Cross-calibration results from reanalysis of observations of the WDs HZ 43 and Sirius B

Vadim Burwitz

International Astronomical Consortium
for High Energy Calibration
May 19-21 2008, Ringberg Castle

Absolute Calibration Soft X-rays

- Absolute Calibration Soft X-rays
  - dependant on model spectra of WDs
  - what models to use?
  - uncertainties?

Beuermann et al. 2006, A&A 458, 541
Beuermann et al. 2008, A&A 481, 769

→ discrepancies between different Model spectra found

TMAP – TLUSTY

Absolute Calibration Soft X-rays

→ New work done

- Thomas Rauch (2008, A&A 481,807)

  → *„Uncertainties in (E)UV model atmosphere Fluxes“*

- Jelle Kaastra et al. (2008, A&A in press)

  → *„Effective Area calibration of RGS on XMM.*

  II. X-ray spectroscopy of DA white dwarfs“

Uncertainties in (E)UV model atmosphere fluxes (Research Note)

Thomas Rauch, Tübingen 2008, *A&A* 481, 807

Context. During the comparison of synthetic spectra calculated with two NLTE model atmosphere codes, namely *TMAP* and *TLUSTY*, we encounter systematic differences in the EUV fluxes due to the treatment of level dissolution by pressure ionization.

Aims. In the case of Sirius B, we demonstrate an uncertainty in modeling the EUV flux reliably in order to challenge theoreticians to improve the theory of level dissolution.

Methods. We calculated synthetic spectra for hot, compact stars using state-of-the-art NLTE model-atmosphere techniques.

Results. Systematic differences may occur due to a code-specific cutoff frequency of the HI Lyman bound-free opacity. This is the case for *TMAP* and *TLUSTY*. Both codes predict the same flux level at wavelengths lower than about 1500 Å for stars with effective temperatures (*Teff*) below about 30 000 K only, if the same cutoff frequency is chosen.

Conclusions. The theory of level dissolution in high-density plasmas, which is available for hydrogen only should be generalized to all species. Especially, the cutoff frequencies for the bound-free opacities should be defined in order to make predictions of UV fluxes more reliable.

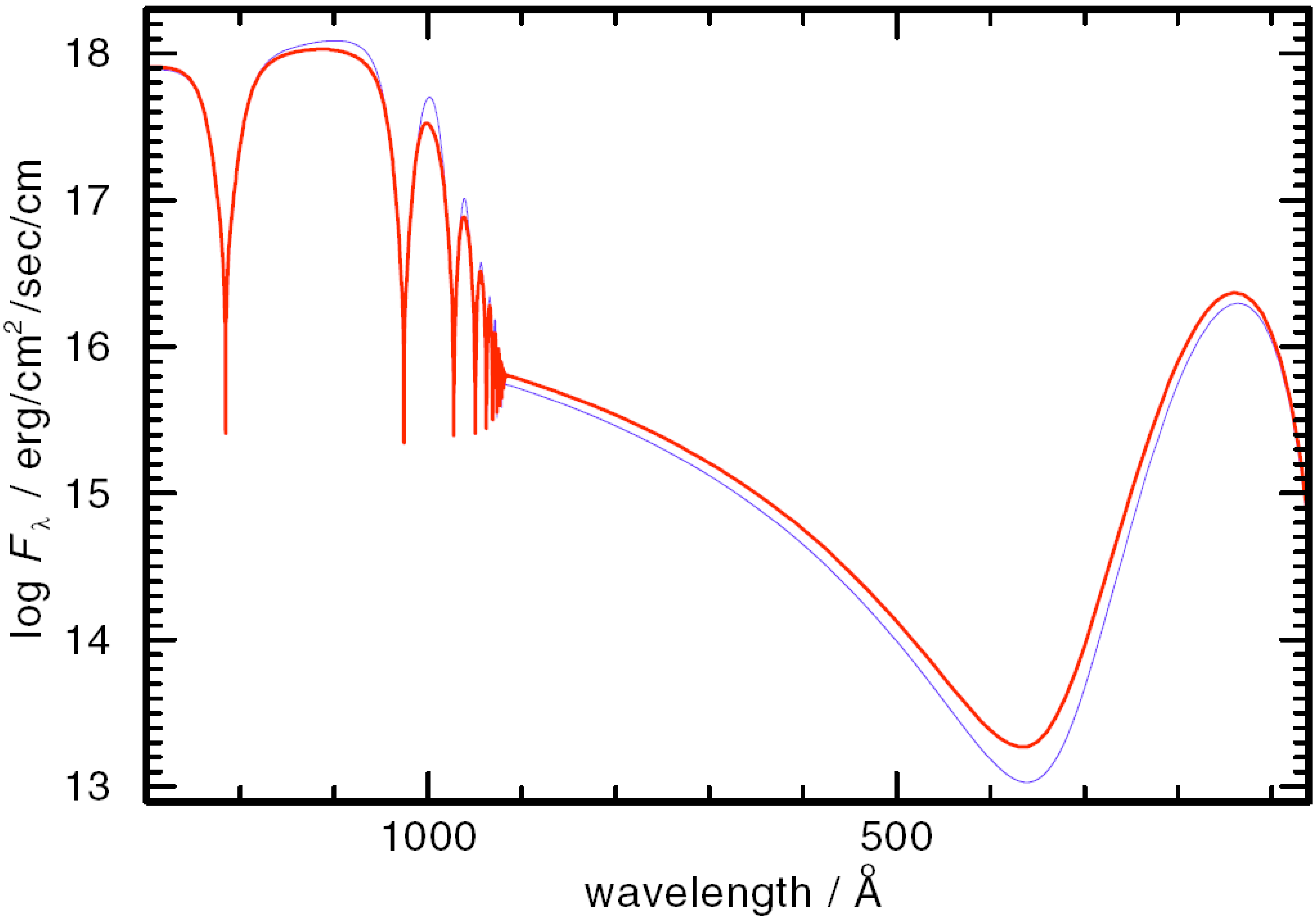


Fig. 2. Discrepancy between synthetic spectra for SiriusB calculated by *TMAP* (thick, long cutoff, see text) and *TLUSTY* (thin, short cutoff, Lanz priv. comm.) with the same parameters.

Rauch, 2008 A&A 481, 807

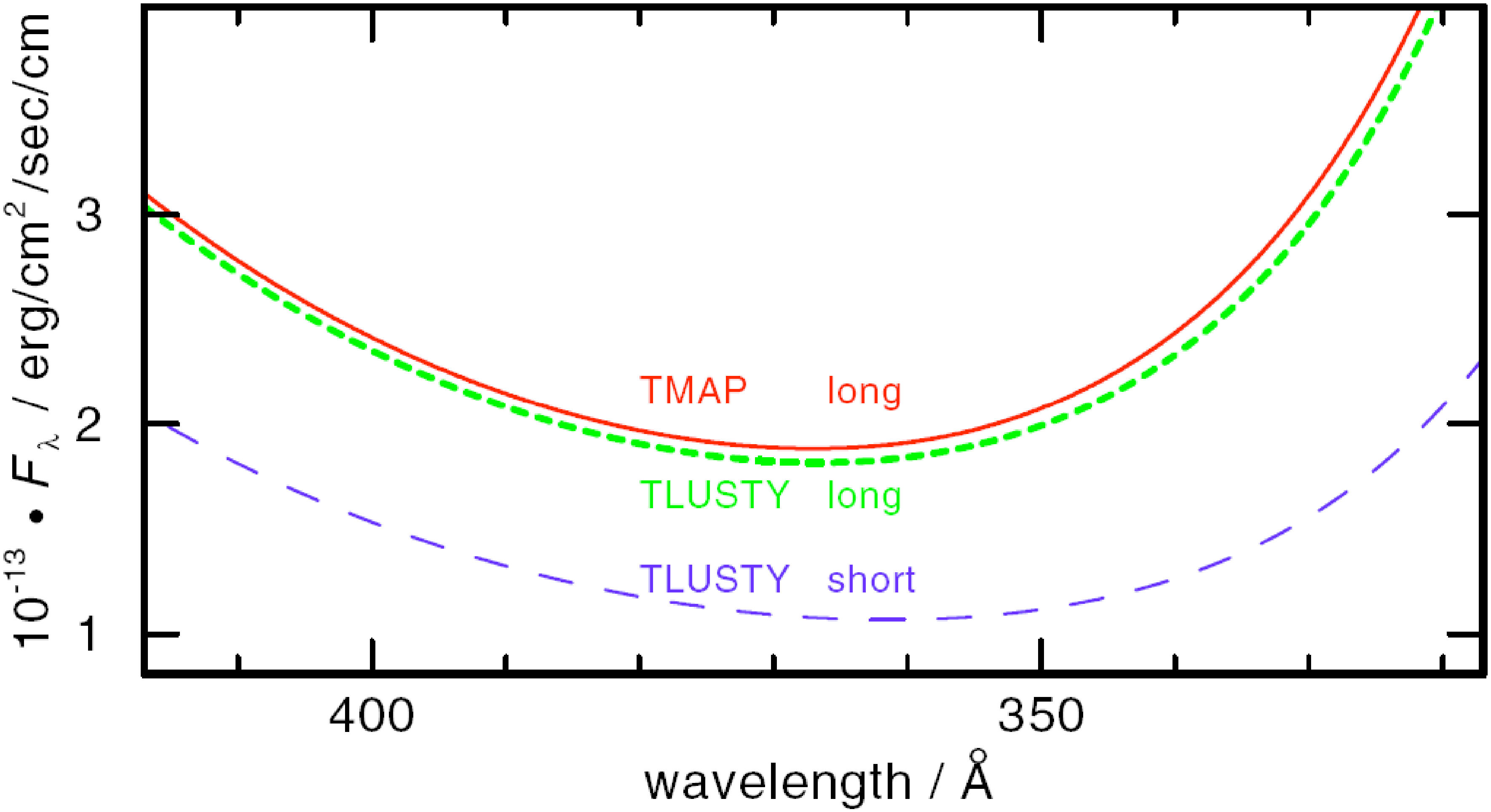


Fig. 4. Comparison of *TMAP* and *TLUSTY* (dotted: long cutoff, dashed: short cutoff) fluxes in the vicinity of the largest deviation (Fig. 2).

Rauch, 2008 A&A 481, 807

Effective area calibration of the Reflection Grating Spectrometers of XMM-Newton. II. X-ray spectroscopy of DA white dwarfs

Jelle Kaastra et al.   2008, A&A in press

Context. White dwarf spectra have been widely used as a calibration source for X-ray and EUV instruments. The in-flight effective area calibration of the Reflection Grating Spectrometers (RGS) of XMM-Newton depend upon the availability of reliable calibration sources.

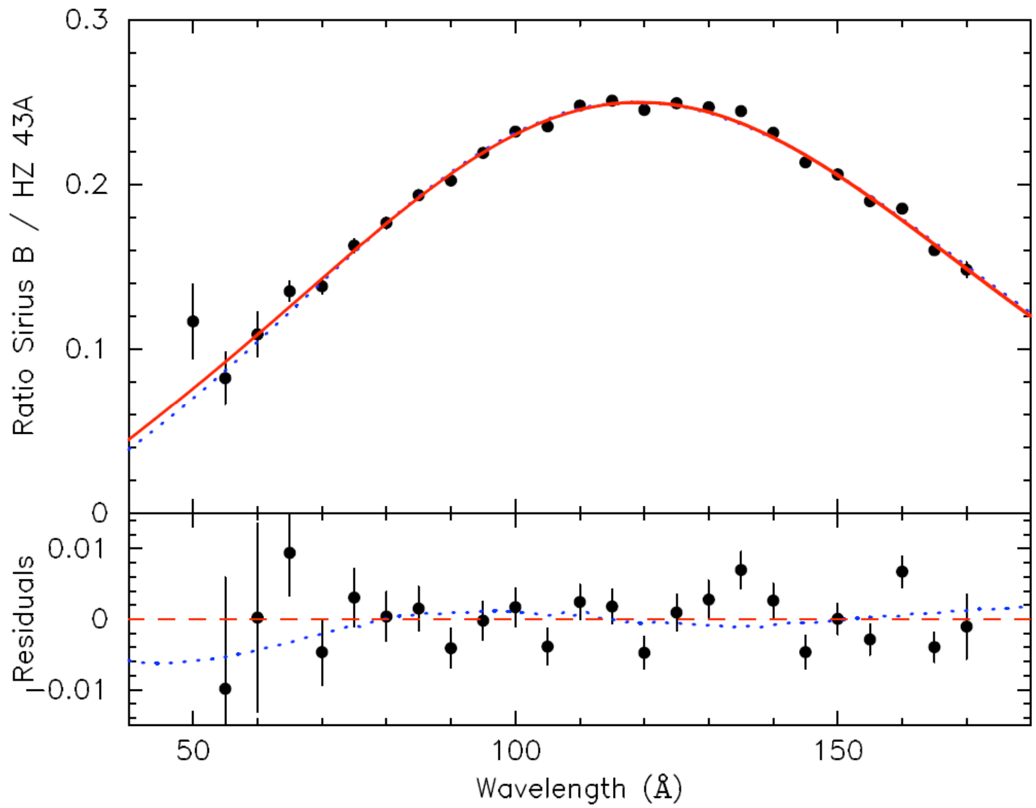
Aims. We investigate how well these white dwarf spectra can be used as standard candles at the lowest X-ray energies in order to gauge the absolute effective area scale of X-ray instruments.

Methods. We calculate a grid of model atmospheres for Sirius B and HZ 43A, and adjust the parameters using several constraints until the ratio of the spectra of both stars agrees with the ratio as observed by the Low Energy Transmission Grating Spectrometer (LETGS) of Chandra. This ratio is independent of any errors in the effective area of the LETGS.

Results. We find that we can constrain the absolute X-ray spectrum of both stars with better than 5 % accuracy. The best-fit model for both stars is close to a pure hydrogen atmosphere, and we put tight limits to the amount of helium or the thickness of a hydrogen layer in both stars. Our upper limit to the helium abundance in Sirius B is 4 times below the previous detection based on EUVE data. We also find that our results are sensitive to the adopted cut-off in the Lyman pseudo-continuum opacity in Sirius B. We get best agreement with a long wavelength cut-off.

Conclusions. White dwarf model atmospheres can be used to derive the effective area of X-ray spectrometers in the lowest energy band. An accuracy of 3–4 % in the absolute effective area can be achieved.

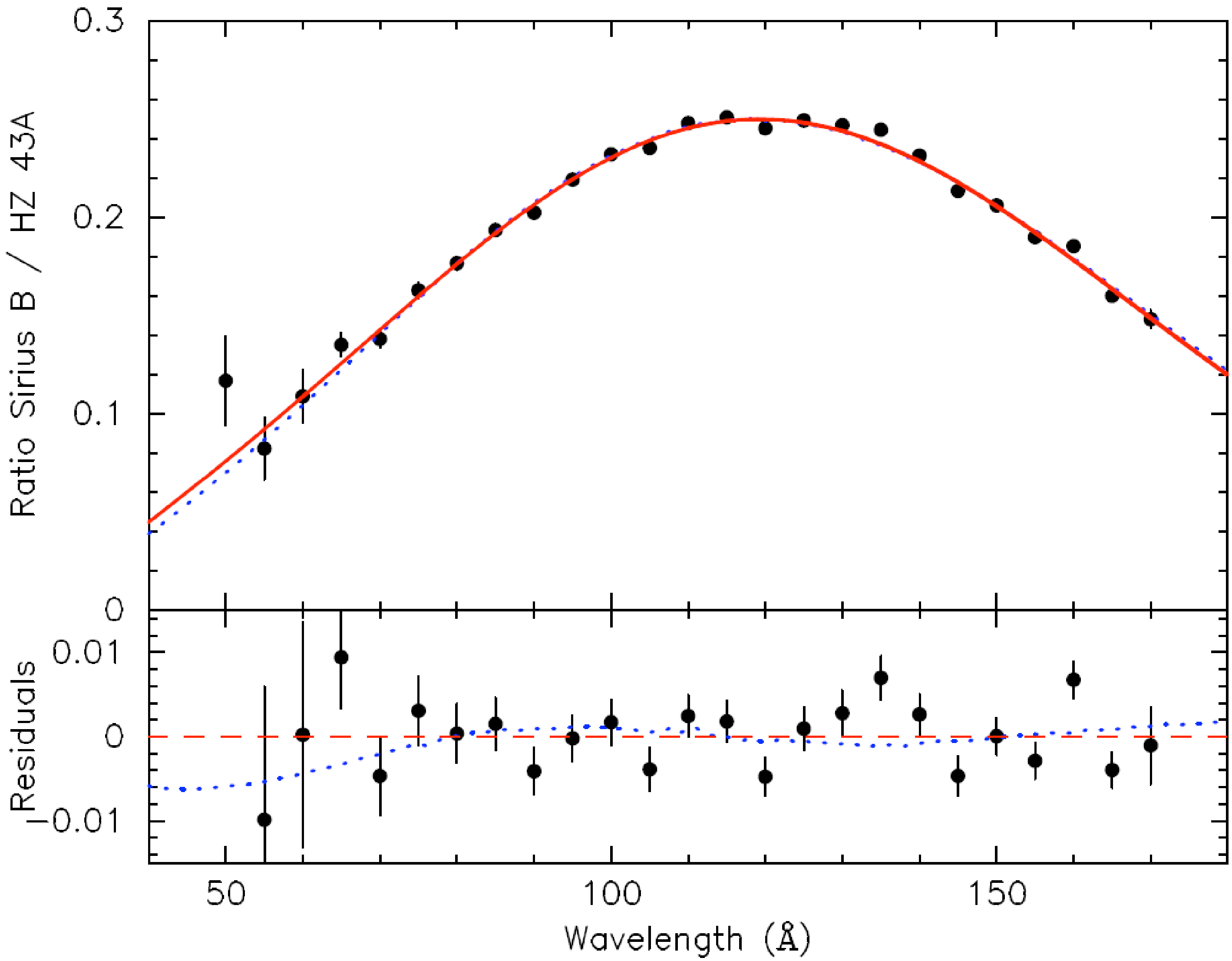
Ratio Sirius B / HZ43 - data/model



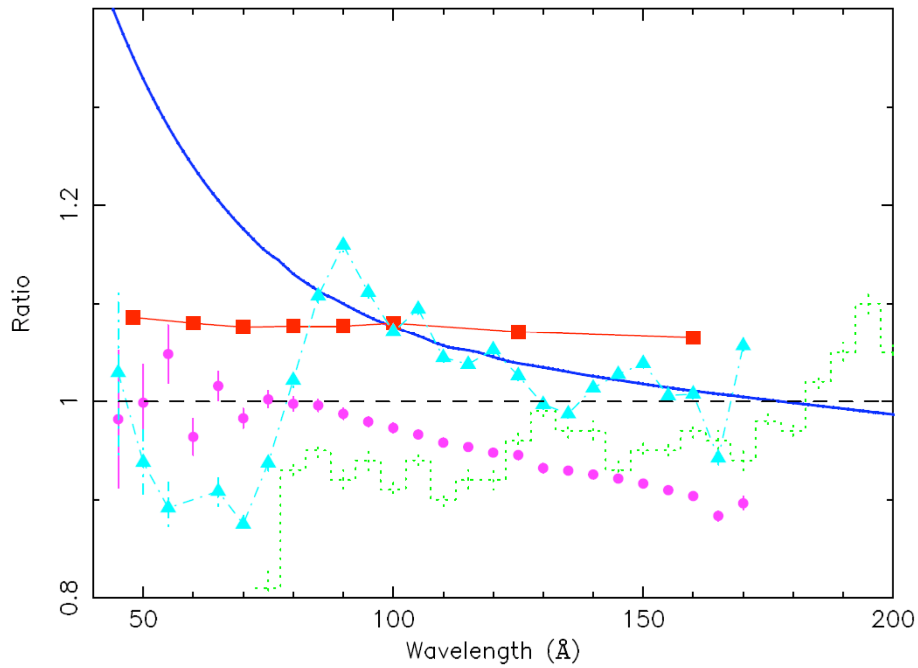
Kaastra et al. 2008 A&A in press

Fig. 1. Ratio of the spectrum of Sirius B to the spectrum of HZ 43A. Data points with error bars: ratio as observed by the LETGS. The solid line shows our best-fit model 2 (with a long wavelength cut-off of the Lyman pseudo-continuum), and the dotted line our best-fit model 1 (short cut-off), as discussed in Sect. 4. The lower panel shows the fit residuals of the observed ratio with respect to model 2; the dotted line in that panel shows on the same scale the differences between model 2 and model 1. Note that the first data point at 50 Å is off-scale in this lower panel.

Ratio Sirius B / HZ43 - data/model



Implications for effective area LETGS



Fluxes of HZ 43A with respect to our model 2 (long cut-off). Solid line: model 1 (short cut-off); circles: fluxed LETGS spectrum using the old (2000) SRON effective area calibration; dashed histogram: EUVE flux; squares: Beuermann et al. 2006 (using TMAP); dash-dotted line, triangles: fluxed LETGS spectrum using the standard CXC CIAO pipeline.

Implications for effective area LETGS