Status and Future of the LETGS Calibration

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1. Effective Area
   - HRC-S QE, QEU improvements
   - Problem areas: Edges, 60-80 AA range
   - Sirius B parameters
   - Relevance of Compton Scattering in WD atmospheres
2. Gain sag and PHA-based background filtering
3. Dispersion Relation, LRF, Degap: Vinay
   1. Improvements and implementation

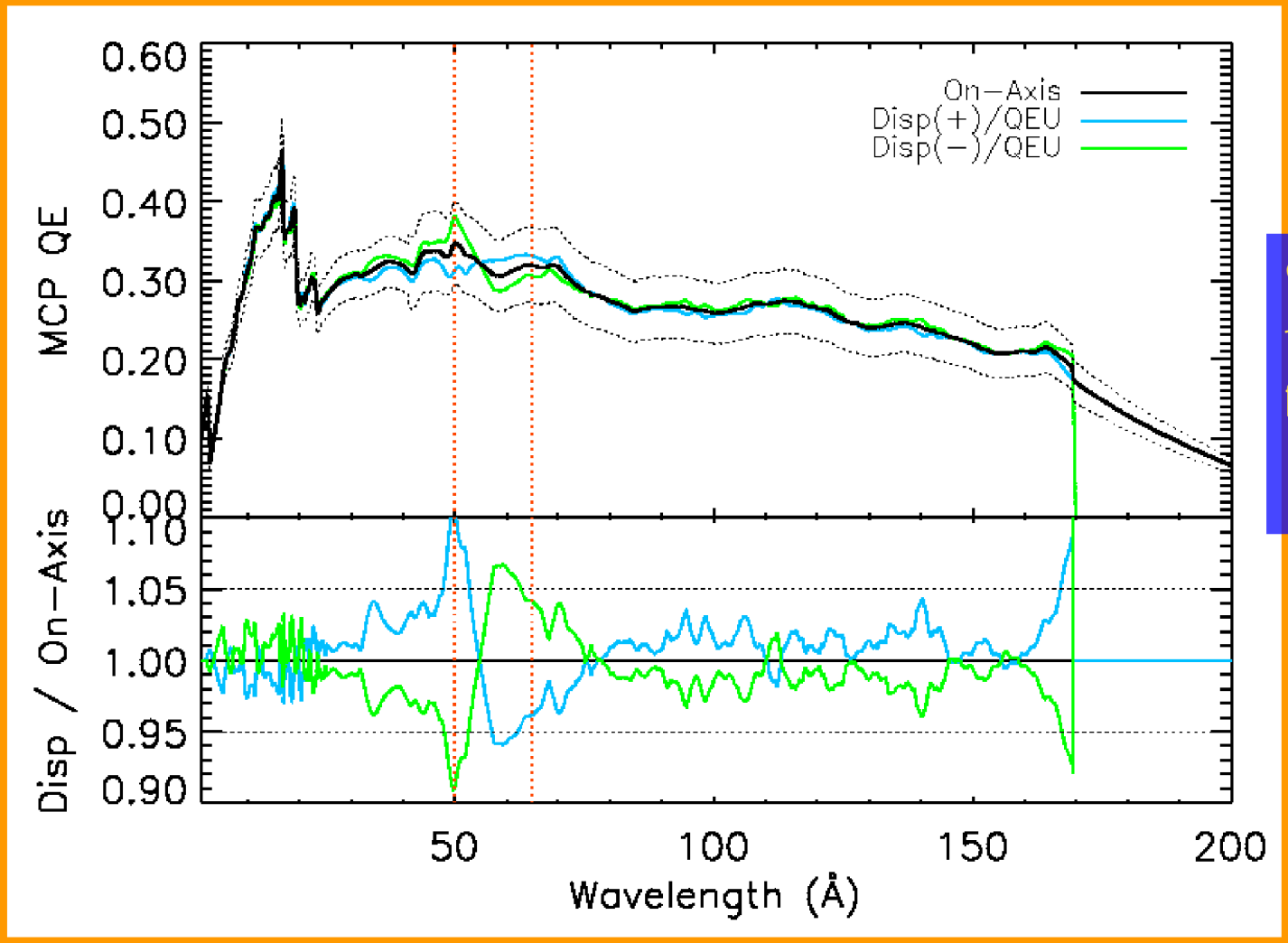
Spectrograph
changed to
Spectrometer

In POG text. sniff.

Effective Area Improvements Implemented in CIAO

- HRC-S QE,QEU improvements using revised higher order LETG diffraction efficiencies

QEU Improvements



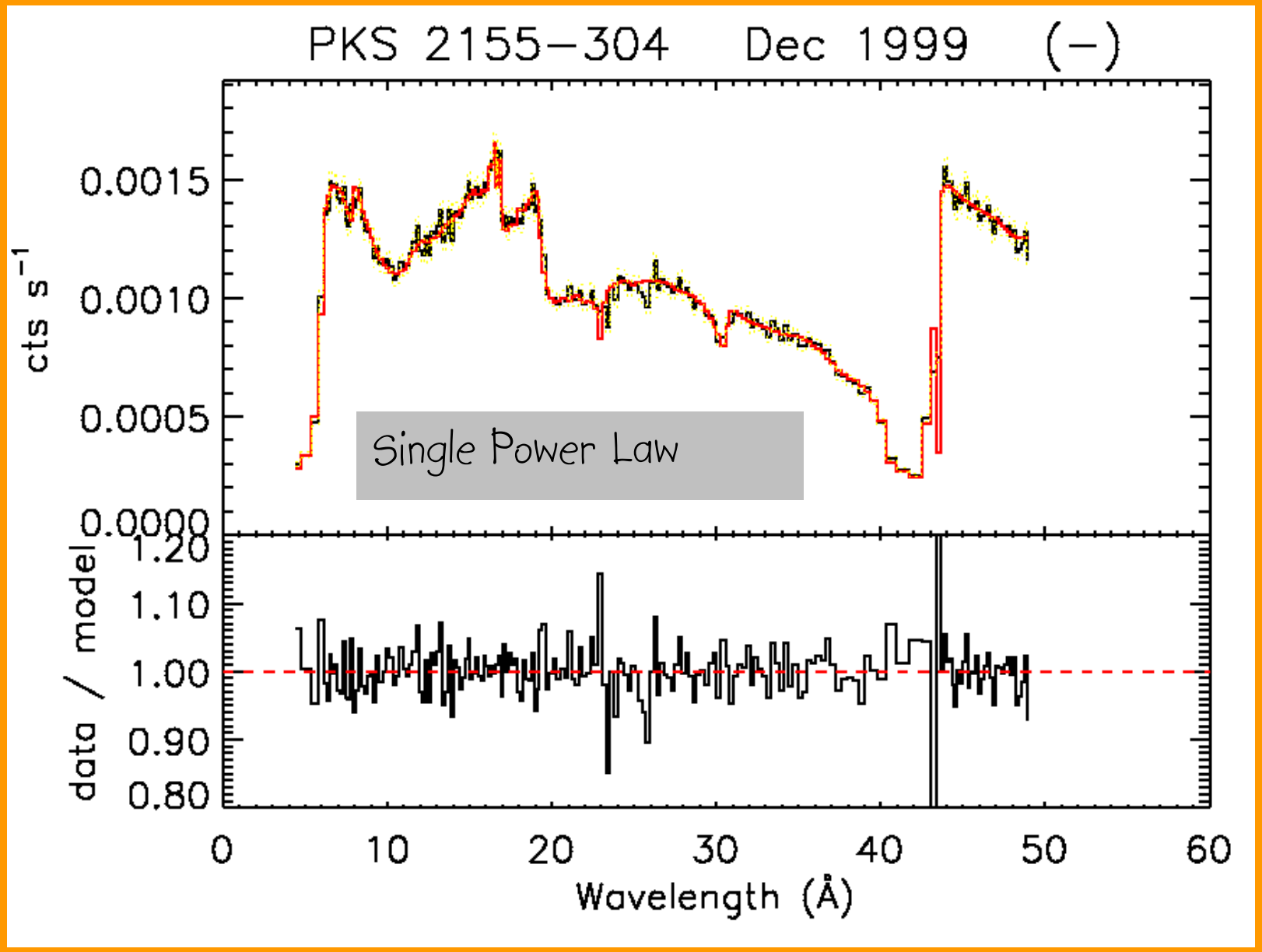
QEU recovers QE for "arbitrary" aim point to 2-3%

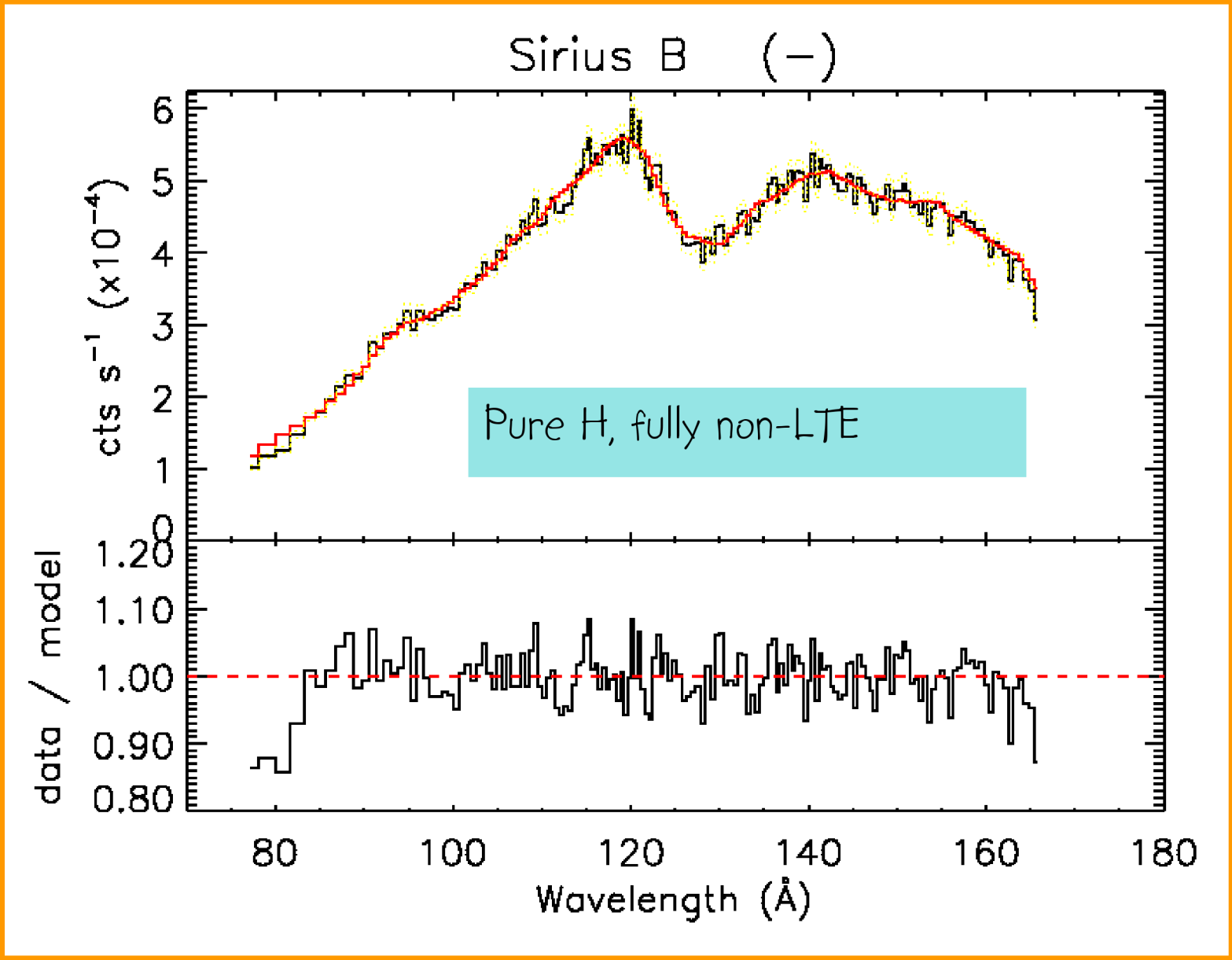
Effective Area Improvements Implemented in CIAO

- HRC-S QE,QEU improvements using revised higher order LETG diffraction efficiencies
  - " negligible" errors in QE reconstruction for small off-axis angles

Effective Area Improvements Implemented in CIAO

- HRC-S QE,QEU improvements using revised higher order LETG diffraction efficiencies
  - " negligible" errors in QE reconstruction for small off-axis angles
- Effective area generally accurate to ~15% across two decades in X-ray energy

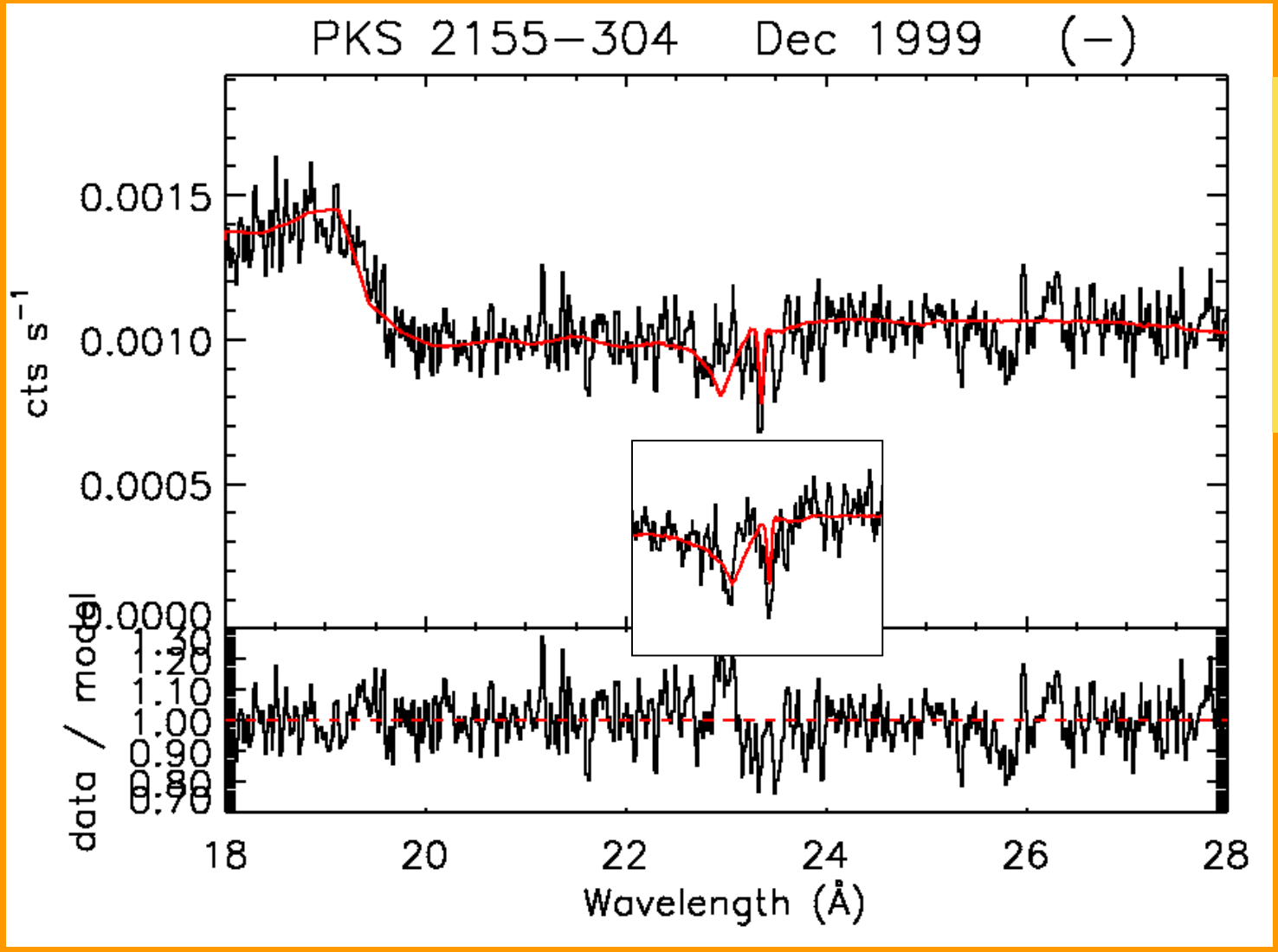

PKS 2155−304 Dec 1999 (−)
cts s^{-1}
0.0015
0.0010
0.0005
0.0000
Single Power Law
data / model
1.20
1.10
1.00
0.90
0.80
0
10
20
30
40
50
60
Wavelength (Å)


Sirius B (–)
cts s^{-1} (x10^{-4})
0
1
2
3
4
5
6
Pure H, fully non-LTE
data / model
0.80
0.90
1.00
1.10
1.20
80
100
120
140
160
180
Wavelength (Å)

Effective Area Issues/Problems

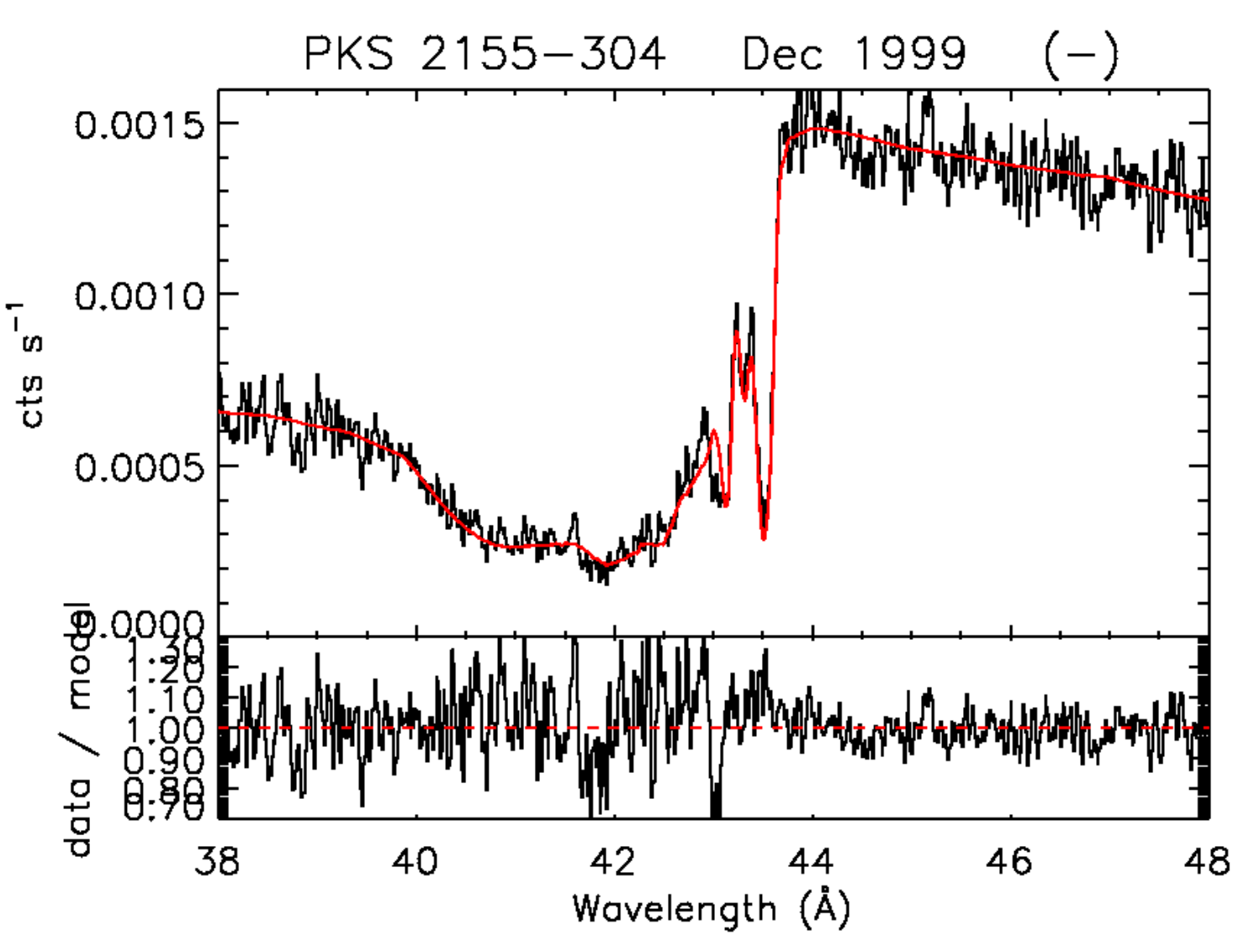
- New HRMA model with overlayer
  - HRC-S QE update in time for HRMA release
- Oxygen K edge, Carbon K edge
- 60-80 Å range
- Sirius B parameter changes?

Problem area: O K edge

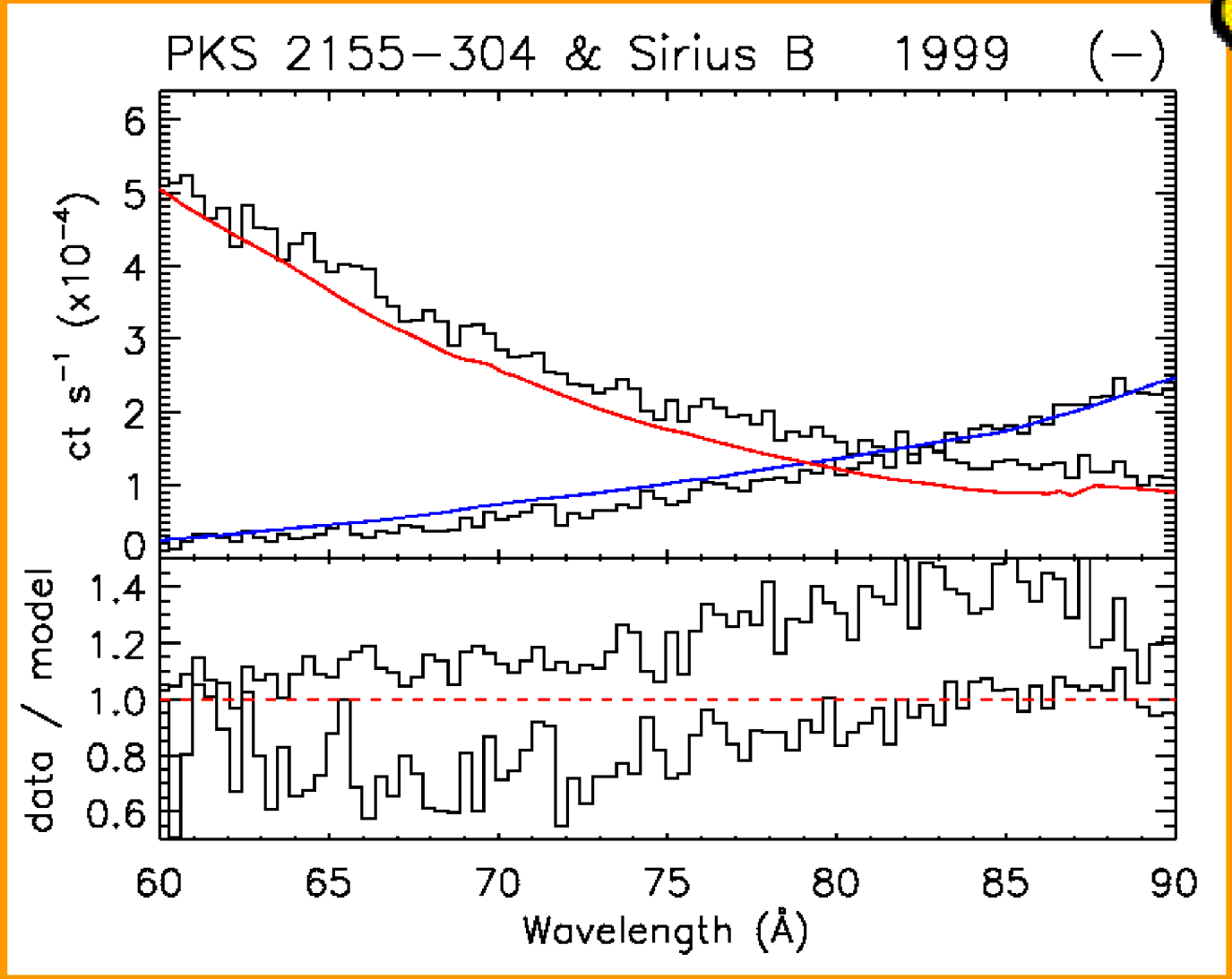


Rendered more complicated by IGM absorption

Problem area: C K edge



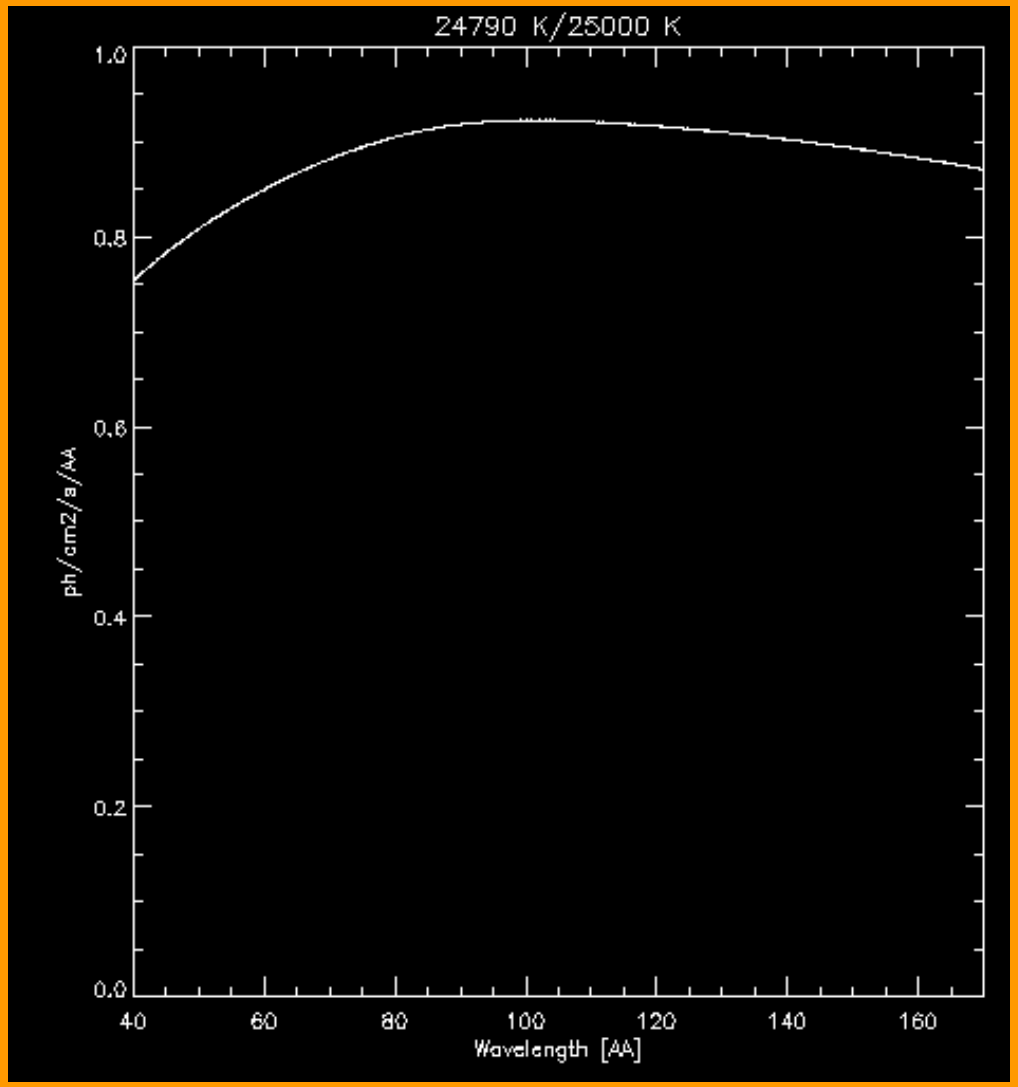
Problem area: 60-80AA



Sirius B and PKS 2155 disagree

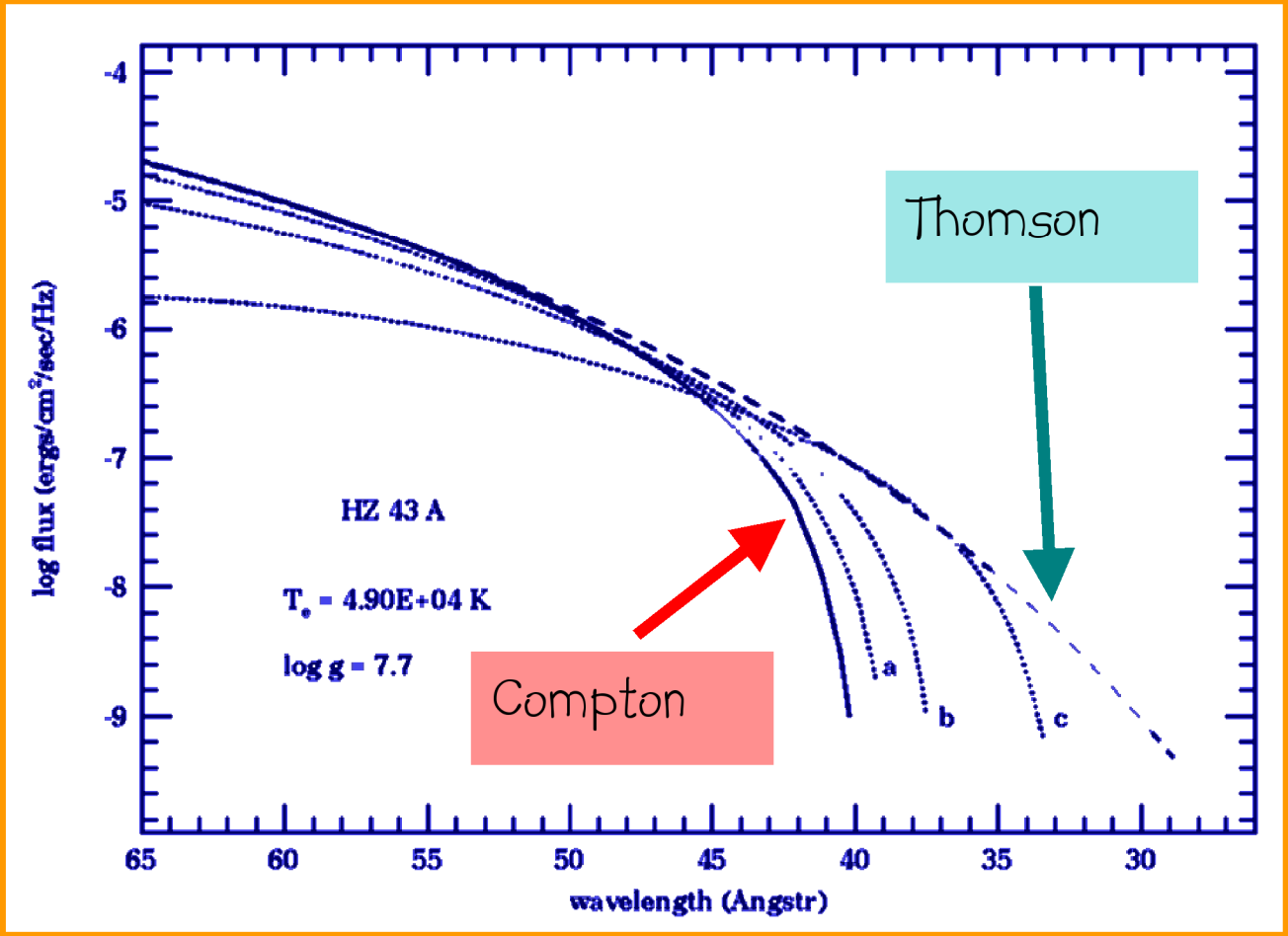
- Double power-law?
- Sirius B T_{eff} /model?

Sirius B



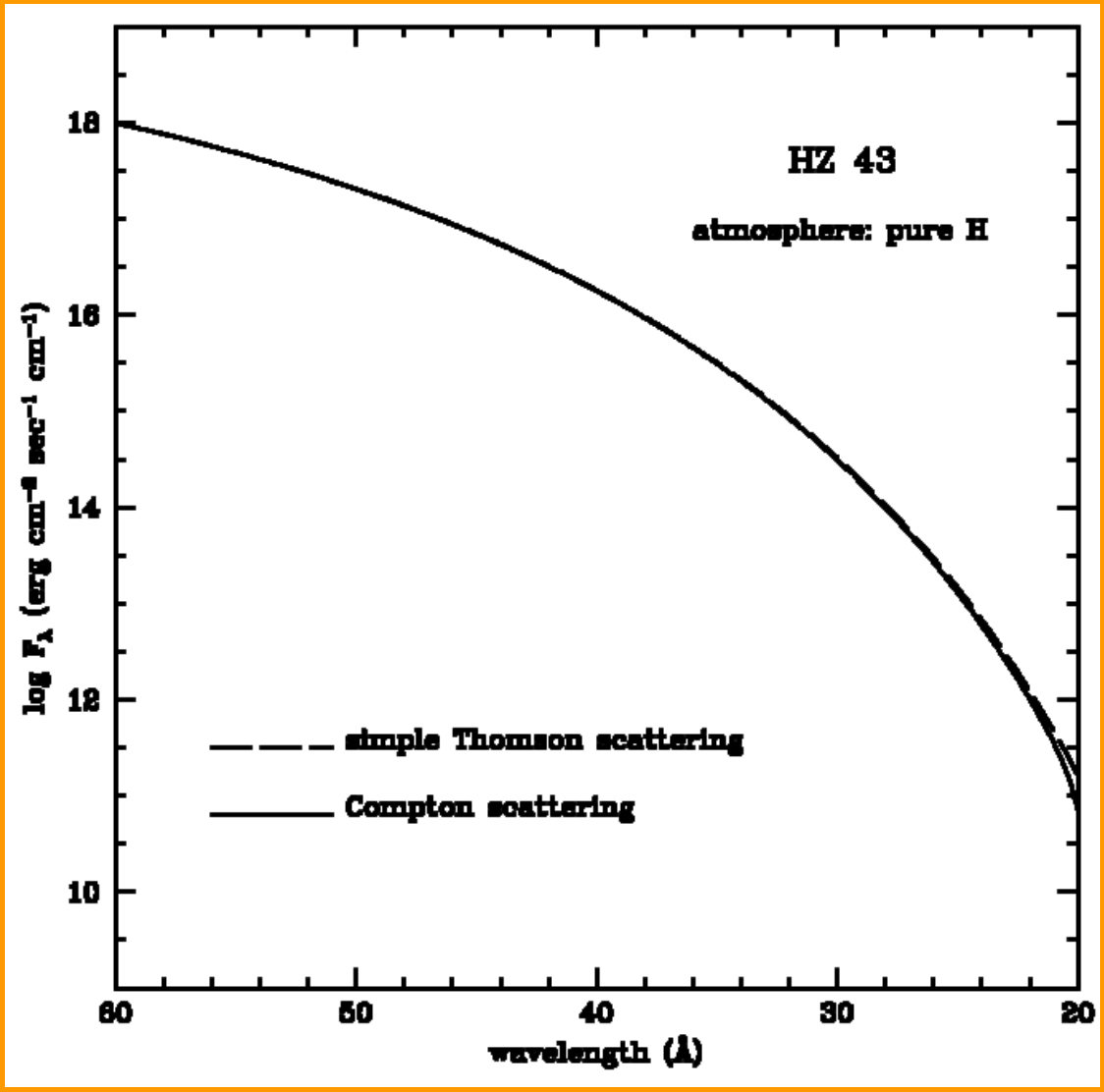
- Barstow et al (2005) estimate T=25193K cf T=24790 K (Holberg et al 1998)
  - appears to be in wrong direction to help...

Is Compton Scattering relevant for WD Calibrators?

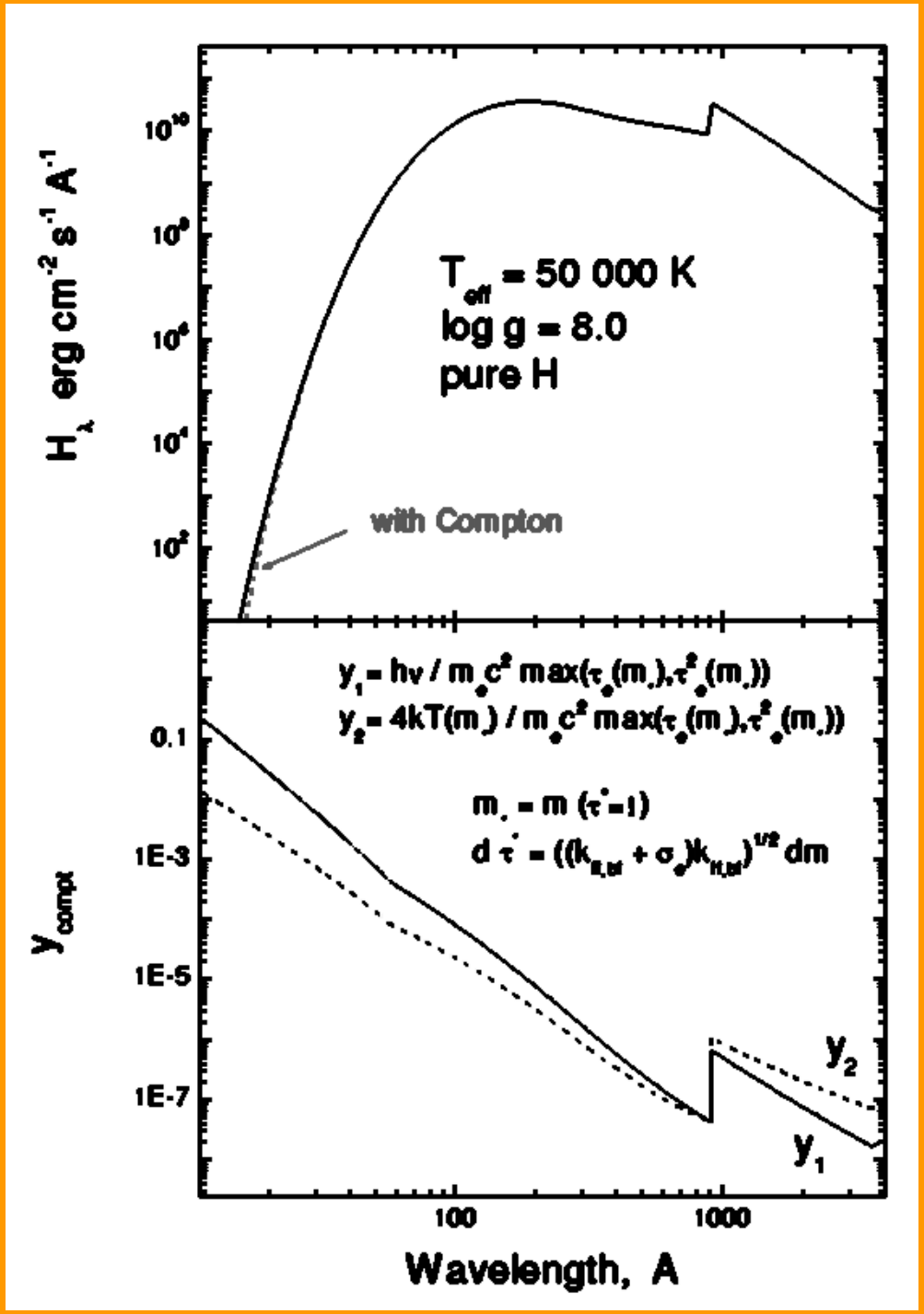


- Madej (1998) indicated possibly large CS effects < 50Å
- Kaastra et al abstract suggests CS important for Sirius B, HZ43 calibration

Is Compton Scattering relevant?

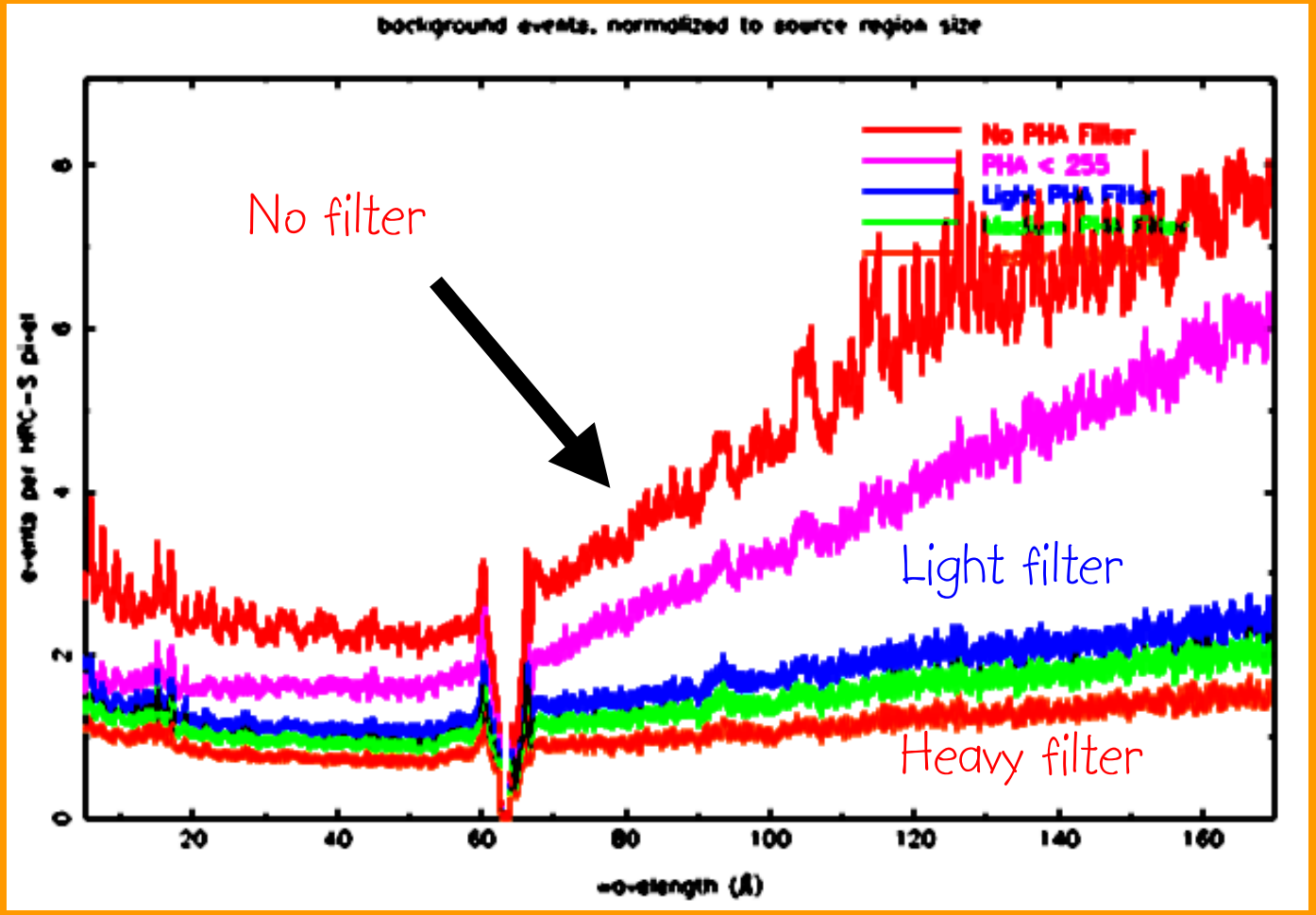


- New calculations by Madej (Warsaw) using more rigorous methods ==> **neglible effects**
- T_{eff} uncertainties MUCH more important
- Confirmed independently by Suleymanov (Tuebingen)



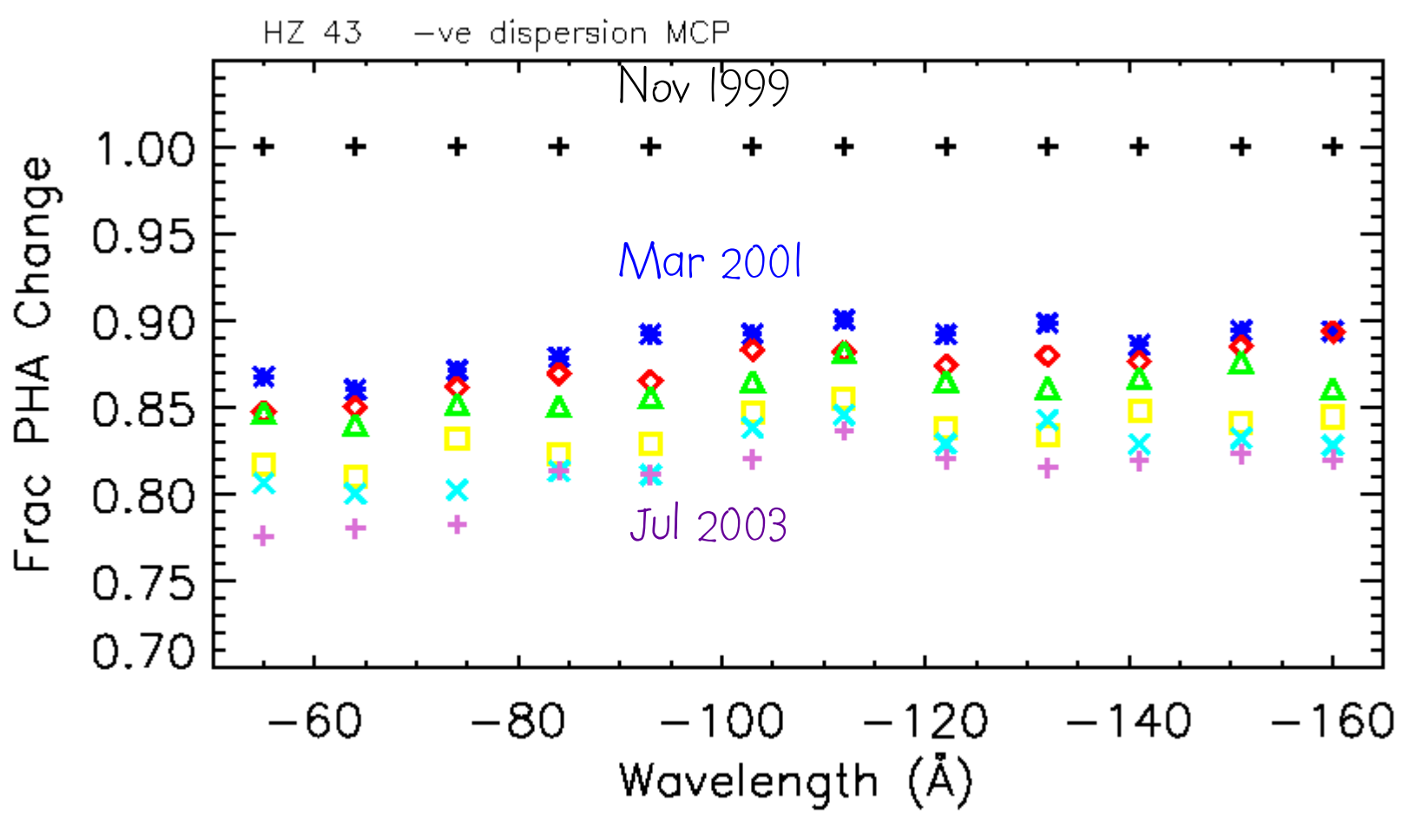
Compton Scattering effects < 10% for > 25Å (Suleymanov 2005, unpublished)

Gain Sag and HRC-S PHA Filter



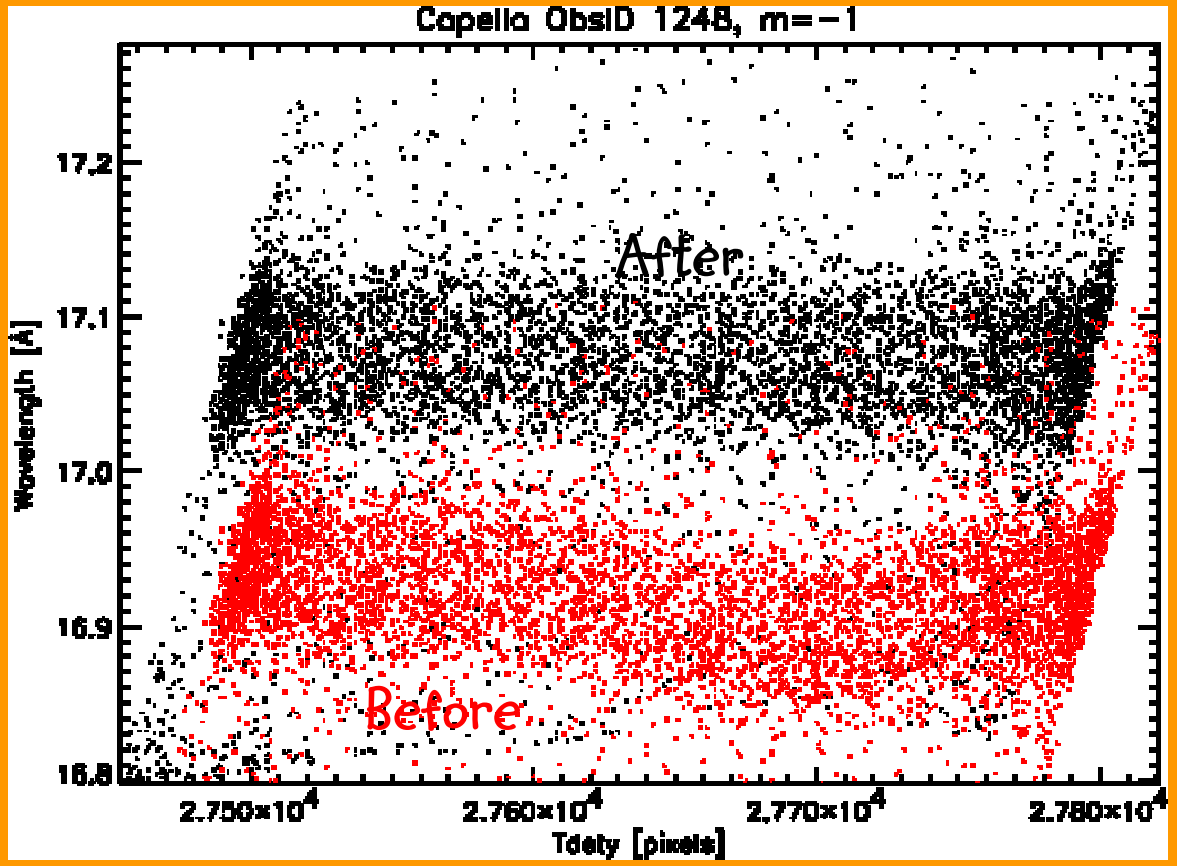
Filter based on pulse height removes 2/3-3/4 of background with negligible X-ray loss

Gain Sag and HRC-S PHA Filter



Gain sag will require time-dependent filter

HRC-S event position errors



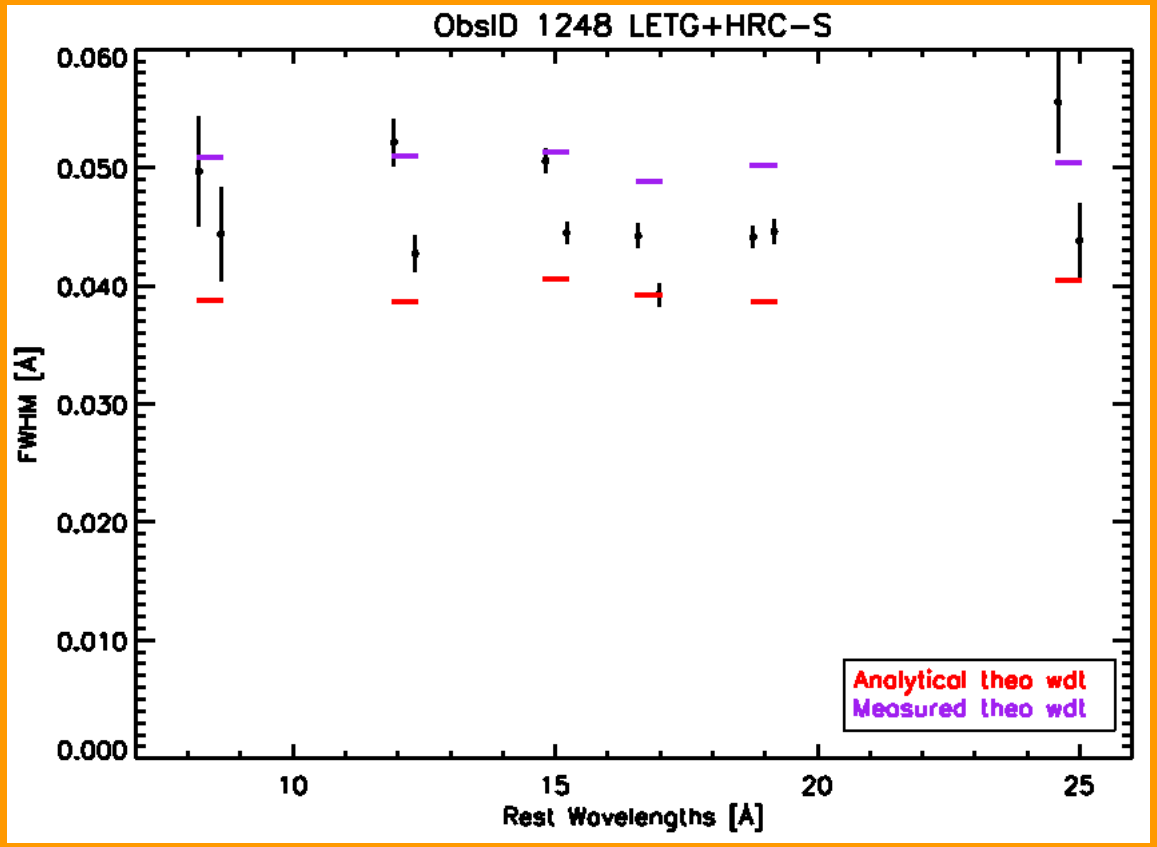
- Causes: imaging non-linearity; dispersion relation distortions; line profile smearing
- Correction "map" built from large set of line source observations

Perl Program `corrlam` (P. Ratzlaff) released Dec 04

http://cxc.harvard.edu/cal/Letg/Corrlam/

Now being implemented in CIAO - Vinay next

LETG+HRC-S FWHM



- Measured widths for most lines significantly larger than theoretical ones by ~10-20%
- Worst agreement for -ve order where detector event position errors are worse; position errors preclude quantitative RMF evaluation