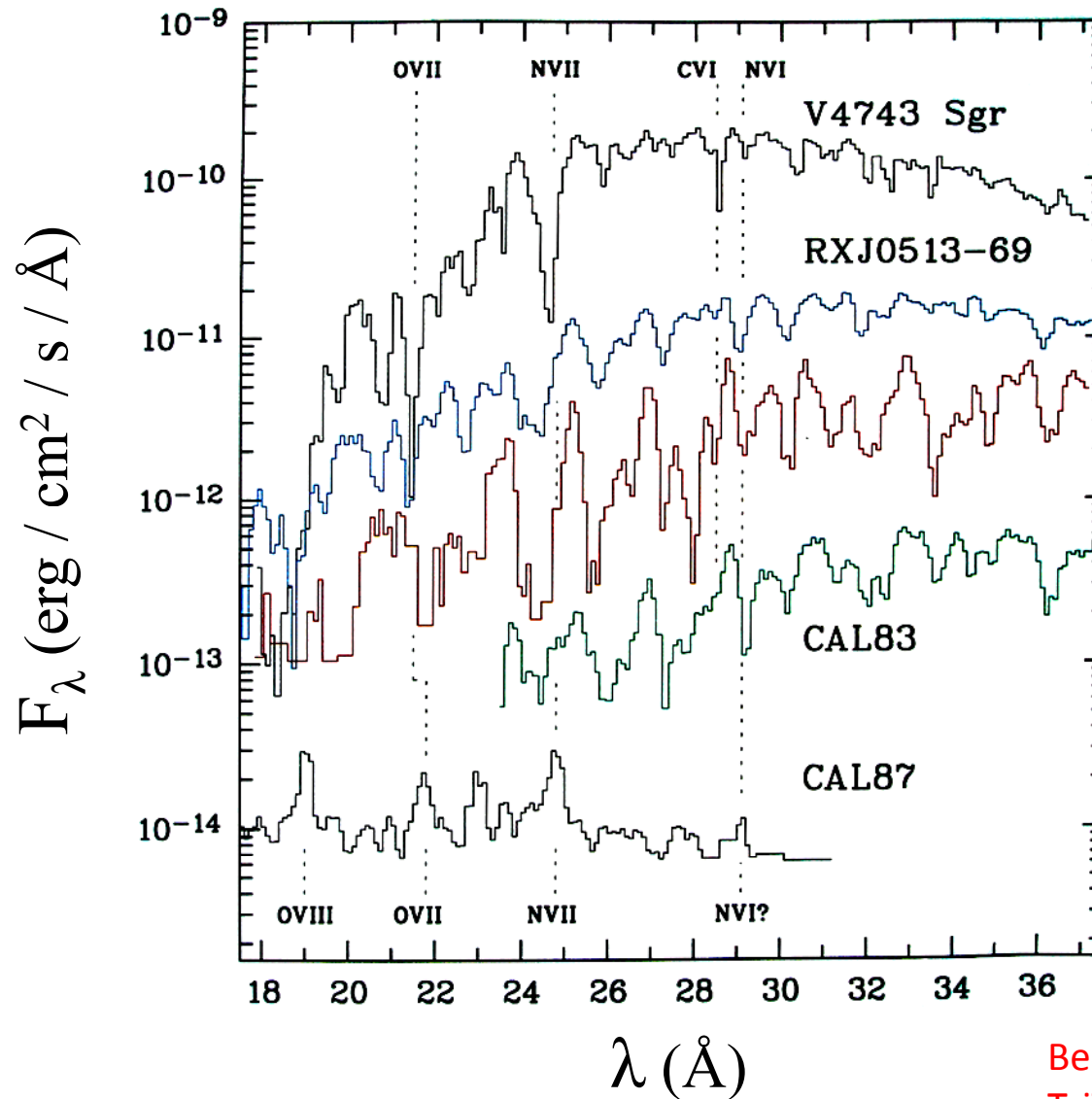
Why calibration at soft X-rays

- Absolute Calibration between

→ Chandra, XMM, ROSAT, EUVE

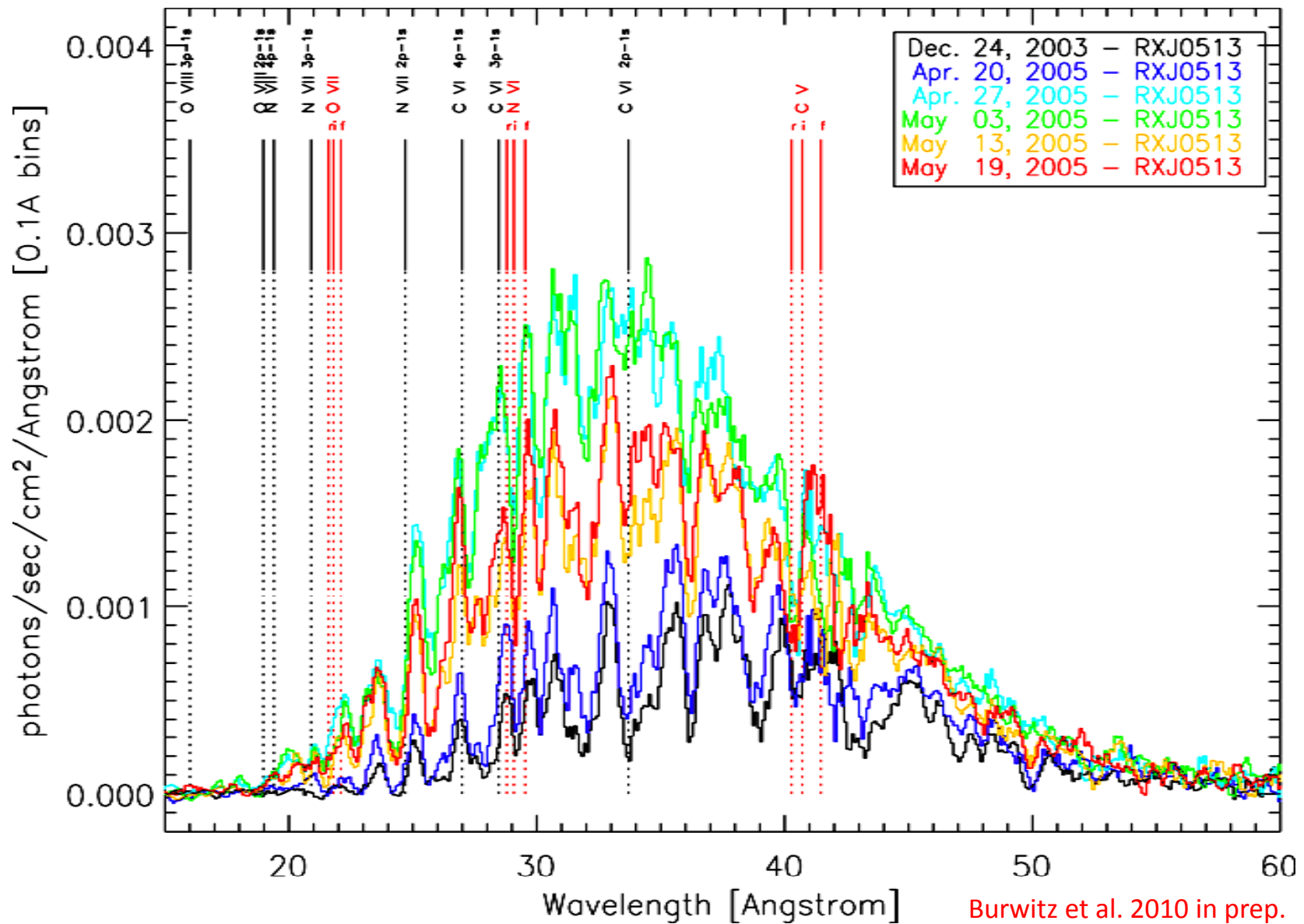
- Important for better as diverse objects as:
 - White Dwarfs
 - Magnetic CVs
 - Novae
 - Supersoft sources
 - Diffuse emission
 - Soft end of spectra of of INS and
bright powerlaw sources

RX J0513-69 vs. other Super-soft sources



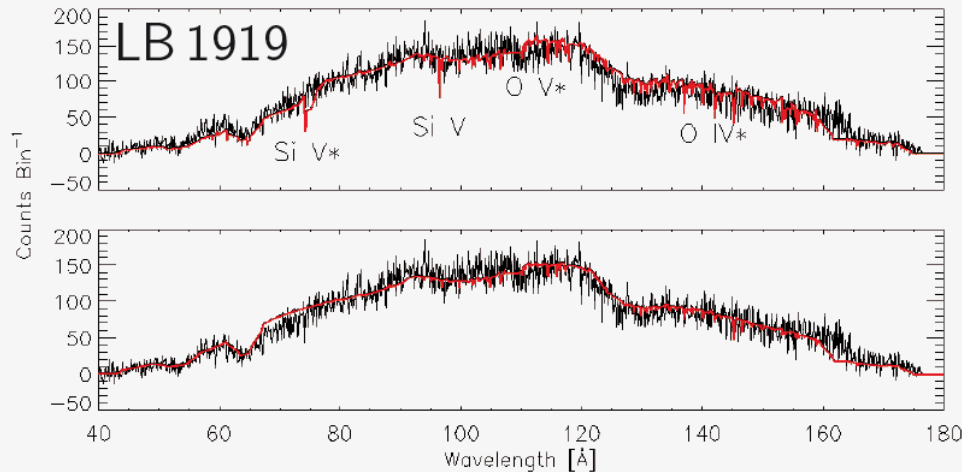
Beuermann in
Trümper & Hasinger 2008

RX J0513-69 LETGS spectra



LB1919 and GD146

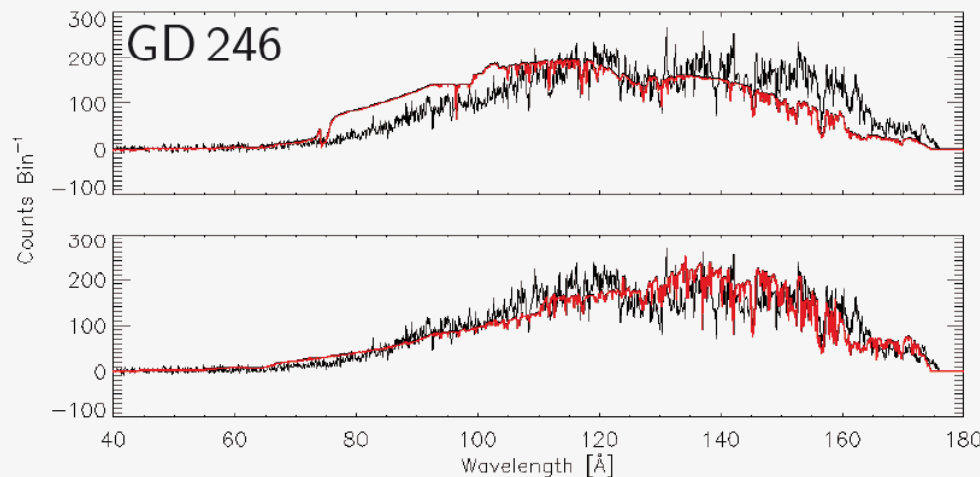
Adamczak et al. 2010



$T_{\text{eff}} = 56\,000\text{ K}$, $\log g = 8.5$
homogeneous

metal poor DA white dwarf

$T_{\text{eff}} = 52\,000\text{ K}$, $\log g = 8.5$
diffusion



$T_{\text{eff}} = 55\,000\text{ K}$, $\log g = 7.3$
homogeneous

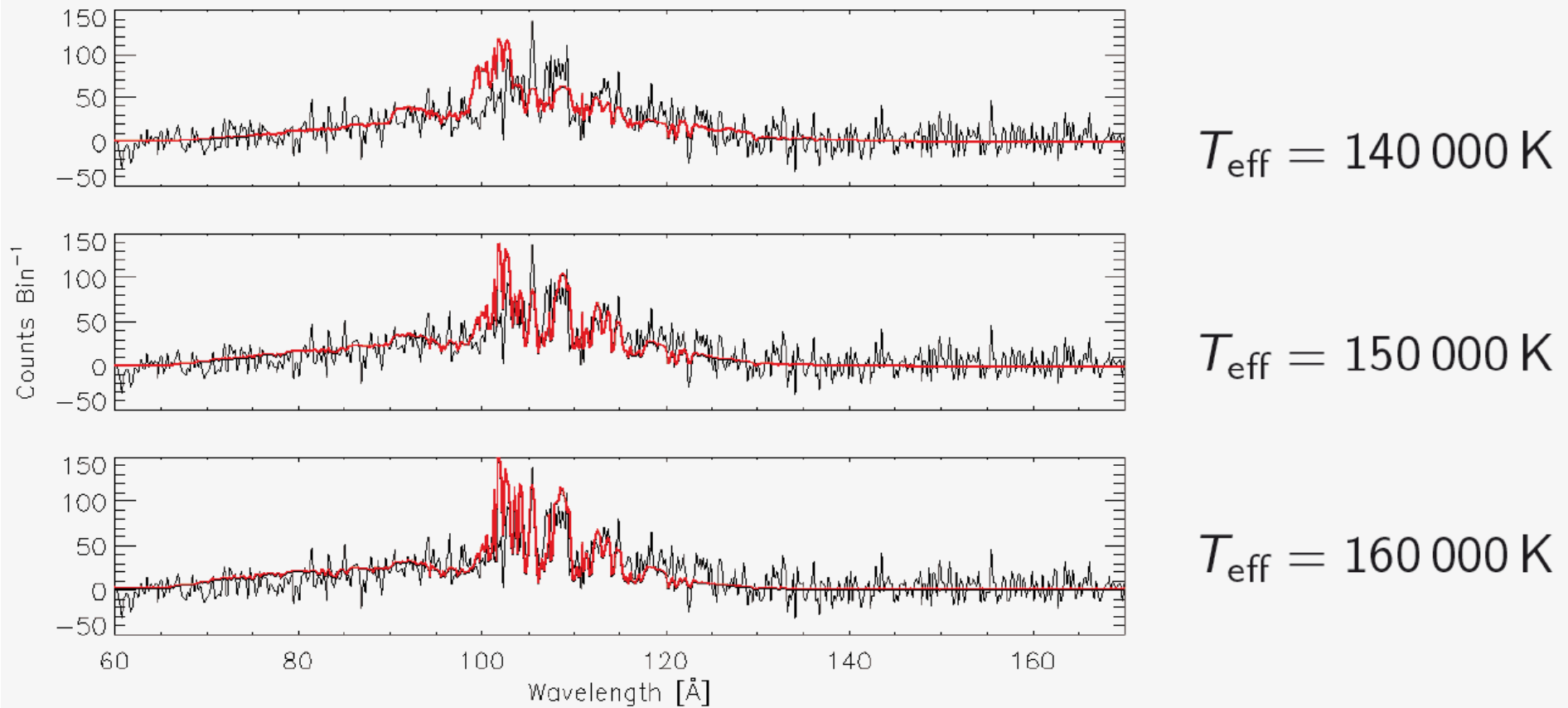
DA white dwarf

$T_{\text{eff}} = 55\,000\text{ K}$, $\log g = 7.9$
diffusion

PG 1520+525

Adamczak et al. 2010

PG 1520+525: He, C, O, Ne, Mg, $\log g = 7.5$ a non-pulsating PG 1159 star



Absolute Calibration at Soft X-rays

- is dependant on model spectra of WDs and iNS
- what models to use? → physical vs. descriptive
- uncertainties?

Beuermann et al. 2006, A&A 458, 541

Beuermann et al. 2008, A&A 481,769

Rauch et al. 2008, A&A 481,807

Kaastra et al. 2009, A&A 497,311

Detailed iNSs were given at the last IACHEC #5 by

→ Valery Suleimanov

This will be detailed WDs in the next talk today by

→ Thomas Rauch

Parameters obtained from fit

Beuermann et al. 2006, 2008

Parameter	Value±Error
(a) HZ43 A ($\lambda = 45 - 160 \text{ \AA}$)	
T_{eff} (K)	51126 ± 660
$\log g$	7.90 ± 0.08
R^2/d^2 (10^{-23})	3.011 ± 0.010
N_{HI} (10^{17} cm^{-2})	8.91 ± 0.37
(b) Sirius B ($\lambda = 74 - 160 \text{ \AA}$)	
T_{eff} (K)	24923 ± 115
$\log g$	$8.6 f^1$
R^2/d^2 (10^{-21})	4.877 ± 0.010
N_{HI} (10^{17} cm^{-2})	6.5 ± 2.0^2
(c) RX J1856 ($\lambda = 15 - 74 \text{ \AA}$)	
kT_{spot} (eV)	62.83 ± 0.41
kT_{star} (eV)	32.26 ± 0.72
R_1/d (km/pc)	0.0378 ± 0.0003
R_2/d (km/pc)	0.1371 ± 0.0010
N_{HI} (10^{20} cm^{-2})	1.10 ± 0.03

Table 2. Parameters of HZ43 A, Sirius B, and RX J1856 based on the simultaneous fit of our model spectra to the LETG+HRC count rate spectra in the wavelength intervals given. The quoted 1- σ ($\Delta\chi^2 = +1$) errors are correlated and derived from fits with the other parameters for each object kept free. The letter *f* indicates: fixed.

¹ Based on Barstow et al. (2005); Holberg et al. (1998)

² Hébrard et al. (1999). Our fit is required to stay within the 1- σ error.

Simultaneous fit to RXJ1856 and the WDs

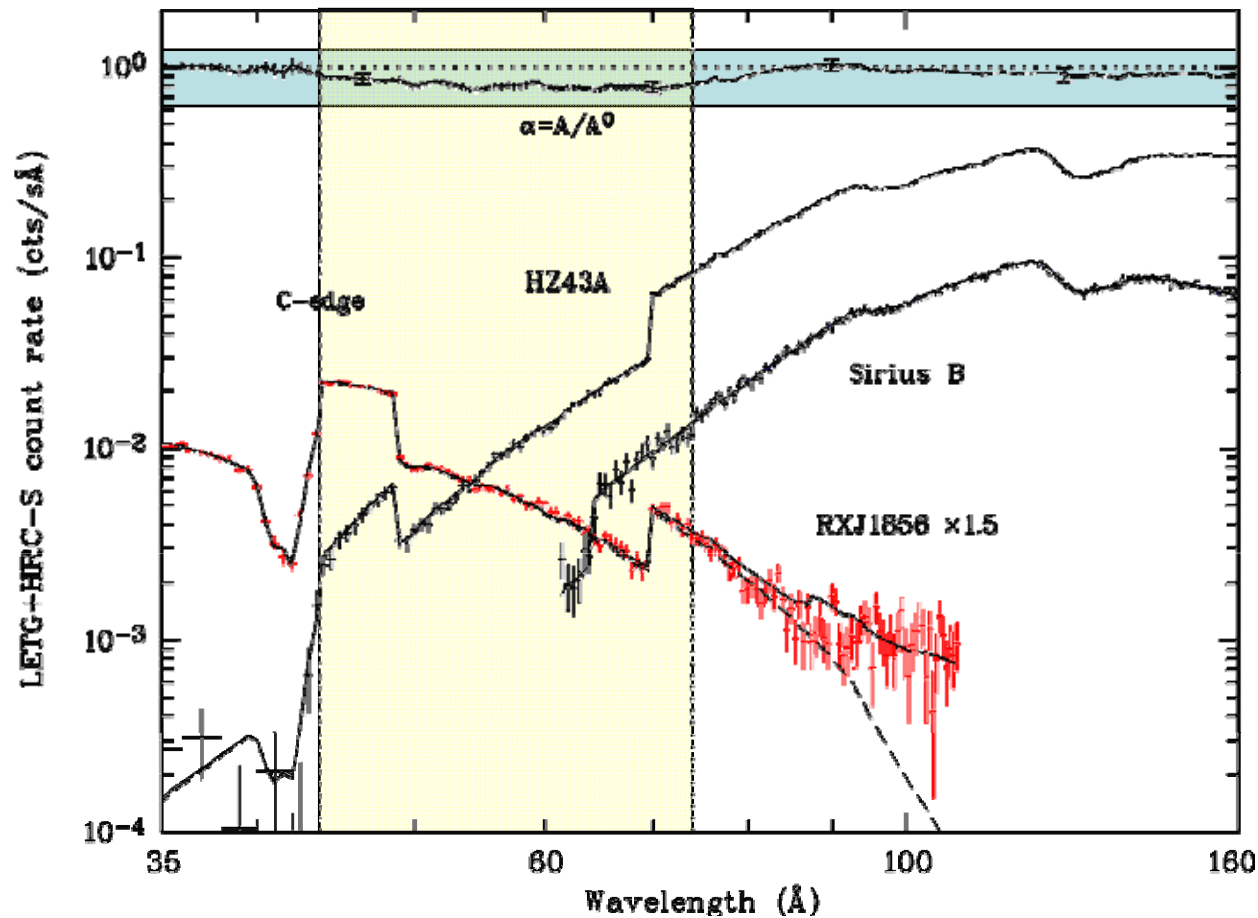
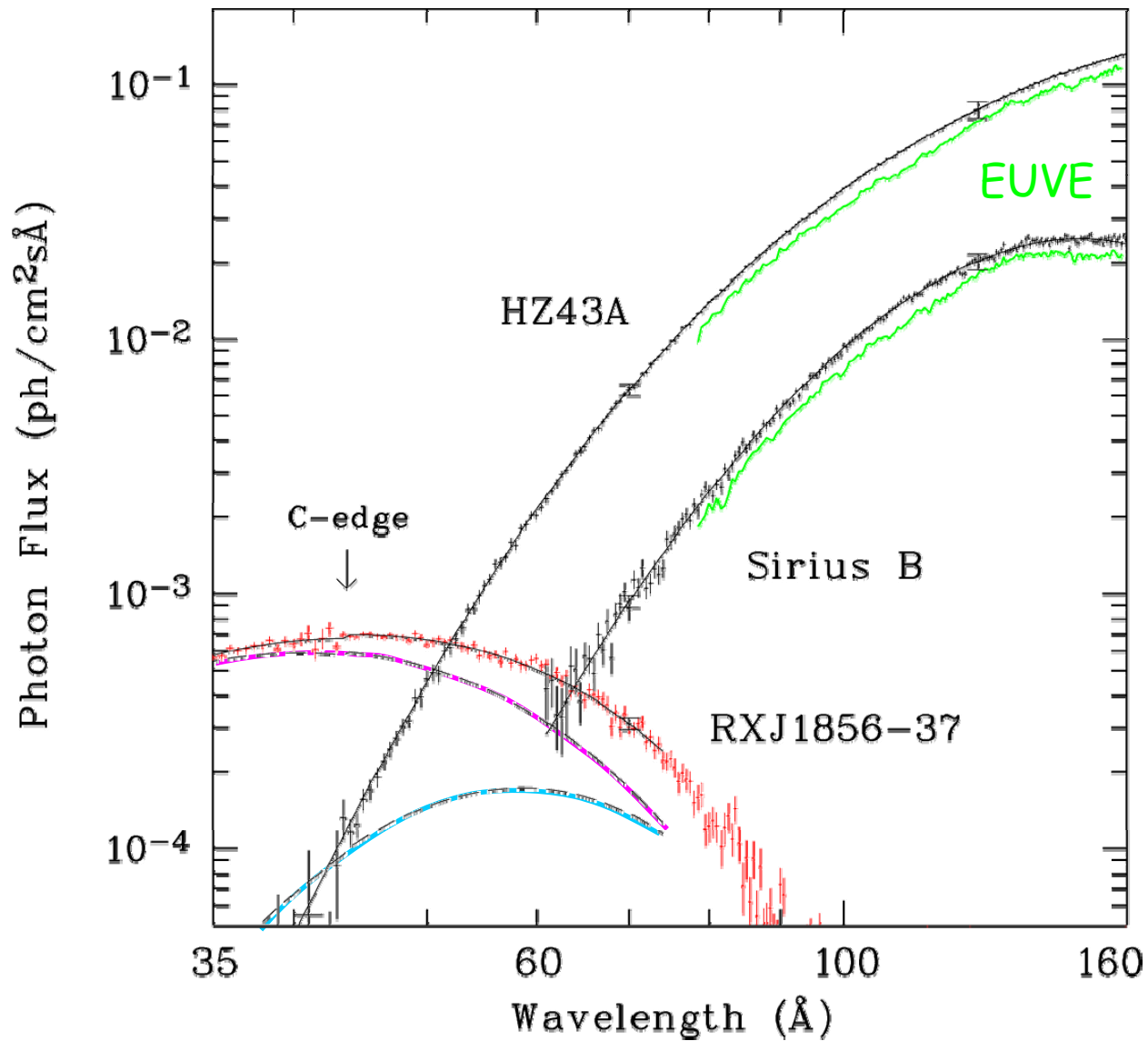


Fig. 5. Simultaneous fit of RXJ1856, HZ43 A, and Sirius B in the wavelength ranges marked by vertical dotted lines (see Sect. 4.4.2). The LETG spectra binned to 0.5\AA are shown as data points, the corresponding best-fit models as solid curves, and the first-order contributions as dashed curves. The area correction function α is shown at the top. It converts the nominal LETG+HRC-S first-order effective area A^0 of the November 2004 release into the adjusted area A used in this paper. Systematic uncertainties in α are indicated by error bars at 46, 70, 90, and 125\AA . The steps in the count rate spectra of HZ43 A and RXJ1856 at 49 and 69\AA result from the detector gaps. Sirius B was observed off axis and its gaps are located differently (see text).

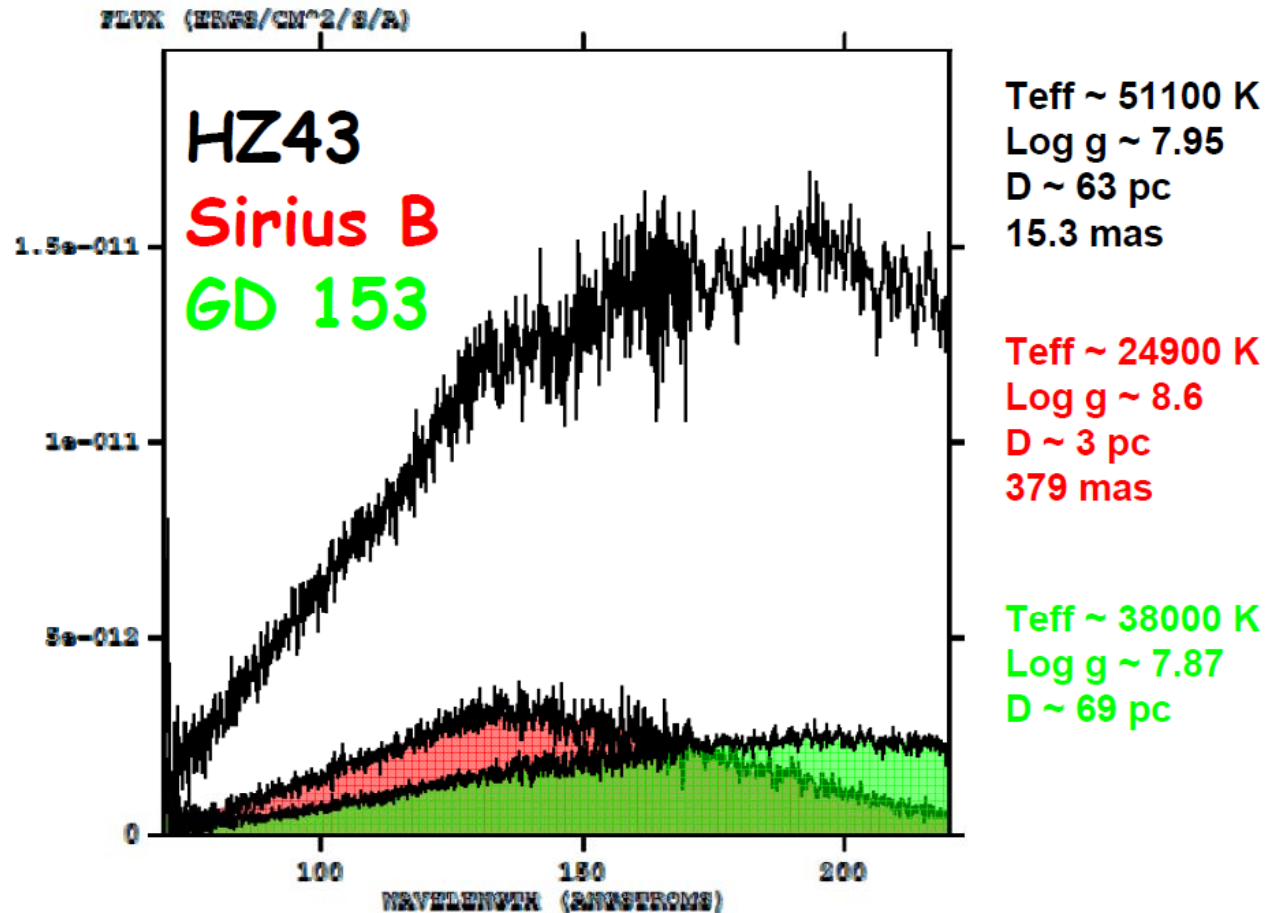
Beuermann et al. 2006, 2008

Comparison of photon spectra

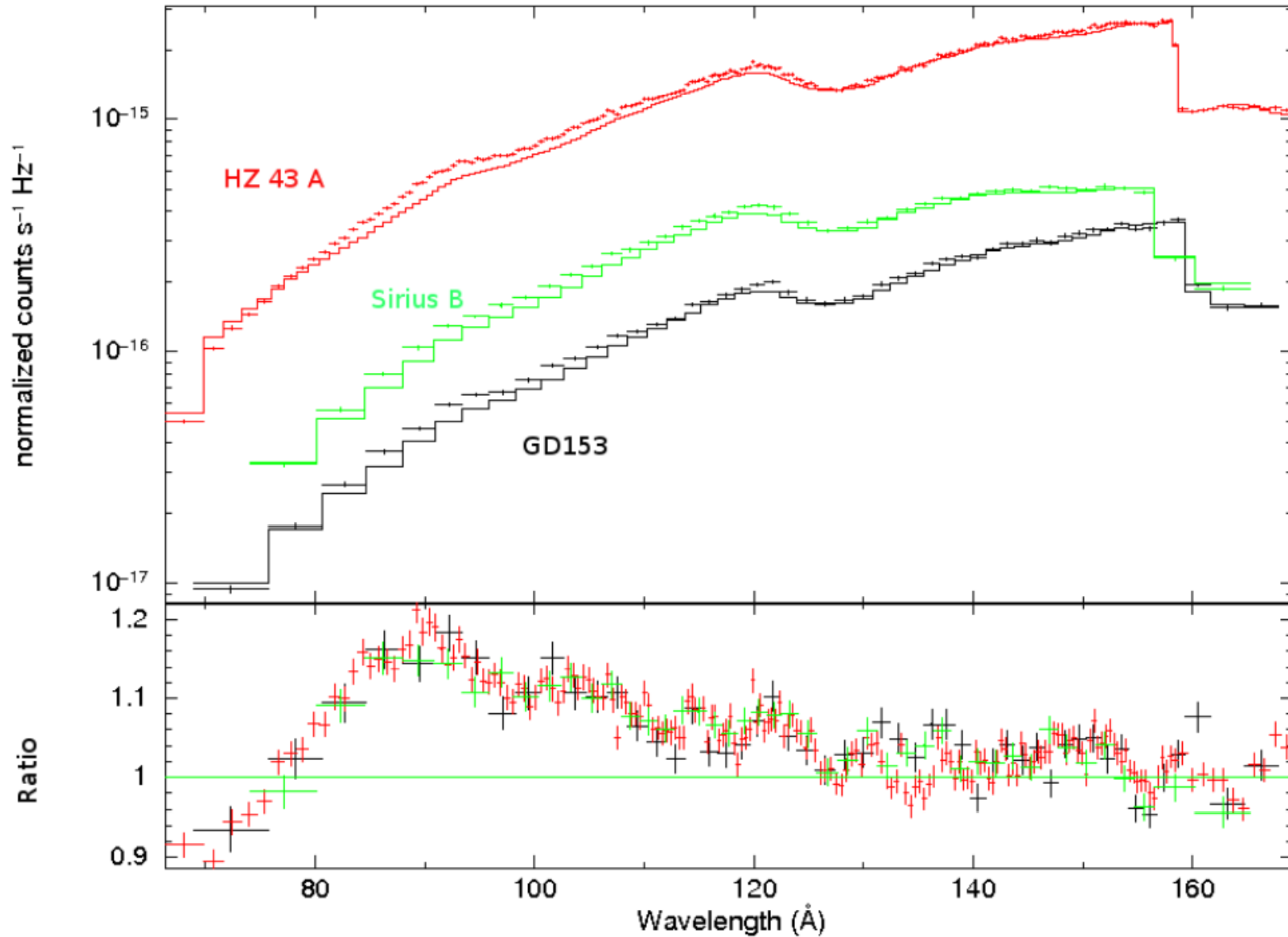


Beuermann et al. 2006, 2008

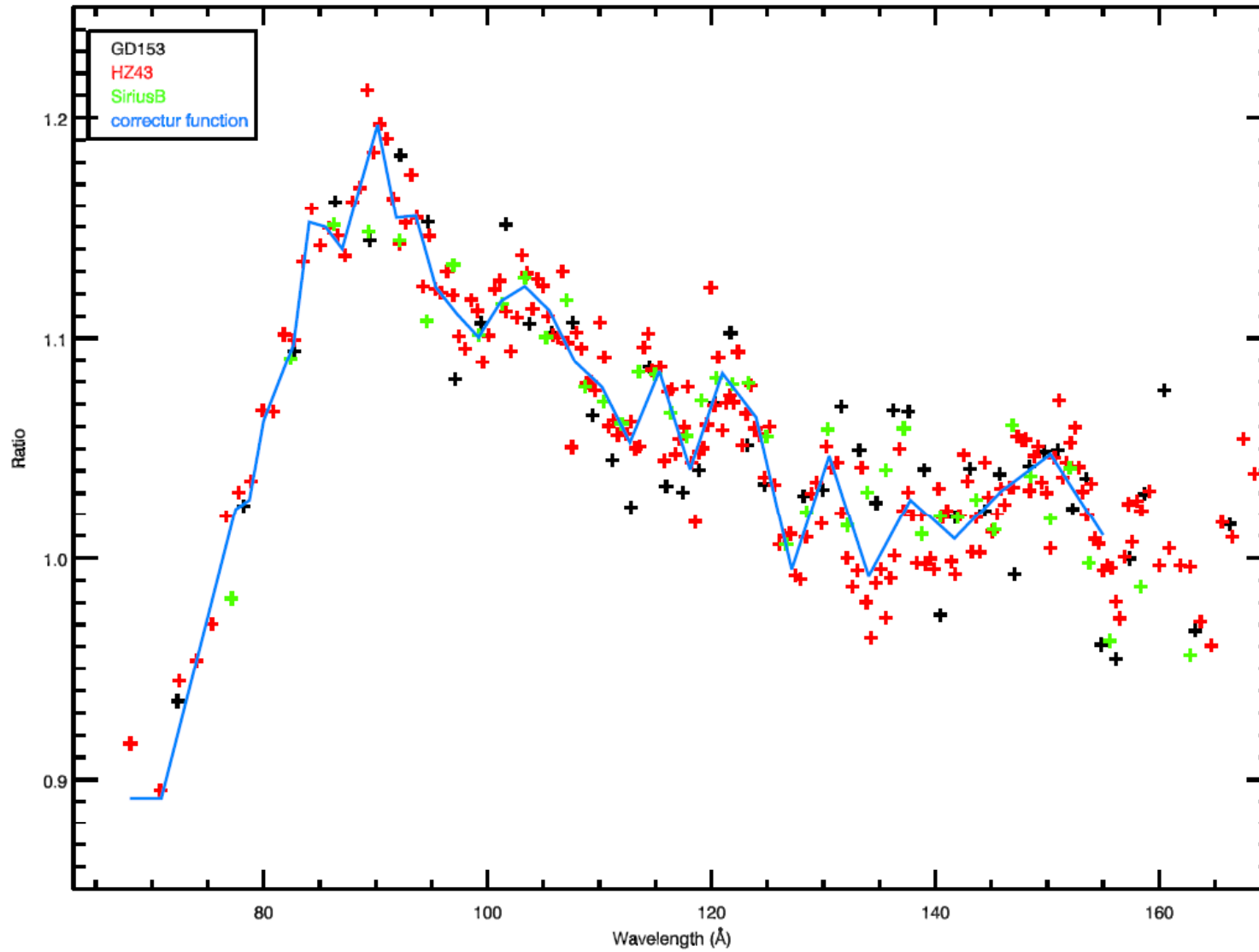
Comparison of EUVE data of WDs



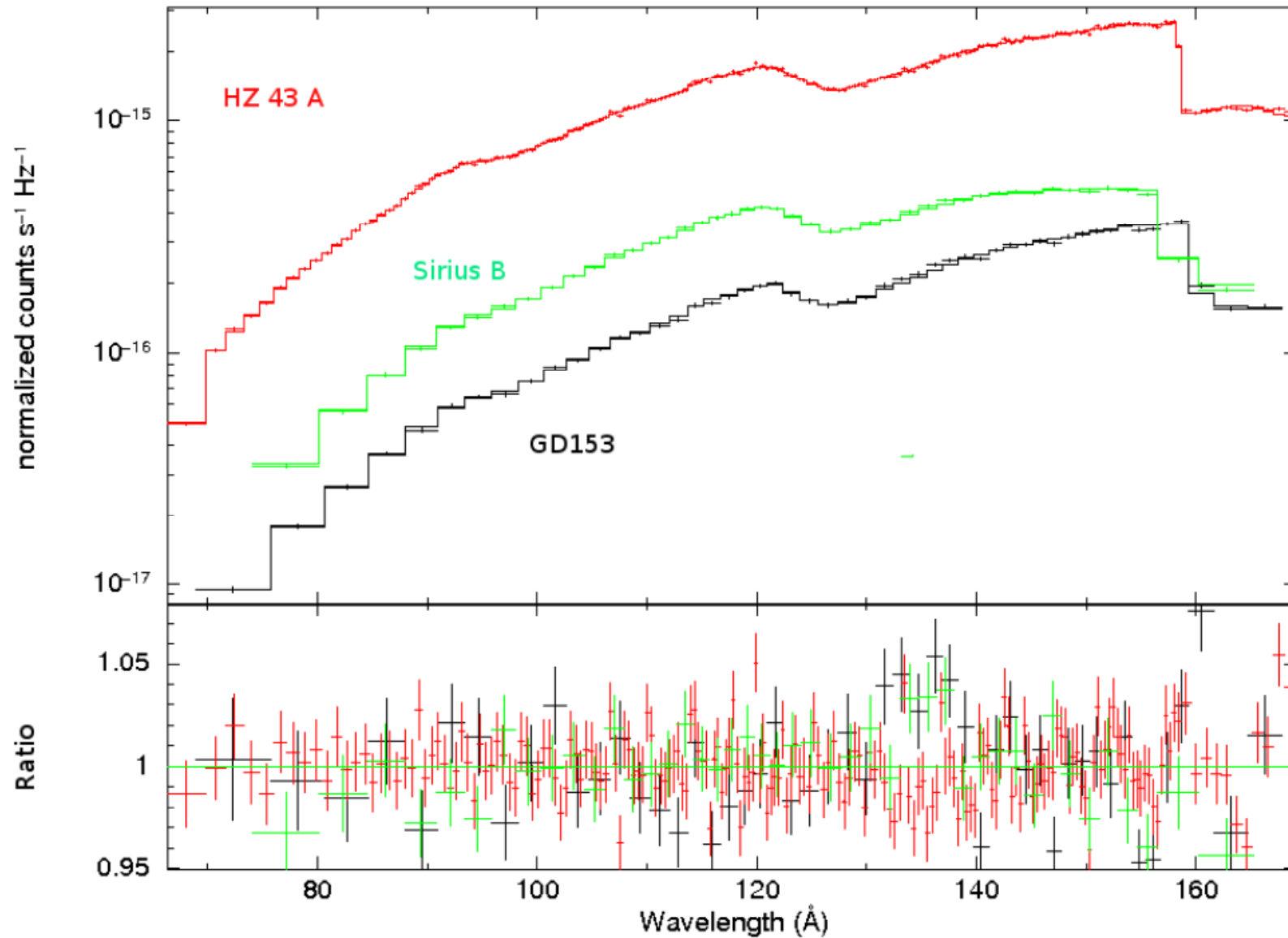
HZ43, Sirius B and GD153



Correction function for LETGS



HZ43, Sirius B and GD153



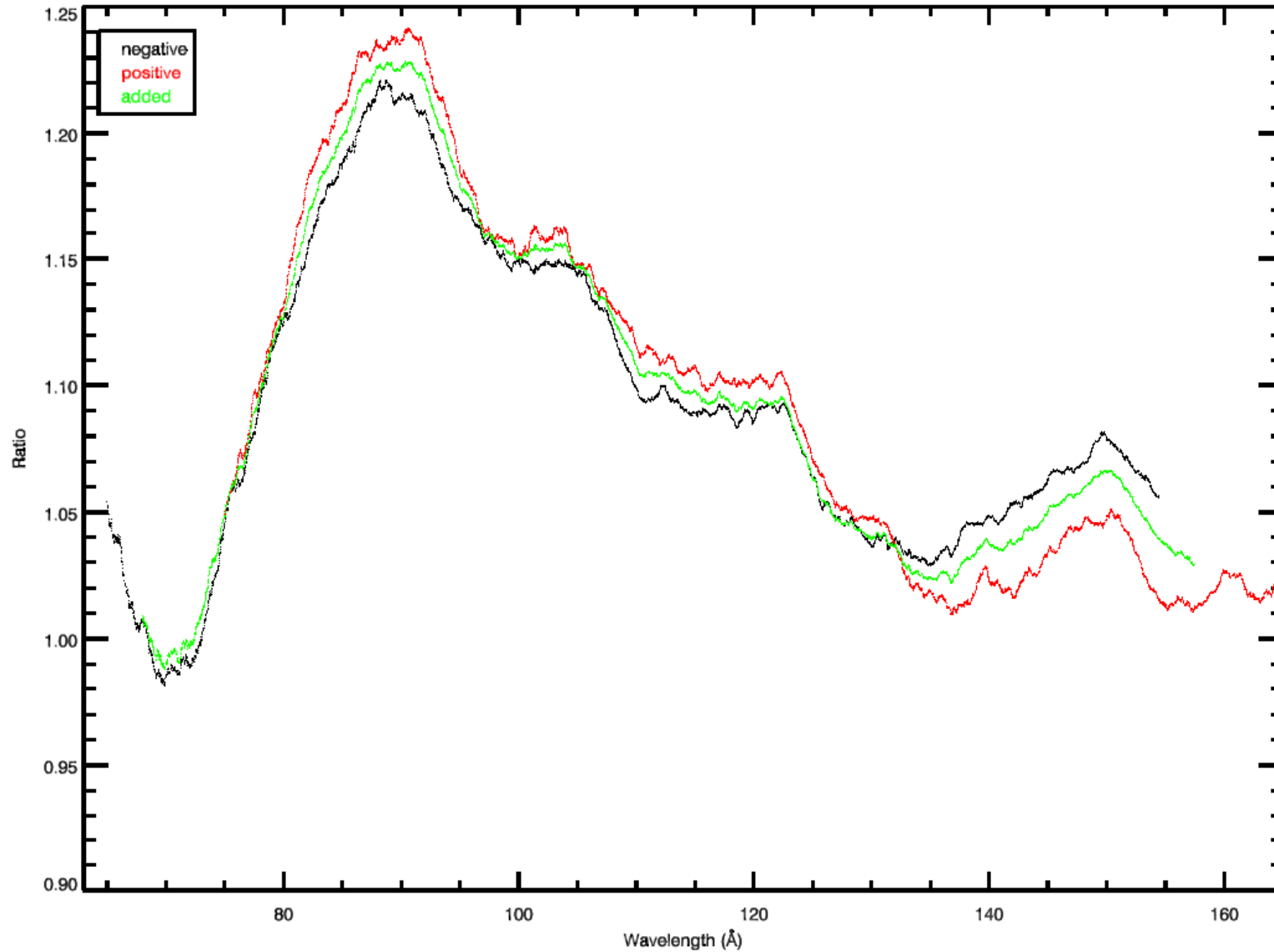
Reprocessed Chandra LETGS HZ43, Sirius B and GD153 white dwarf Spectra

Target	nH [10^{22} cm^{-2}]	T [K]	Norm	Log g [cm/s^2]
GD 153	$<3.2 \times 10^{-4}$	41000 +/- 2000	0.50 +/- 0.22	7.8
HZ 43	$<2.6 \times 10^{-4}$	49800 +/- 2200	1.12 +/- 0.43	7.9
Sirius B	$<2.5 \times 10^{-4}$	25300 +/- 300	117 +/- 16	8.6

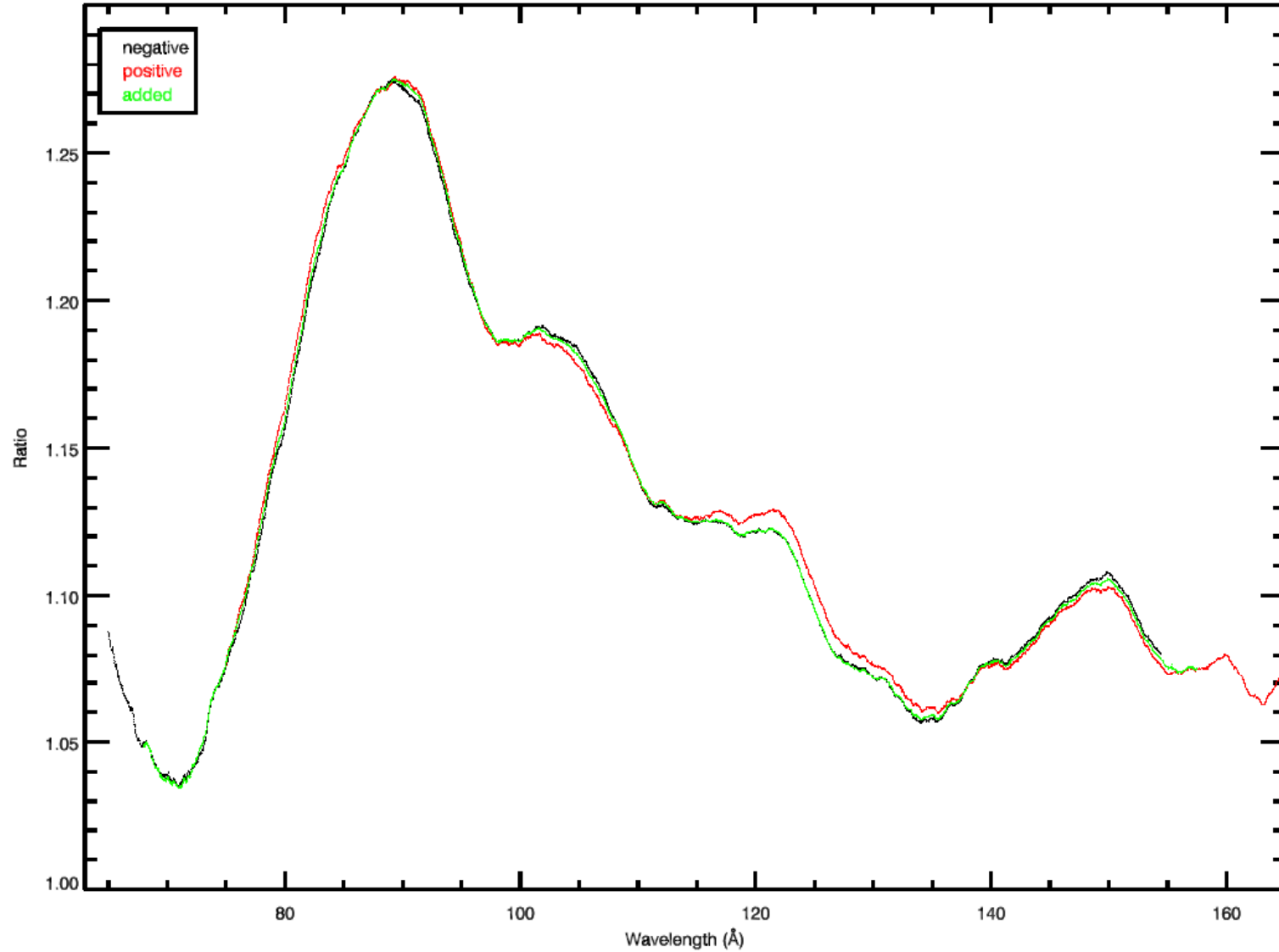
Chandra LETGS HZ43 observations

Obs ID	Date	Exp (ks)	GTI (ks)
00059	1999-11-12	40	35
01011	2001-03-18	20	16
01012	2001-08-18	20	18
02584	2002-01-01	20	16
02585	2002-07-23	20	18
03676	2002-04-12	20	15
03677	2003-07-24	20	16
05042	2003-12-20	20	20
05044	2004-07-19	20	19
05957	2005-02-02	20	10
05959	2005-07-29	20	8
06473	2006-03-13	20	19
06475	2006-08-07	20	11
08274	2007-03-14	20	19
10622	2009-03-18	20	17
11933	2010-03-15	20	17
	Total	340	

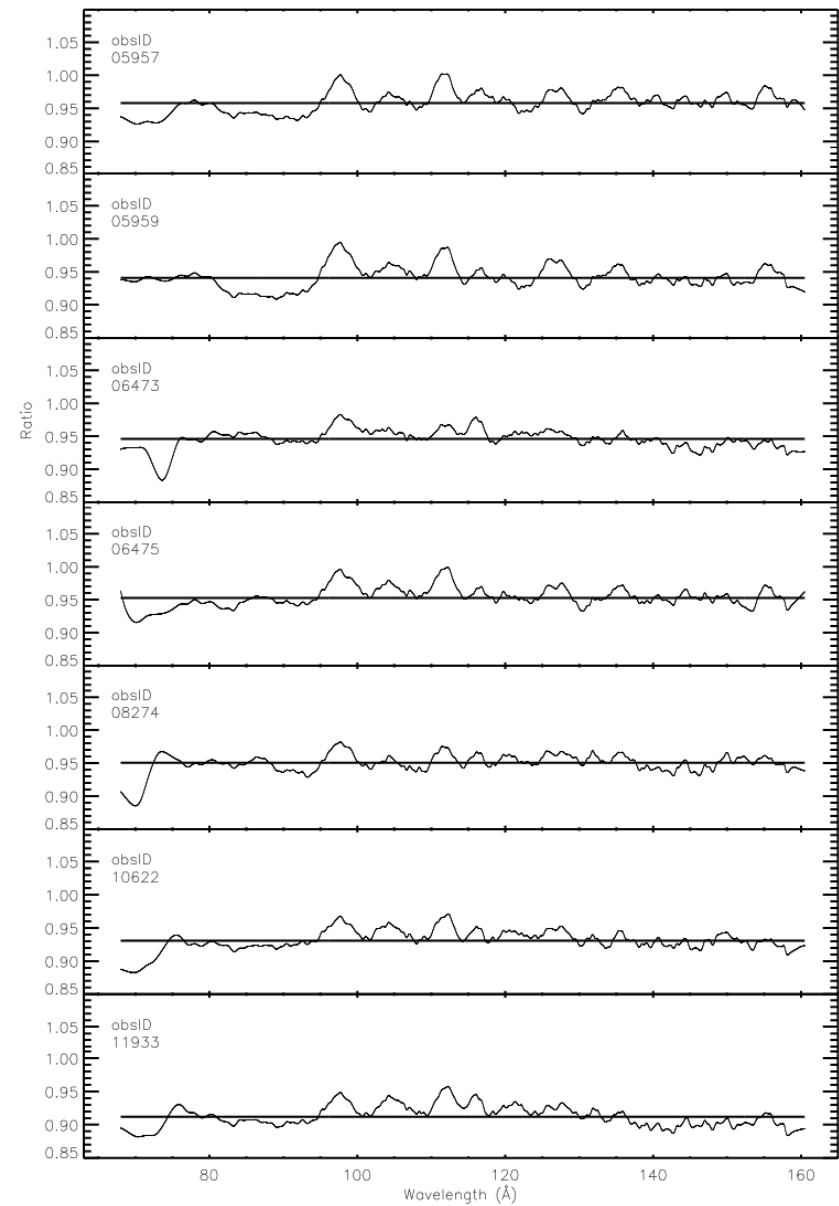
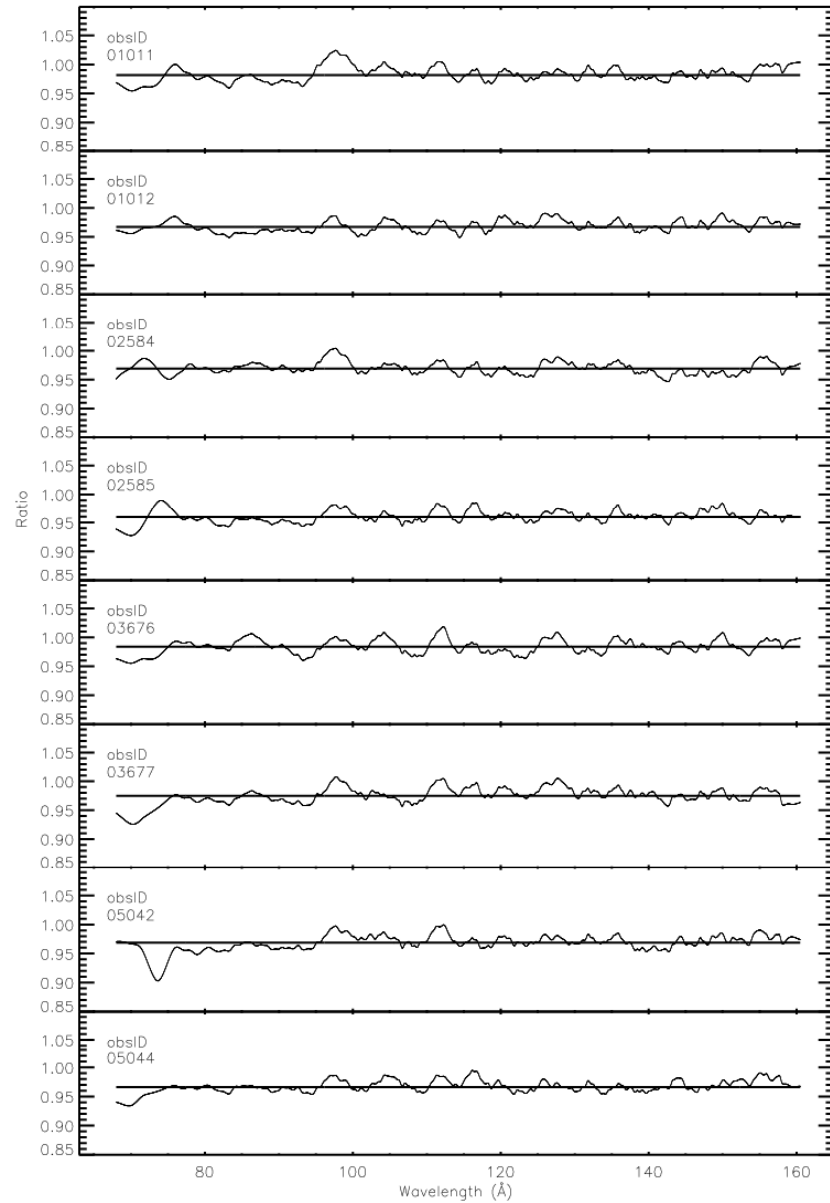
HZ43 on-axis 2007-2010



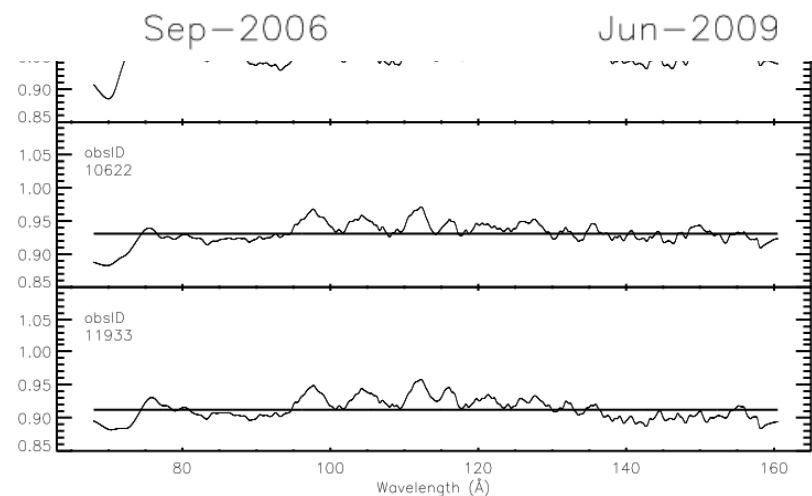
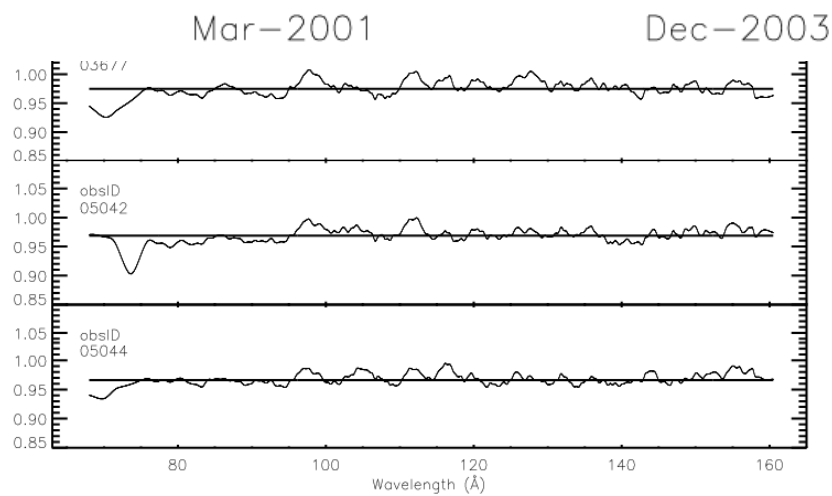
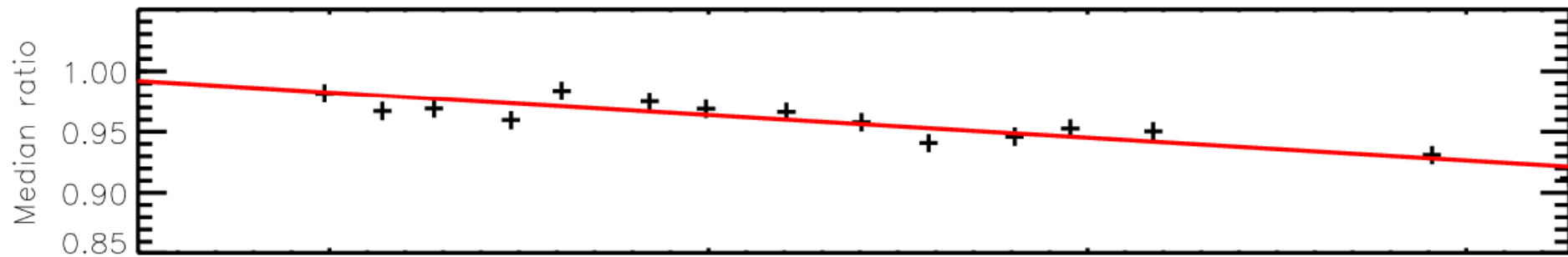
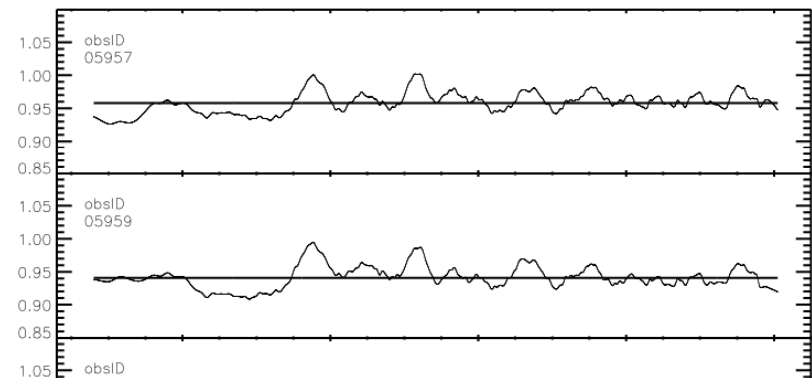
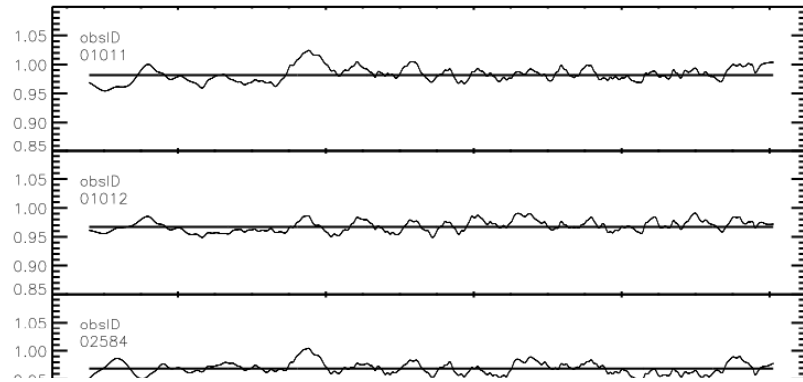
HZ43 on-axis 1999-2010



HZ43 time dependence



HZ43 time dependence



Chandra LETGS *Sirius B* observations

Obs ID	Date	Exp (ks)	GTI (ks)
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off axis observations

01421	1999-10-28	25	14
01452	1999-10-26	28	13
01459	1999-10-27	12	12

on axis observations detector edge

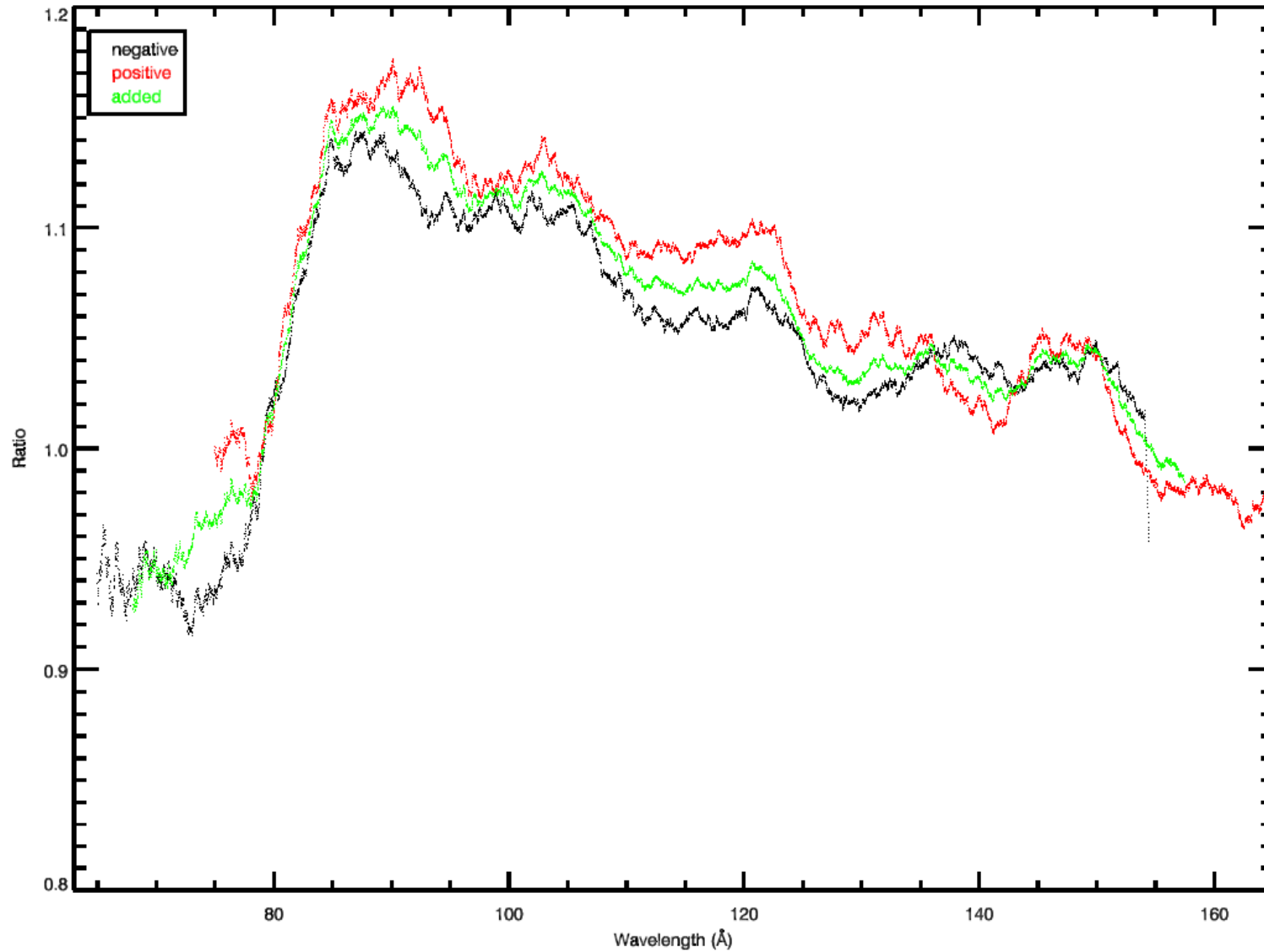
09617	2008-01-17	47	37
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on axis observations

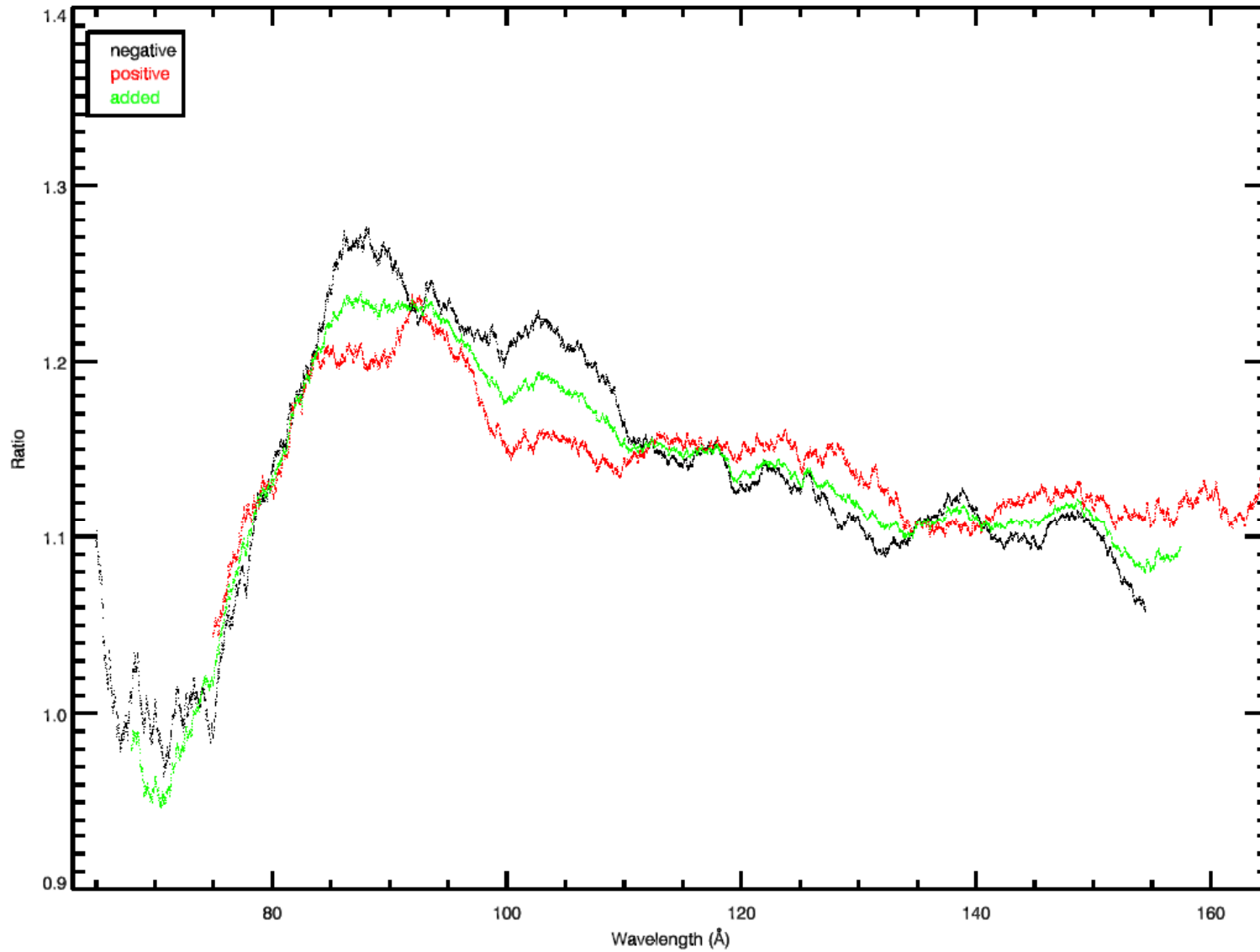
09815	2008-05-26	51	50
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Total		163	126
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Sirius B ratio on-axis



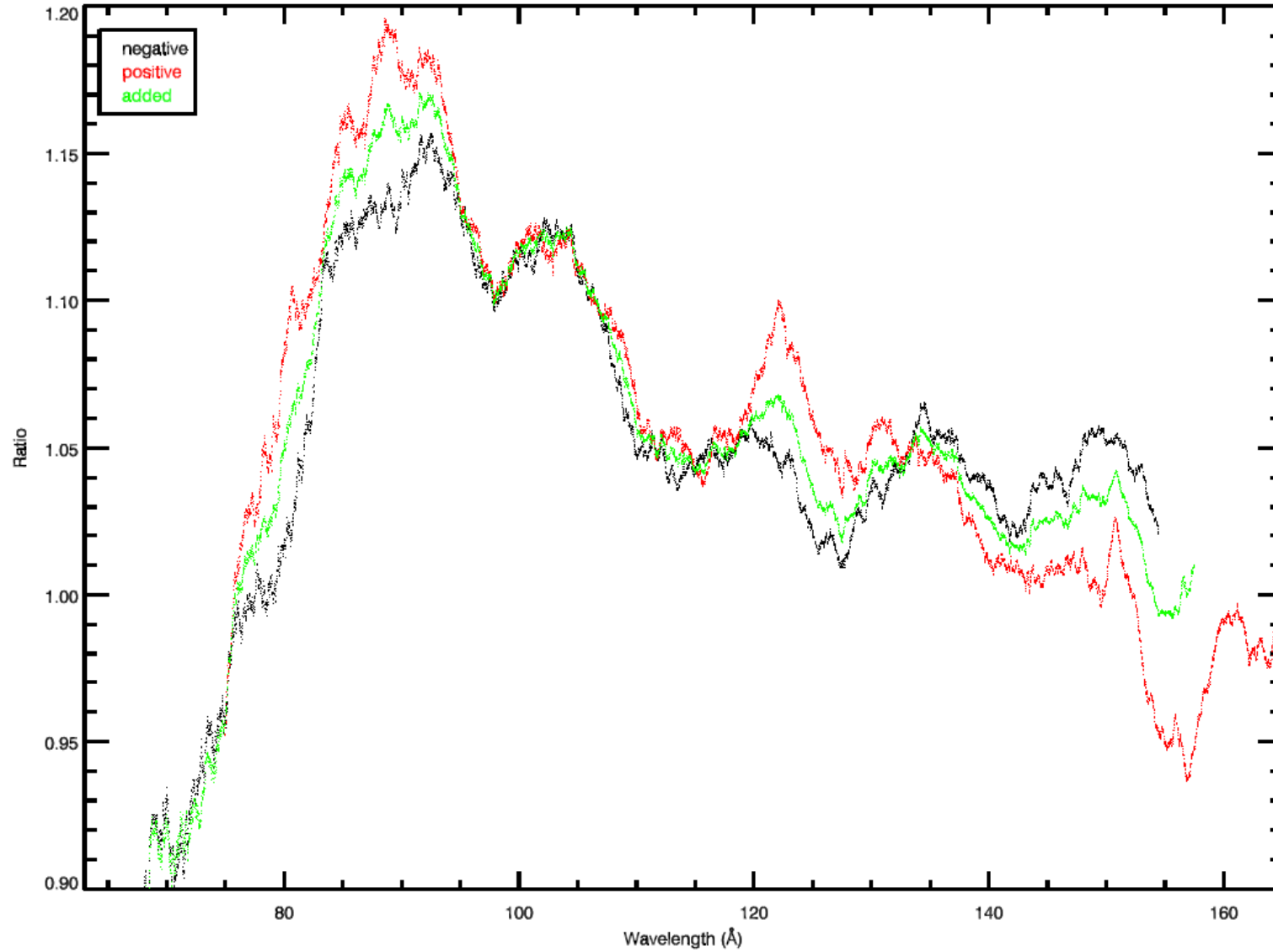
Sirius B ratio off-axis



Chandra LETGS GD153 observations

Obs ID	Date	Exp (ks)	GTI (ks)
11805	2010-03-29	25	24
12132	2010-03-30	45	28
12133	2010-04-01	49	46
Total		119	98

GD153 ratio on-axis



Home work from IACHEC 2009

- Discuss possible Chandra LETGS improvements with Chandra calibration Group
 - influence of new HRMA effective areas ...
- Analyse LETGS data on
 - Sirius B (50ks on-axis and 50ks off-axis observations)
- GD153 110ks observation in the queue
 - Prepare grid of models (Lanz, Rauch)
 - analyse data as soon as available.
- Provide WD spectra in xspec format on web
- Improve link to iNS RXJ1856

Home work from IACHEC 2009

- Discuss possible Chandra LETGS improvements with Chandra calibration Group
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 - Sirius B (50ks on-axis and 50ks off-axis observations)
- GD153 110ks observation in the queue
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**GD153 110ks LETGS
Observation just performed**

Home work from IACHEC 2009/2010

- Discuss possible Chandra LETGS improvements with Chandra calibration Group
 - influence of new HRMA effective areas ...
- Analyse LETGS data on
 - Sirius B (50ks on-axis and 50ks off-axis)
- GD153 110ks observation in the queue
 - Prepare grid of models (Larsson et al 2008)
 - analyse data as soon as available
- Provide WD spectra in xspec format on web
- Improve link to iNS RXJ1856

Sirius B on/off axis LETGS comparison beeing done

GD153 110ks LETGS Analysis in full swing

Summary

→ Other Calibration Observations

- Chandra Calibration data
 - Sirius B in 2008 (off axis, on axis).
 - HZ 43 regular observations
 - no Chandra LETGS INS RXJ1856 observation has been done since the 500 ks observation , XMM and SWIFT observe it regularly.

→ Recent observations

- Joint SRON (Kaastra) /MPE (Predehl) /CXC (Murray)
 - 110 ks Chandra LETGS observation of the white dwarf GD153 results presented here
- WG Meeting
 - Meet to discuss about the GD153 data and reprocessed observations.