PCARMF v2.02

Abstract

This memo describes briefly PCARMF v2.02, which is intended to be distributed as part of ftools v3.6.1. PCARMF v2.02 is also available via anonymous ftp from lheaftp:/pub/keith/pcarmf_v2.02.tar.

1 Results from the Crab

PCARMF v2.02 does well (i.e. reproduces an answer similar to previous experiments) in fitting the integrated (pulsar plus nebula) Crab spectrum in regions well away from the Xenon absorption edges and where the signal is much alrger than the background. Figure 1 shows the raw spectrum and estimated background for the front layer of one detector (PCU 0) from a short observation on 96 May 03. Figure 2 shows simultaneous fits to numerous independent spectra from this observation. The 15 spectra are one each for each layer of each PCU. The absolute normalizations of each detector is allowed to float but the layers of individual detectors are tied together. The detectors vary from each other by less than 4%. The normalization is gives the XSPEC derived normalization times the geometric area as no ancilliary response files are included. The fit, performed from 7-30 keV, is described by XSPEC as follows:

```
---------------------------------------------------------------------------
---------------------------------------------------------------------------
mo = constant[1] (wabs[3] (powerlaw[2]))
Model Fit Model   Component     Parameter   Value                      Data
par   par comp                                                         group
  1    1    1       constant    factor     1.00000     frozen            1
  2    2    2       powerlaw    PhoIndex   2.06909     +/-      0.       1
  3    3    2       powerlaw    norm       12719.0     +/-      0.       1
  4    4    3       wabs        nH 10^22  0.300000     frozen            1
  5    5    4       constant    factor    0.988265     +/-      0.       2
  6    2    5       powerlaw    PhoIndex   2.06909     = par   2         2
  7    3    5       powerlaw    norm       12719.0     = par   3         2
  8    4    6       wabs        nH 10^22  0.300000     = par   4         2
  9    6    7       constant    factor     1.00194     +/-      0.       3
 10    2    8       powerlaw    PhoIndex   2.06909     = par   2         3
```

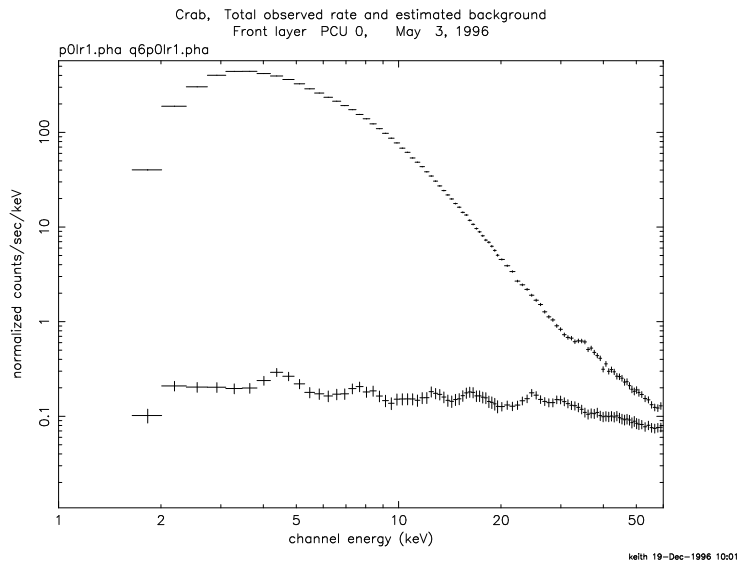

Figure 1: Observed data and estimated background for front layer of PCU 0 during May 3, 1996 Observation of the Crab.

```
 11    3    8      powerlaw    norm       12719.0     = par   3          3
 12    4    9      wabs        nH 10^22  0.300000     = par   4          3
 13    7   10      constant    factor    0.992992     +/-      0.        4
 14    2   11      powerlaw    PhoIndex   2.06909     = par   2          4
 15    3   11      powerlaw    norm       12719.0     = par   3          4
 16    4   12      wabs        nH 10^22  0.300000     = par   4          4
 17    8   13      constant    factor    0.961742     +/-      0.        5
 18    2   14      powerlaw    PhoIndex   2.06909     = par   2          5
 19    3   14      powerlaw    norm       12719.0     = par   3          5
 20    4   15      wabs        nH 10^22  0.300000     = par   4          5
-------------------------------------------------------------------------
-------------------------------------------------------------------------
```

The figures 3 through 7 show the same fit as in figure 2 although data is now considered from 2-60 keV on the front layers and from 7-60 on the inner layers. The data have been heavily rebinned at the higher energies using the XSPEC "set rebin 100 50" command. In each figure the balck line shows the front layer, the red line the second layer, and the green line the third layer.

PCARMF now allows an ad hoc adjustment to the efficiency. The adjustment is exactly the ratio of data to model as shown in these figures. For matrices constructed for individual layers, the relevant curve is chosen; for matrices which include the entire detector, the curve for the front layer is used. These adjustments are specific to version 2.02 of pcarmf, which is anticipated for release with ftools version 3.6.1. Future version of pcarmf will have different corrections, which will be smaller, we hope.

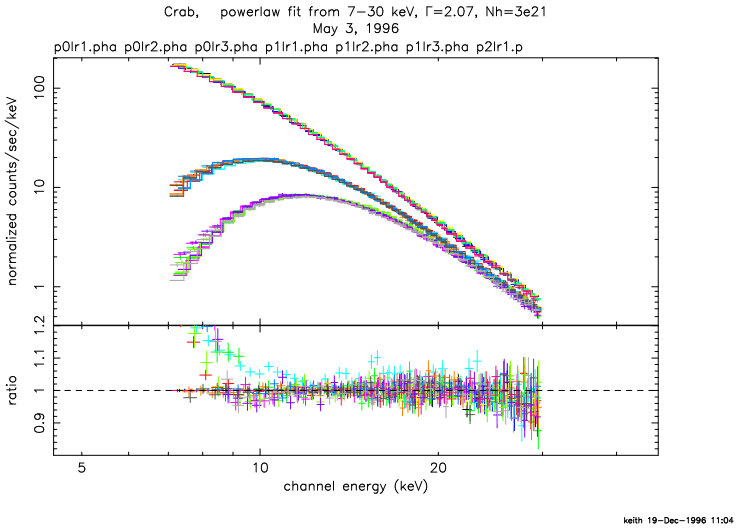

Figure 2: Crab data fit to powerlaw from 7-30 keV. Data handled separately for each detector and layer.

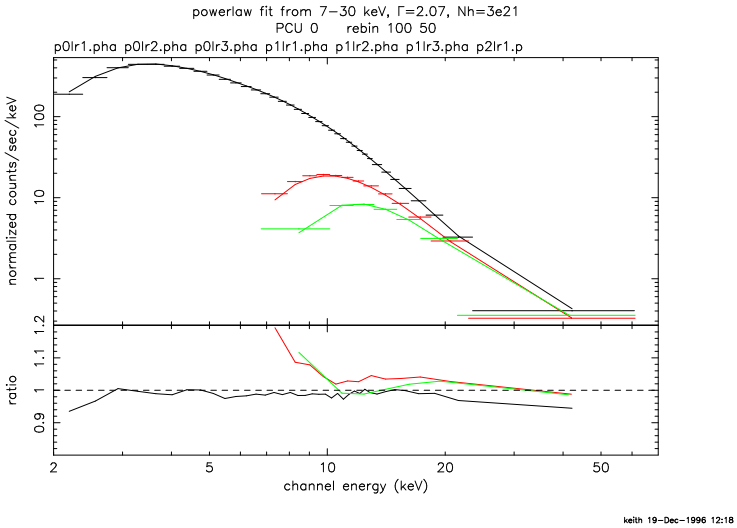

Figure 3: PCU 0, residuals to powerlaw fit between 7 and 30 keV

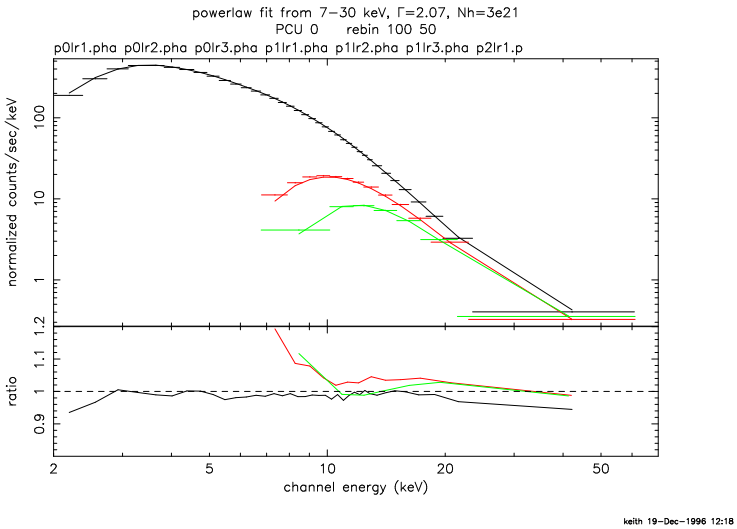

Figure 4: PCU 1, residuals to powerlaw fit between 7 and 30 keV

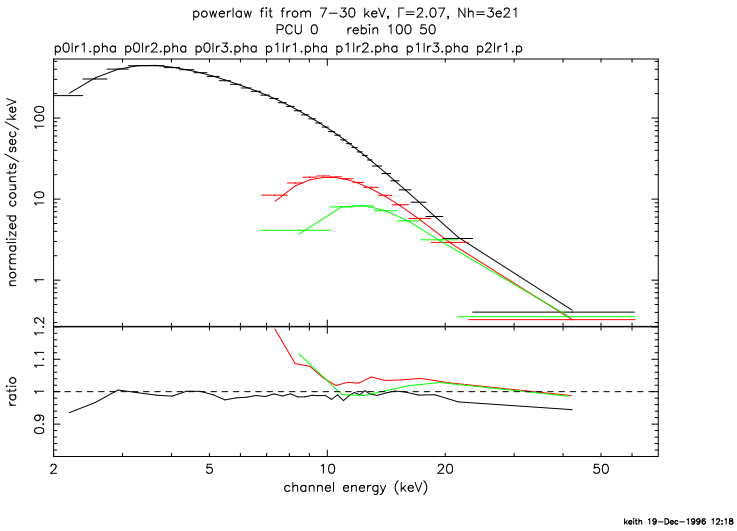

Figure 5: PCU 2, residuals to powerlaw fit between 7 and 30 keV

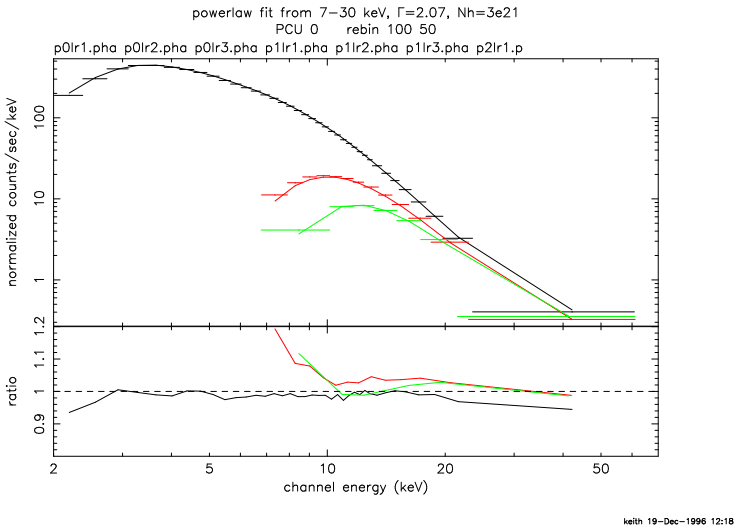

Figure 6: PCU 3, residuals to powerlaw fit between 7 and 30 keV

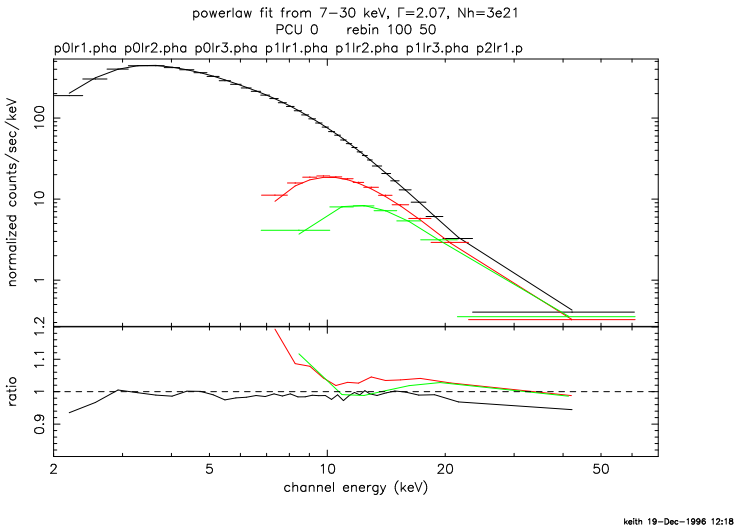

Figure 7: PCU 4, residuals to powerlaw fit between 7 and 30 keV

Table 1: Calibration line energies

Line number	Energy (keV)	$\frac{E_\gamma}{w(E)}$	Line source
1	4.110	186.47	Xenon L-escape
2	13.925	637.51	Np L_α
3	17.534	804.40	Np L_{beta}
4	21.125	970.85	Np L_{gamma}
5	~ 26		blend Kβ escape from 7 and Am^{241}
6	29.870	1372.75	Kα escape line from 7
7	59.537	2735.71	Am^{241}

2 Prospects for improvement

The details of the energy to channel scale at the lowest energies is both crucial and poorly determined. The large residuals for PCU 1 are certainly due to a misdetermination of the slope in the channel to energy relationship. The continuous calibration lines from the Americium 241 source are all between 13 and 60 keV. Table 1 gives the energies that are available from the calibration source. The lowest energy line, the Xenon L-escape photon at 4.1 keV, is only occasionally available, and without any information about which signal chain the events originate on. Examination of table 2 suggests that the differences from layer to layer, while small, may be important. A new mode has been developed, and is scheduled to be run on January 1, 1997, which will break the layer degeneracy. We also hope to include, self consistently, the physics of photoelectric conversion and subsequent electron production in Xenon filled counters.

Table 2: Fits to epoch 3 calibration lines

Energy	4.110	Xe-edge(4.78)	Cas-A(6.59)	13.925	17.534	21.125	29.87	59.537
Energy-p	4.102			14.025	17.697	21.359	30.20	60.186
PCU 0 - all	10.98		18.68	37.62	47.29	56.46	79.84	156.0
PCU 0 - LR1		12.43		37.90	47.70	56.81	80.35	156.6
PCU 0 - LR2		12.57		37.60	47.24	56.45	79.68	156.1
PCU 0 - LR3		12.35		37.54	47.12	56.26	79.48	155.2
PCU 1 - all	11.65		18.91	39.28	49.32	58.80	83.03	162.5
PCU 1 - LR1		12.72		38.93	49.02	58.40	82.61	161.4
PCU 1 - LR2		12.77		38.86	48.88	58.32	82.49	161.6
PCU 1 - LR3		13.16		39.60	49.75	59.44	83.98	164.4
PCU 2 - all	10.81		18.89	37.81	47.61	56.87	80.46	157.4
PCU 2 - LR1		12.44		37.96	47.81	57.01	80.62	157.5
PCU 2 - LR2		12.49		38.51	48.41	57.77	81.52	159.5
PCU 2 - LR3		12.75		37.43	47.00	56.12	79.35	155.5
PCU 3 - all	11.80		19.29	40.65	51.01	60.81	85.80	167.4
PCU 3 - LR1		13.43	19.22	40.63	51.05	60.85	85.78	167.0
PCU 3 - LR2		13.78		40.64	50.98	60.78	85.81	167.7
PCU 3 - LR3		13.72		40.66	51.01	60.80	85.82	167.6
PCU 4 - all	10.60		16.94	36.15	45.45	54.17	76.54	149.5
PCU 4 - LR1		11.68	17.00	36.21	45.58	54.23	76.70	149.8
PCU 4 - LR2		11.98		36.26	45.60	54.34	76.78	150.1
PCU 4 - LR3		12.31		36.08	45.28	54.02	76.19	148.8