

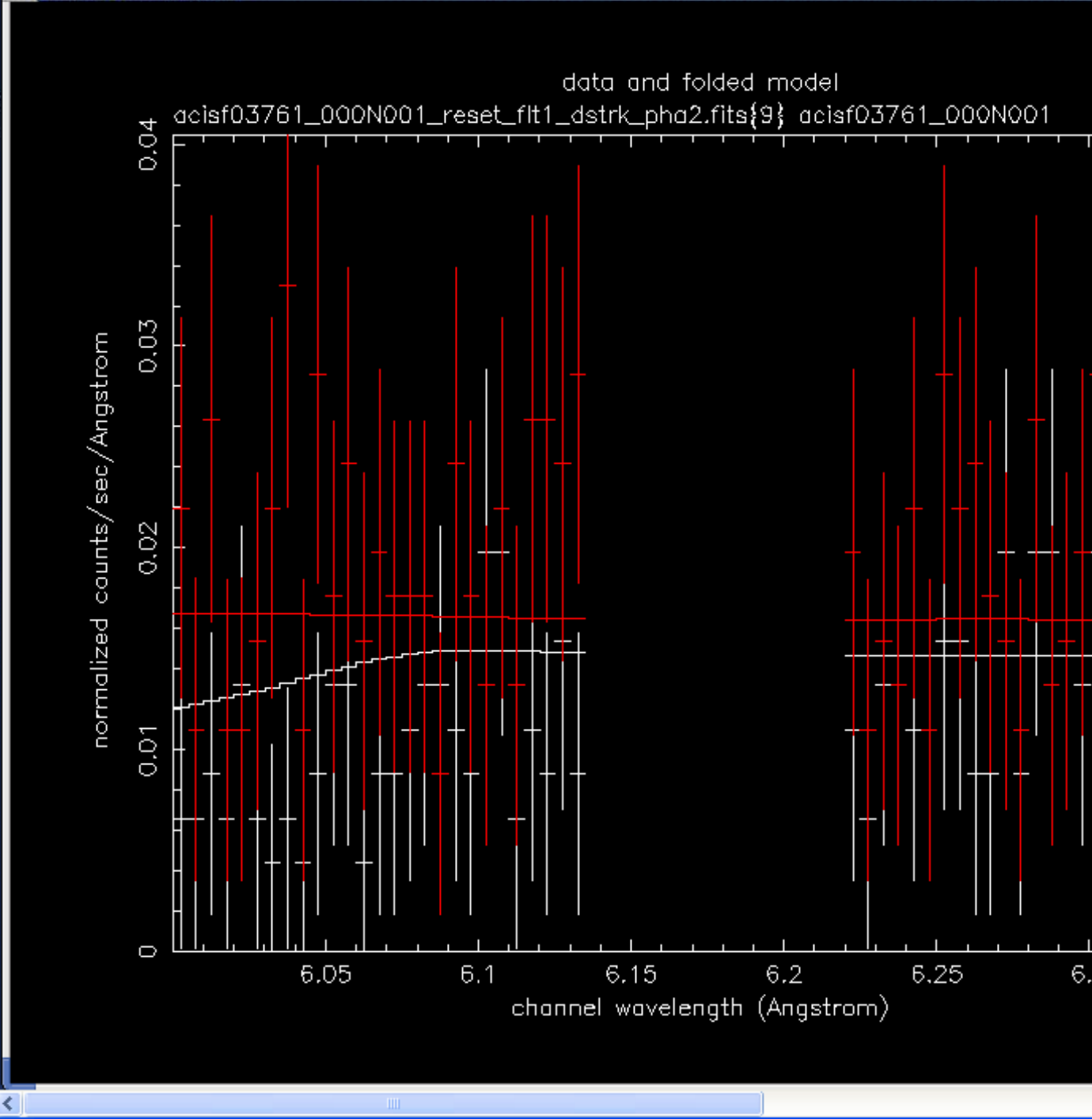
Fitting continuum near line (ignore: 0.0-6.00, 6.14-6.22, 6.35-**) N=104 bins
power law with index fixed at 2.0

Note: silicon Ly alpha is a doublet with components at 6.1804 and 6.1858 - the f-value weighted mean wavelength is 6.1822

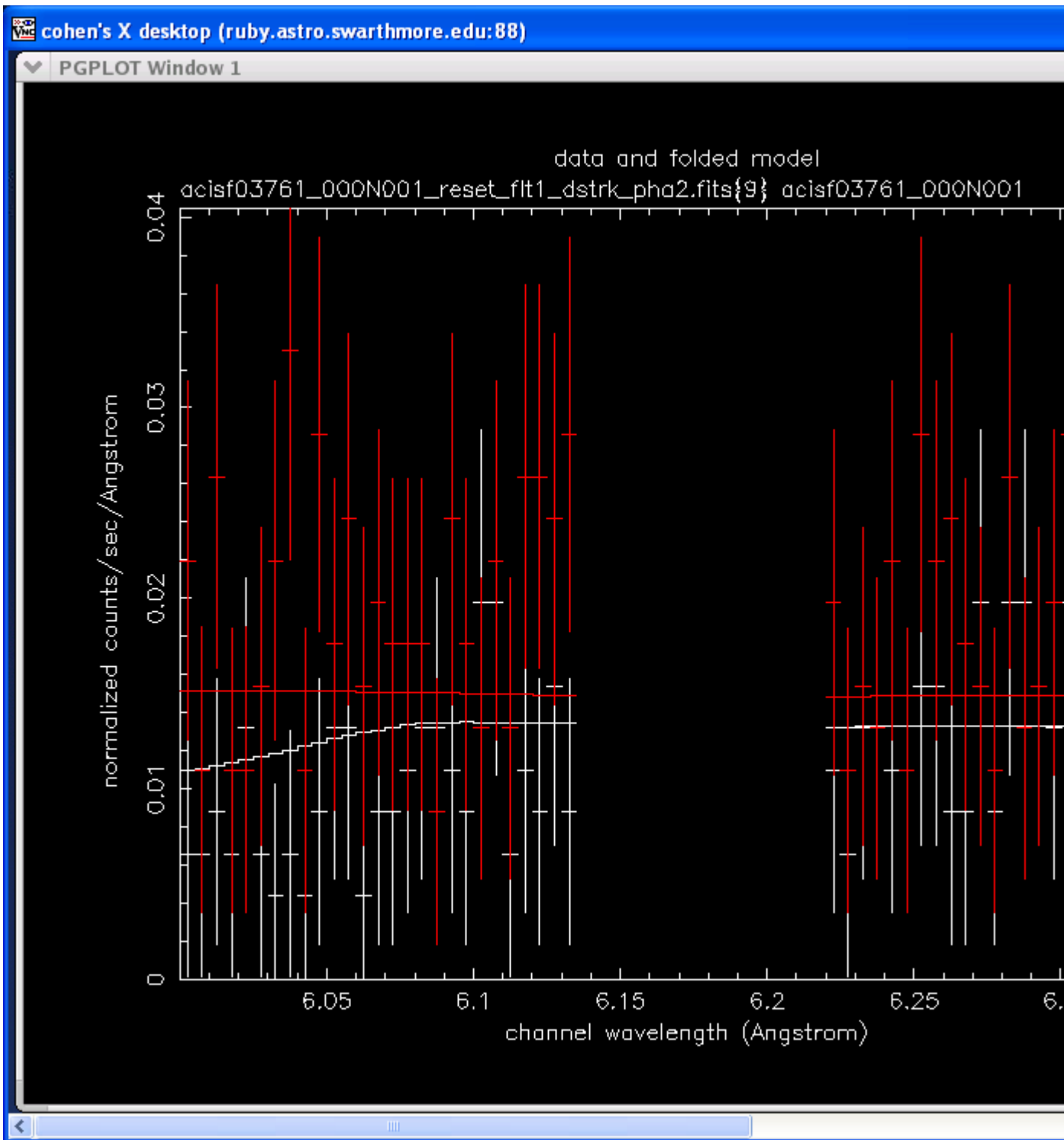
1A) FIRST WE'LL FIT THE MEG COMBINED +1,-1 SPECTRUM (CONTINUUM ONLY)

MEG +/- 1: norm=8.90e-3 (C-stat=114.0 > 61%) or norm=8.05e-3 (chisq=53.8 nu=103 100%)

Here's the best C-stat continuum fit:

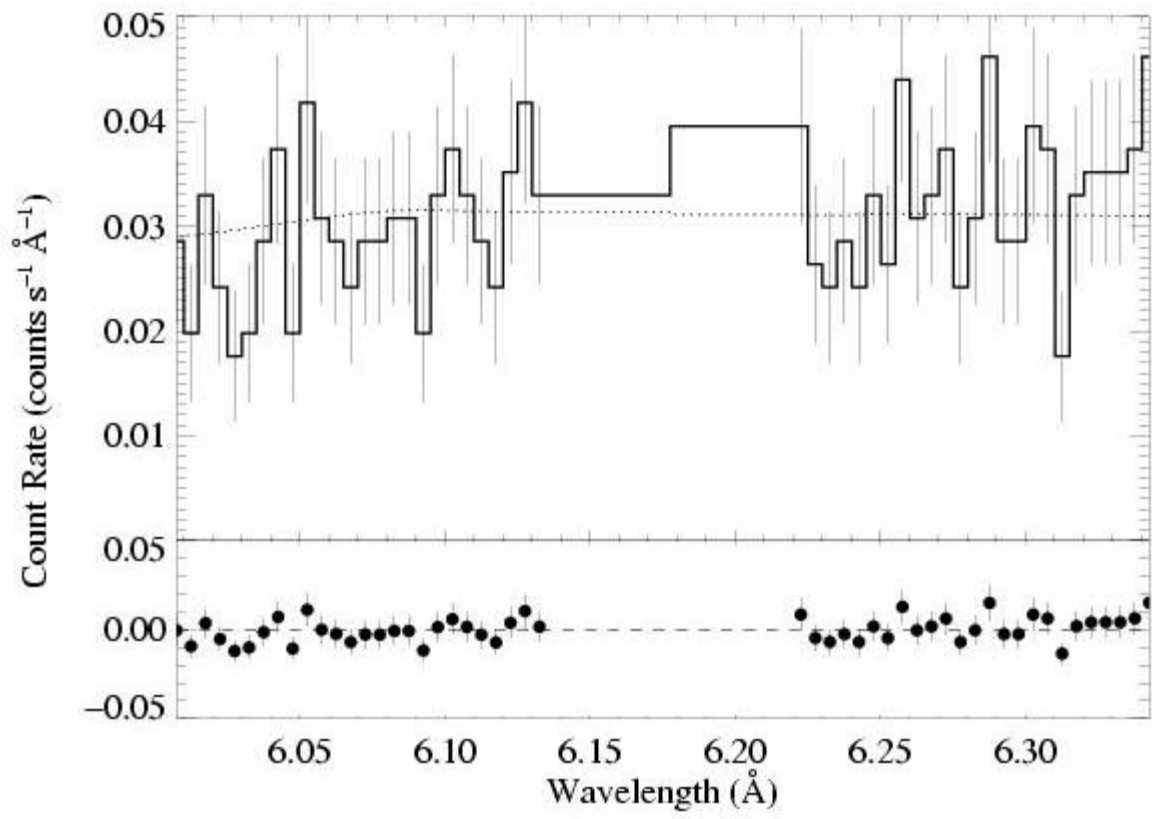


Here's the best Chi-square continuum fit:

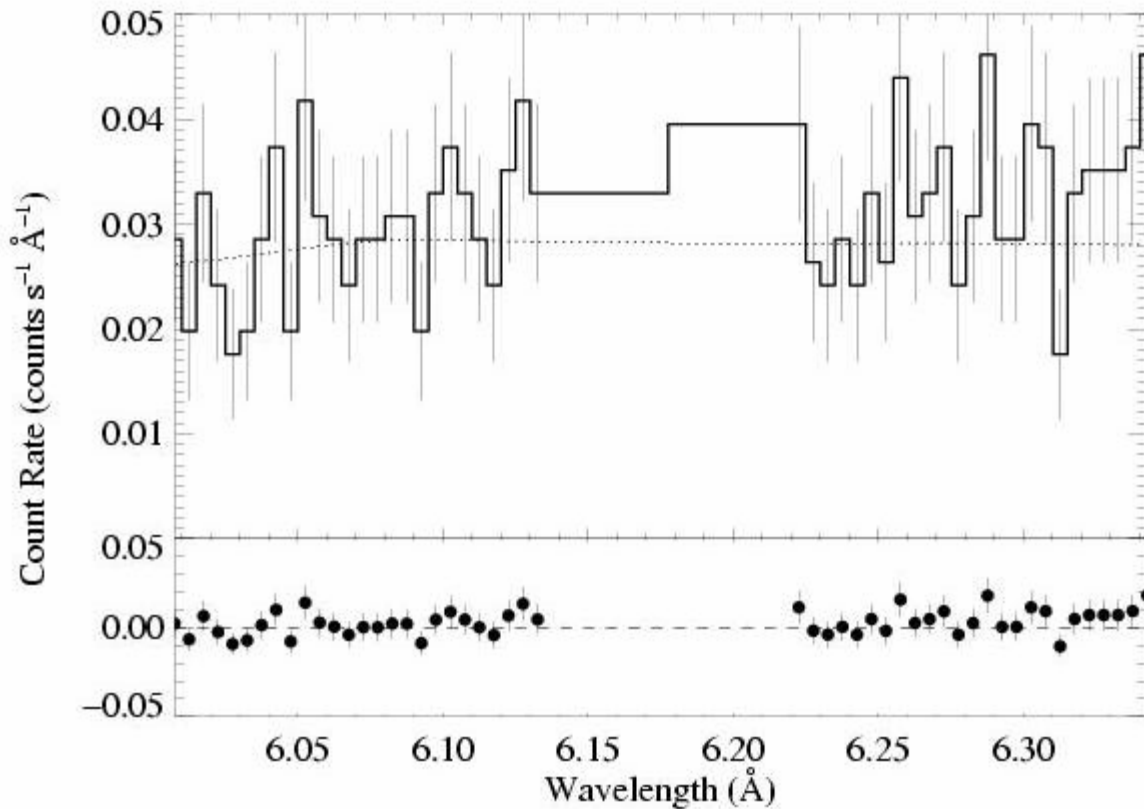


Co-added spectra -

First C-stat fit:



Then Chi-square fit:



*The chi-square fit is lower, and less believable. Formally it's (too) good; The C-stat fit is formally good (and reasonable).

However, I worry about systematic-looking differences in the negative and positive orders (see the top plots, comparing the red and the white points; but notice also that the effective areas are different along the two grating arms, especially at the shorter wavelengths.)

Quantifying the uncertainty (on the C-stat fit):

8.55:9.23 e-3 at the $\Delta(C)=1$ limit

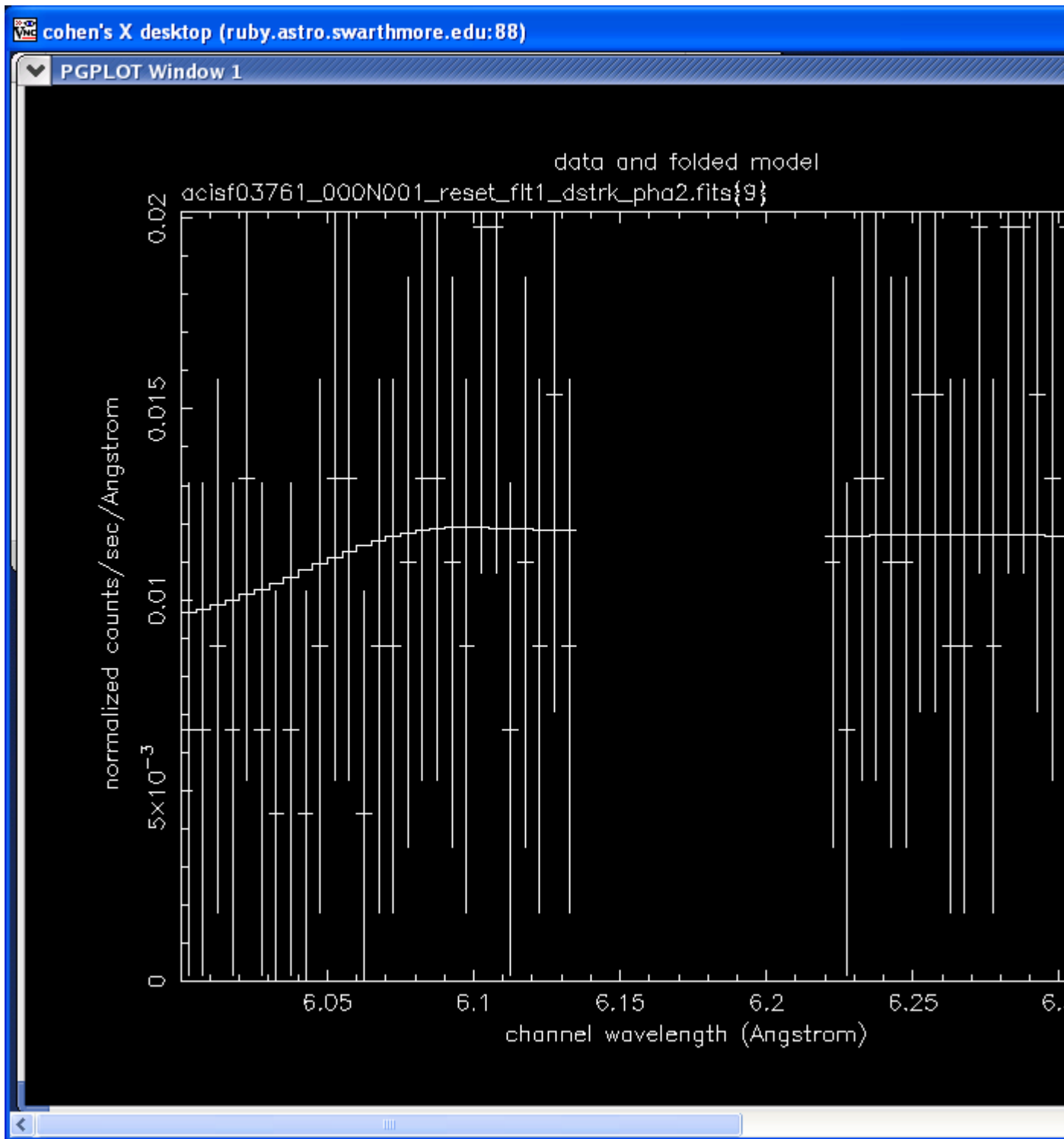
1B) REPEATING THIS EXERCISE - FITTING ONLY THE CONTINUUM - FOR THE -1 AND THE +1 SPECTRA, INDIVIDUALLY (THOUGH THAT'S NOT FORMALLY NECESSARY, AS WE GET A DECENT FIT FOR THE COMBINED SPECTRA).

m=-1 only:

N=52

norm=7.09e-3 (C-stat=36.1 > 7%) or norm=6.54e-3 (chisq=15.5 nu=51 100%)

Fit shown is for the C-stat based fit:



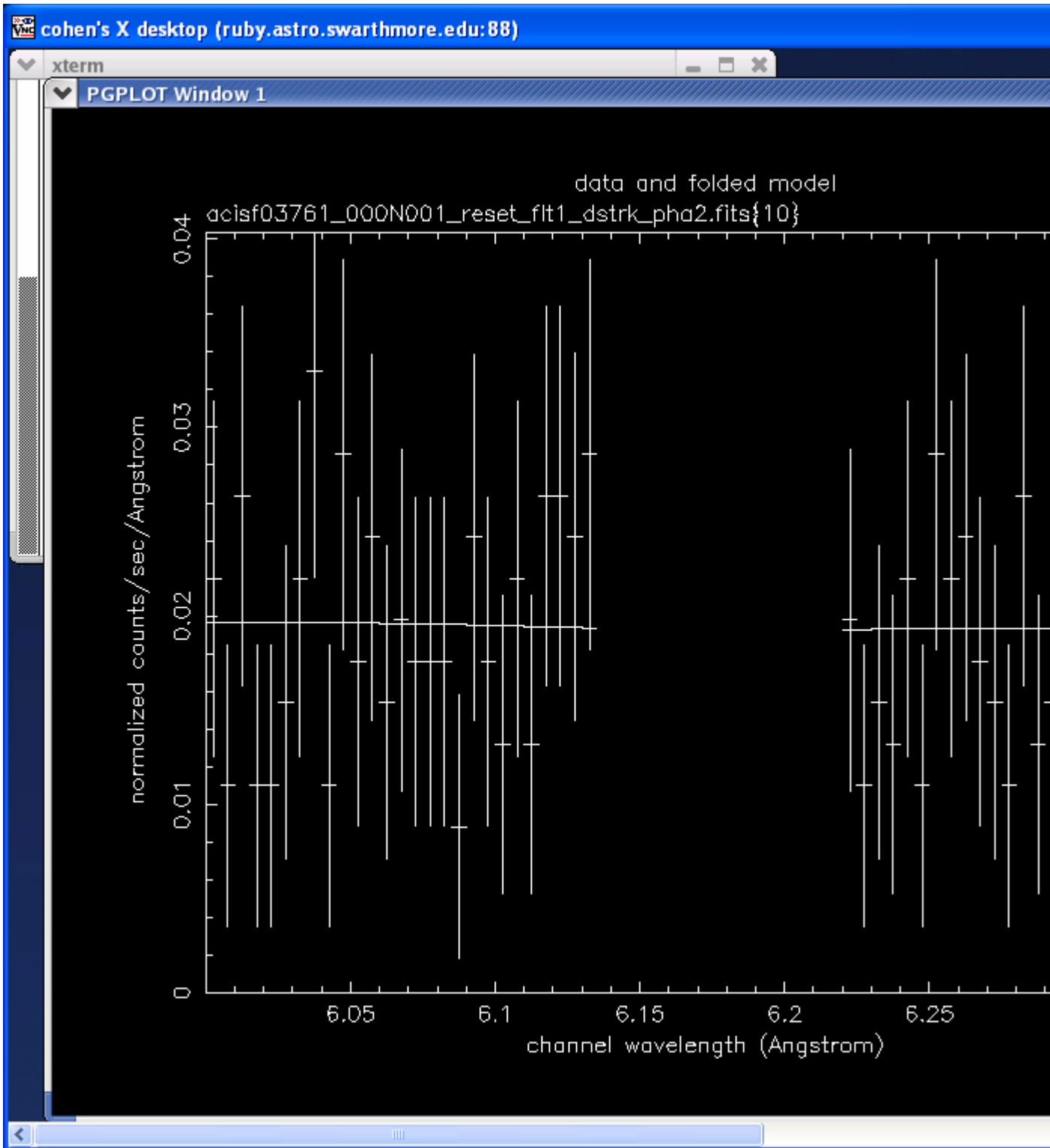
6.67:7.53 e-3 at the $\Delta(C)=1$ limit

m=+1 only:

N=52

norm=1.046e-2 (C-stat=51.5 > 42%) or norm=9.66e-3 (chisq=26.5 nu=51 99.8%)

Fit shown is for the C-stat based fit:



9.97:10.95 e-3 at the $\Delta(C)=1$ limit

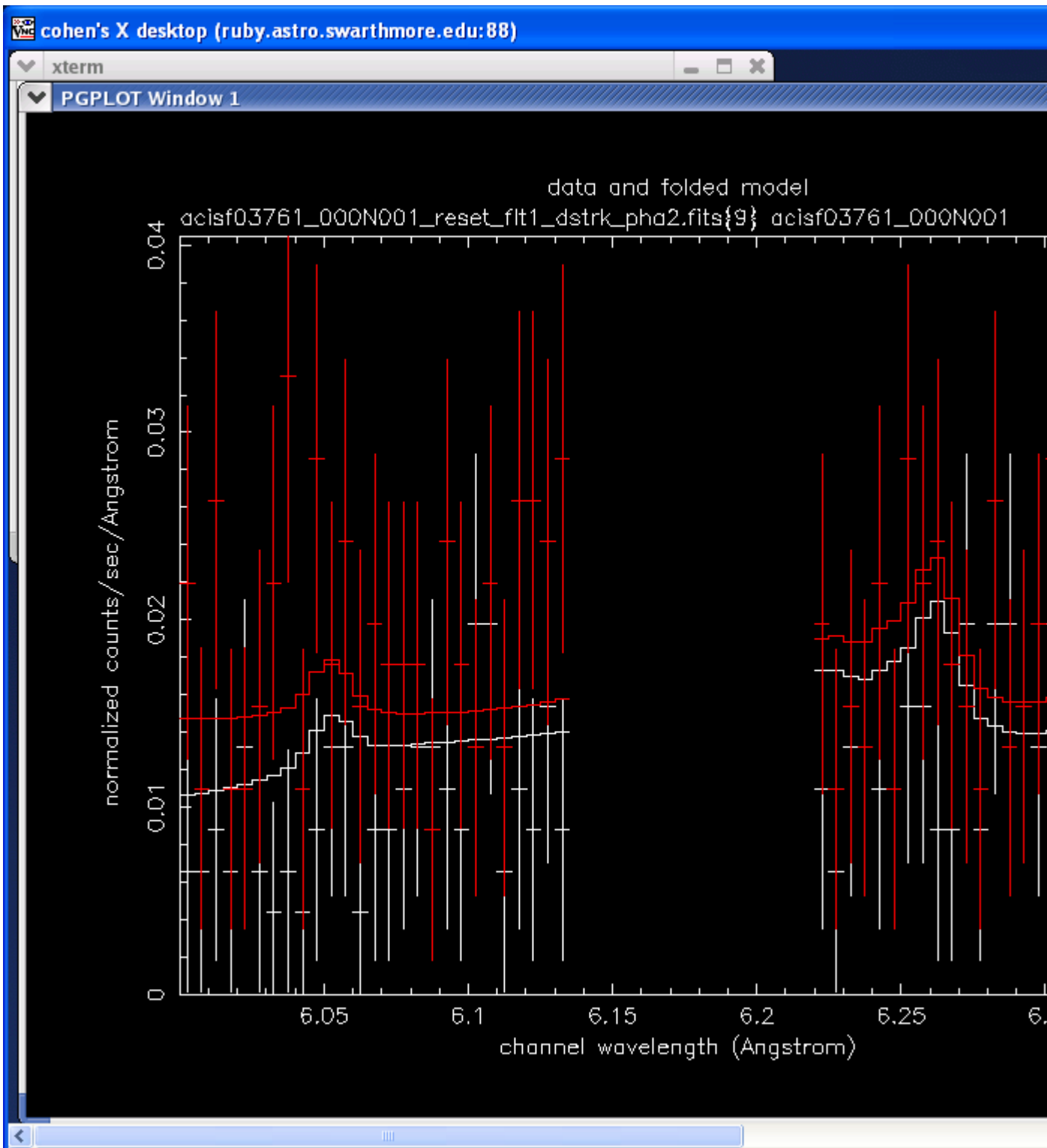
CONCLUSIONS: The $m=-1$ and $m=+1$ continuum levels are different at a statistically significant

level - so, systematic calibration issue? However, the combined data can be fit with a single continuum model that provides an adequate fit to the data. Probably, the spectra should be fit separately.

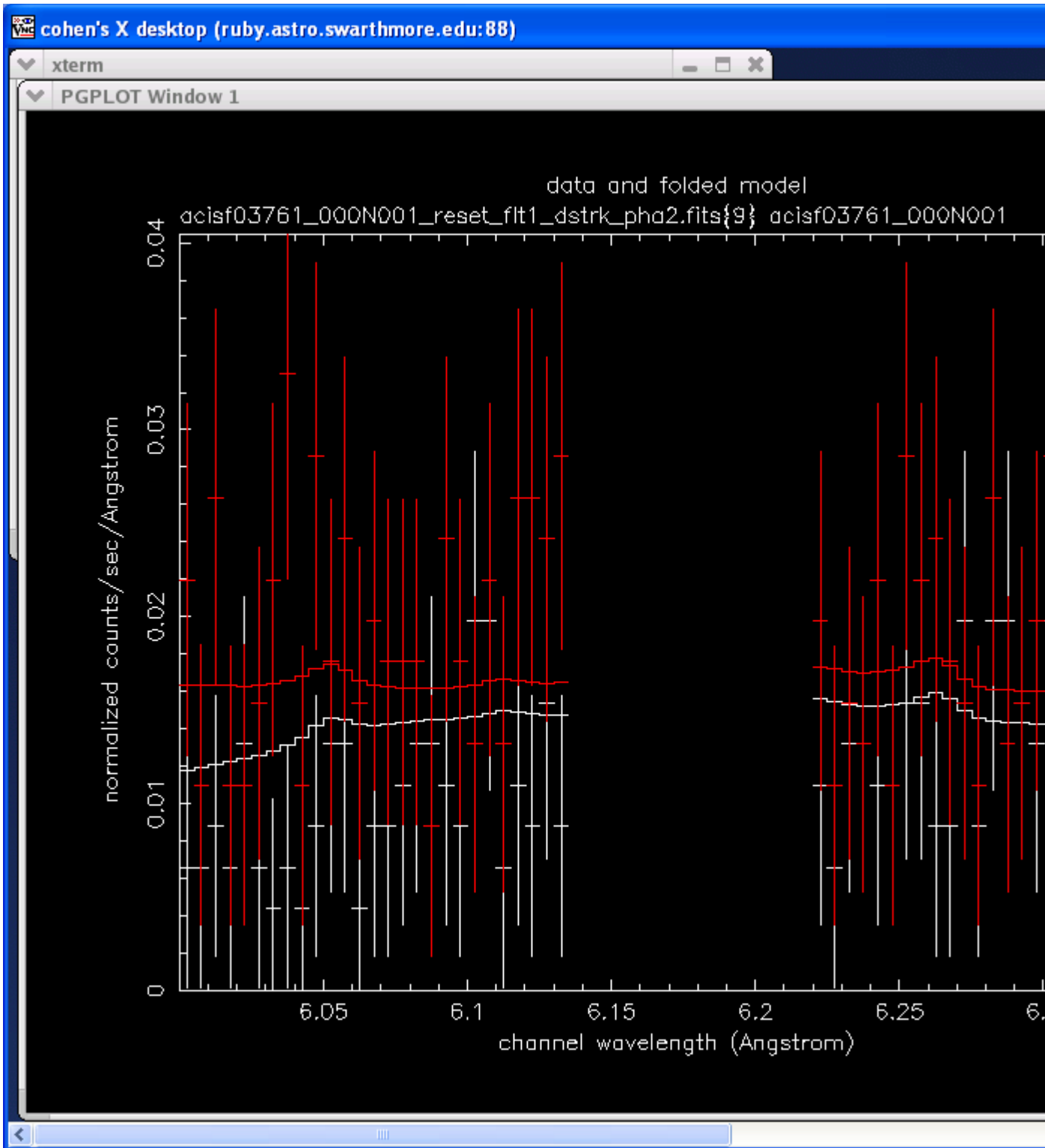
The fits using chi-square are systematically lower than those using C. If nothing else, this indicates that it makes a difference which statistic you use. We should probably just use C and forget about chi-square.

QUESTION: COULD THE RELATIVELY POOR FIT TO THE CONTINUUM (ASIDE FROM THE APPARENTLY DIFFERENT OVERALL CONTINUUM LEVELS BETWEEN THE -1 AND +1 SIDES) BE DUE TO THE PRESENCE OF LINES?

TEST: look at APEC models in this vicinity. A couple of weak to moderate lines at $kT=1\text{keV}$:



the lines are weaker at 2keV:



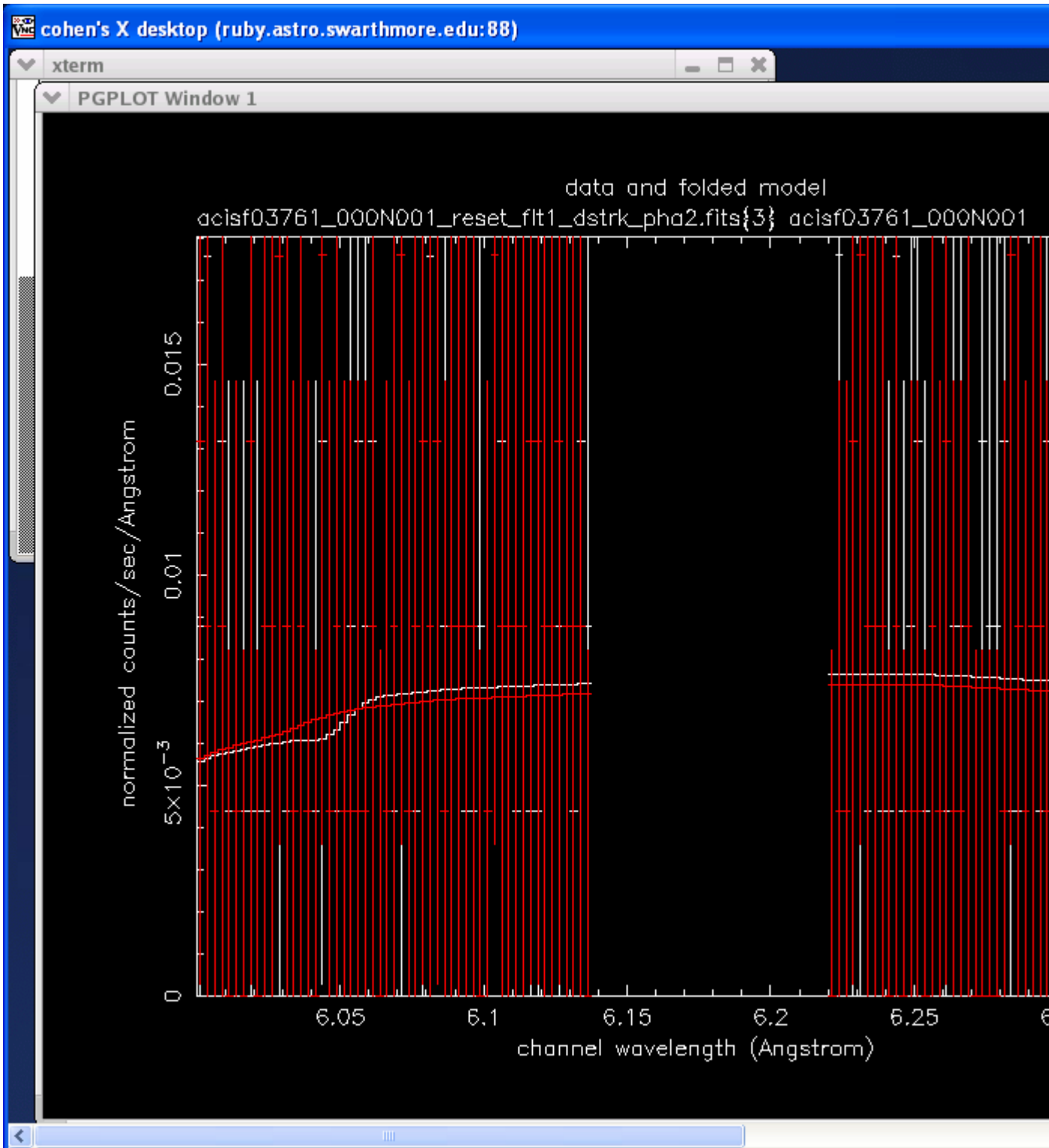
Those lines appear to be Al XIII at 6.05 and a satellite line of Si XIV at 6.26

1C) NOW, WE'LL LOOK AT THE HEG COMBINED +1,-1 SPECTRUM (CONTINUUM ONLY)

N=212

HEG +/- 1: norm=3.91e-3 (C-stat=214.4 > 7%) or norm=3.02e-3 (chisq=45.1 nu=211 100%)

Here's the best C-stat continuum fit:



3.70:4.12 e-3 at the $\Delta(C)=1$ limit

1D) ARE THE -1 AND +1 ARMS CONSISTENT?

HEG-1: norm=3.61e-3 (Delta(C)=1 gives a range of 3.33e-3:3.90e-3)

HEG+1: norm=4.22e-3 (Delta(C)=1 gives a range of 3.91e-3:4.54e-3)

CONCLUSIONS: The HEG and MEG levels also don't agree, with HEG being lower. However the two HEG grating arms do agree with each other (but this is probably due to the very low signal to noise).

Given this overall disagreement, let's fit the line on top of the continuum separately for each of the four spectra. For each of these, I've fixed the continuum level at that given by the continuum fitting described above (a different level for each of the four separate spectra).

HEG-1: best width = 0.06 mA (0.0 : 1.9 at the 68% level)

lam_o = 6.1836

norm = 2.24e-5

HEG+1: best width = 4.42 mA (3.6 : 6.3 at the 68% level) !aside: free lam_o gives a worse C than free lam_o?!?

lam_o = 6.1831

norm = 1.93e-5

MEG-1: best width = 5.4 mA (3.3 : 8.1 at the 68% level)

lam_o = 6.18127

norm = 4.95e-5

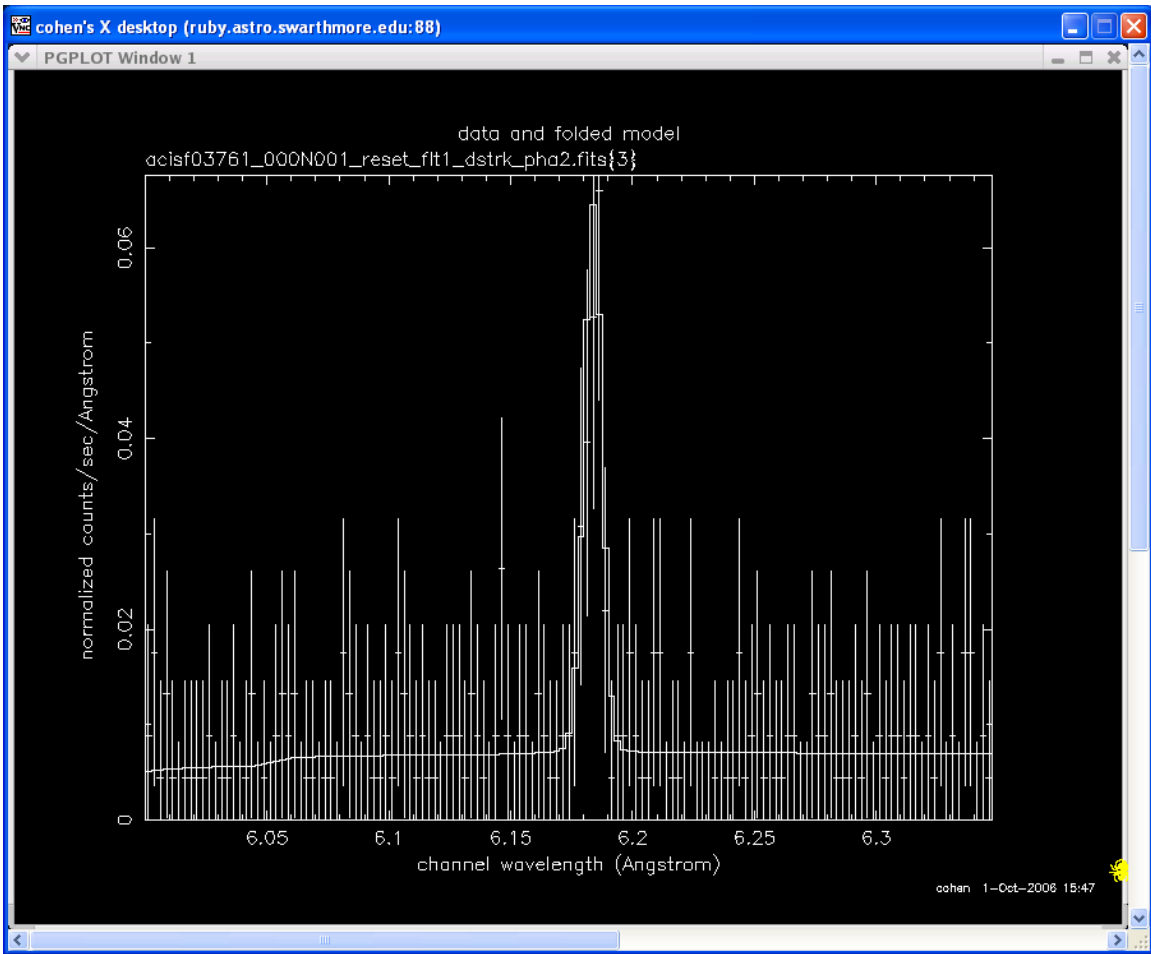
MEG+1: best width = 4.69 mA (2.7 : 6.4 at the 68% level)

lam_o = 6.18313

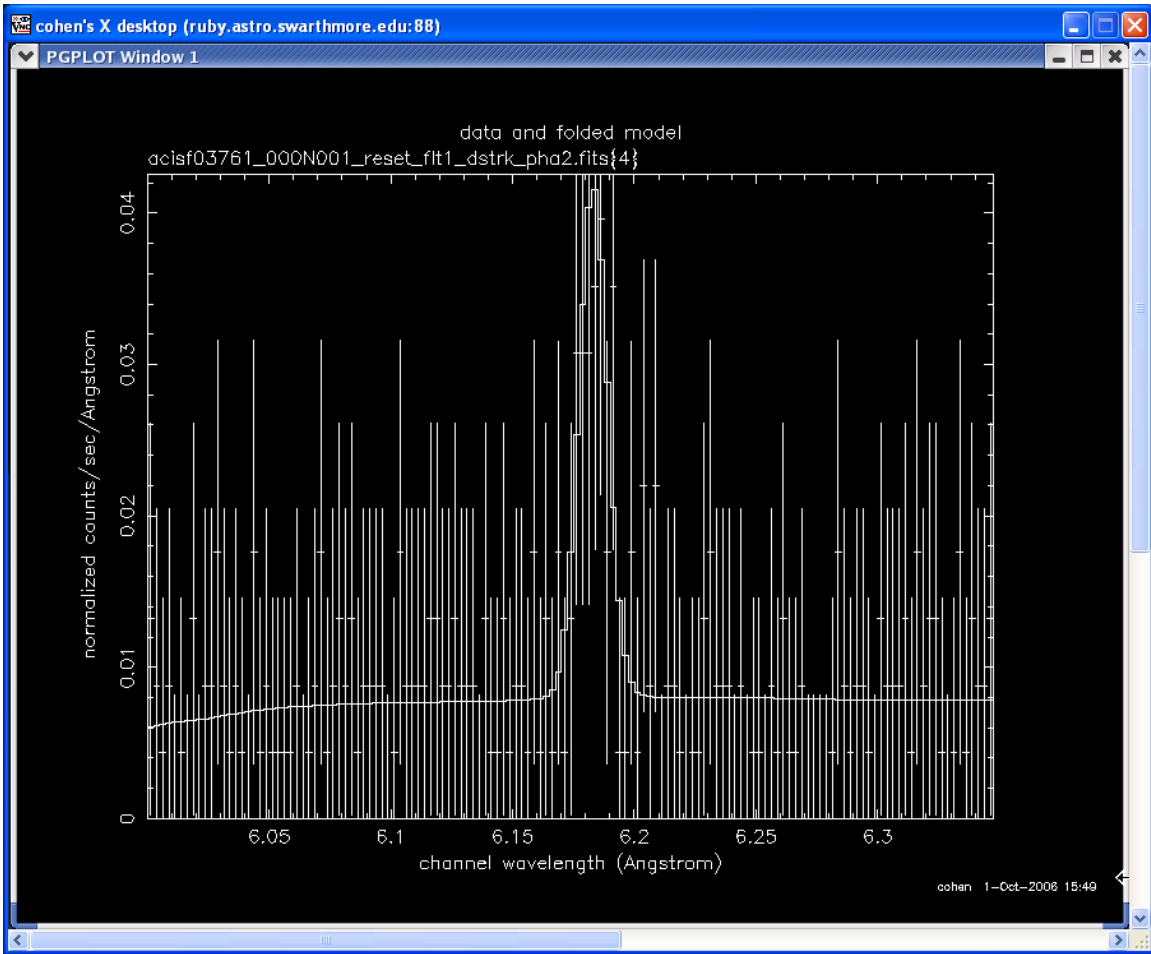
norm = 5.70e-5

Snapshots of each of these fits:

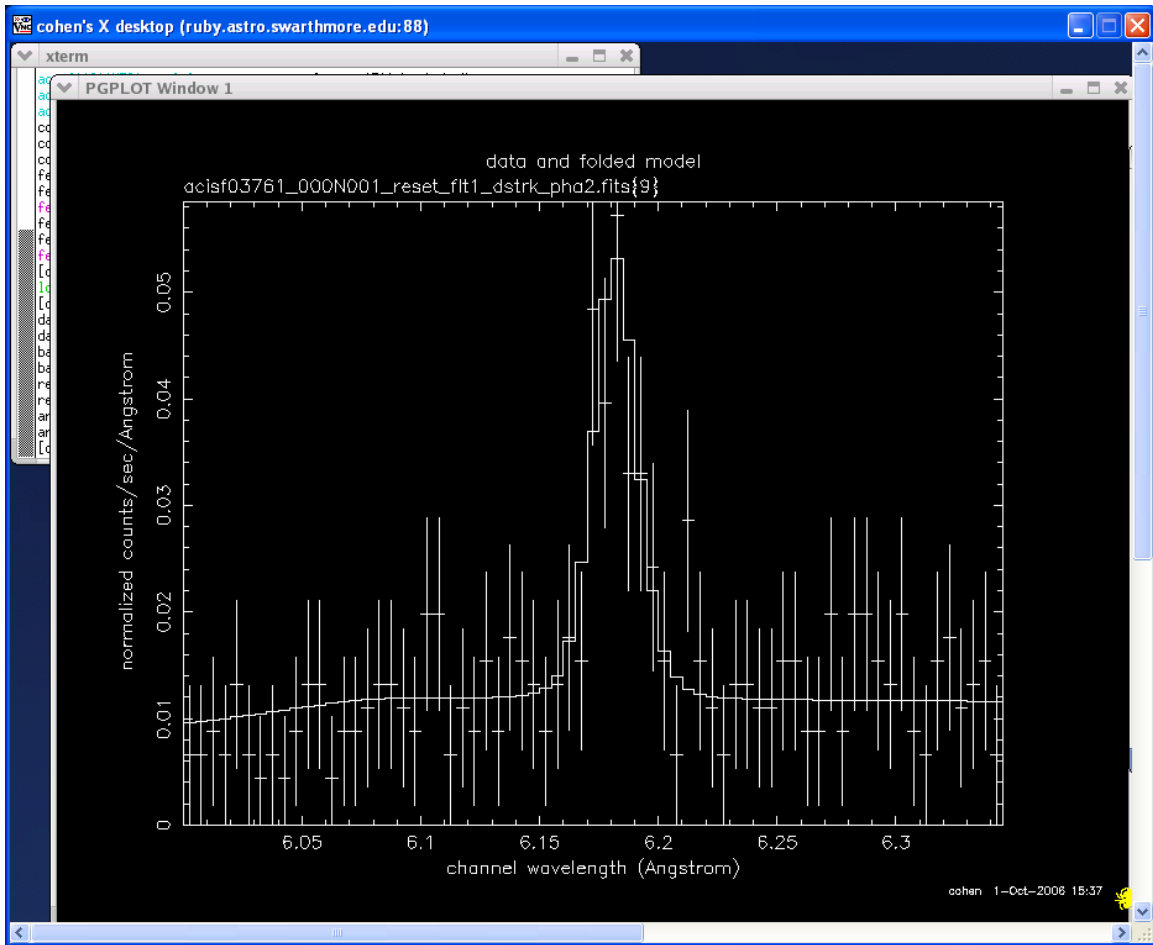
HEG-1:



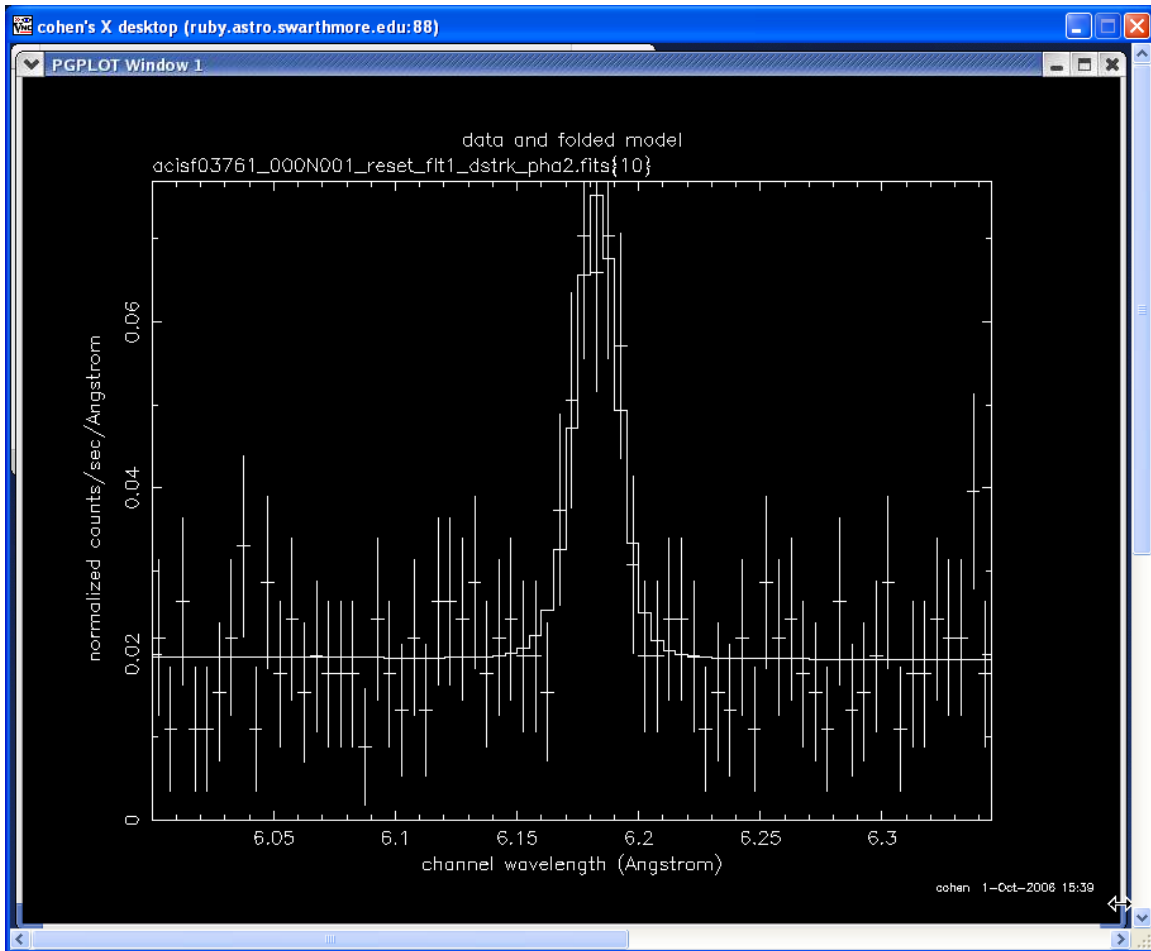
HEG+1:



MEG-1:



MEG+1:



CONCLUSIONS: No strong evidence for broadening. The broadening seen in the combined fit must have been due to slight offsets in the wavelength solution. Also, bear in mind that Ly-alpha lines are doublets – not resolved by any means, but this too will contribute to the appearance of broadening.

Another issue, though, is the sensitivity – relatively speaking, among the four spectra – the apparent discrepancy in the continuum levels and, in addition, of the normalizations of the Gaussians, points to some sort of systematic issue here.

Note: this message is given when loading the HEG-1 arf:

```
!XSPEC> resp 1 heg_m1.rmf;
```

```
!XSPEC> tclunknown resp 1 heg_m1.rmf
```

```
!XSPEC> ::namespace current
```

```
!XSPEC> response 1 heg_m1.rmf
```

```
!XSPEC> arf 1 acisf03761HEG_-1_garf.fits;
```

```
Note that RESPFILE keyword in ARF is grid(heg_p1_rmf.fits[cols ENERG_LO,ENERG_HI])
```

```
Note that RESPFILE keyword in ARF is grid(heg_p1_rmf.fits[cols ENERG_LO,ENERG_HI])
```

→ it looks like the garf was made with the +1 rmf... IS THIS OK?