Results of GS1354-645

A. one corona model

saved as: one_relxill

```
========================================================================
Model constant<1>*TBabs<2>*relxill<3> Source No.: 1   Active/On
Model Model Component  Parameter  Unit     Value
 par  comp
                    Data group: 1
   1    1   constant   factor            1.00000      frozen
   2    2   TBabs      nH        10^22    0.700000     frozen
   3    3   relxill    Index1             7.97899      +/-  1.90951
   4    3   relxill    Index2             0.576484     +/-  0.641333
   5    3   relxill    Rbr                4.97911      +/-  1.48078
   6    3   relxill    a                  0.997999     +/-  1.05997E-02
   7    3   relxill    Incl      deg      77.8588      +/-  1.64913
   8    3   relxill    Rin               -1.00000      frozen
   9    3   relxill    Rout               400.000      frozen
  10    3   relxill    z                  0.0          frozen
  11    3   relxill    gamma              1.81364      +/-  5.28792E-02
  12    3   relxill    logxi              0.988028     +/-  2.21393
  13    3   relxill    Afe                0.500000     +/-  7.62925E-02
  14    3   relxill    Ecut      keV      224.858      +/-  53.6875
  15    3   relxill    refl_frac          4.25646      +/-  1.29526
  16    3   relxill    norm               8.95778E-03  +/-  1.41709E-04
                    Data group: 2
  17    1   constant   factor             0.966432     +/-  1.09473E-03
  18    2   TBabs      nH        10^22    0.700000     = p2
  19    3   relxill    Index1             7.97899      = p3
  20    3   relxill    Index2             0.576484     = p4
  21    3   relxill    Rbr                4.97911      = p5
  22    3   relxill    a                  0.997999     = p6
  23    3   relxill    Incl      deg      77.8588      = p7
  24    3   relxill    Rin               -1.00000      = p8
  25    3   relxill    Rout               400.000      = p9
  26    3   relxill    z                  0.0          = p10
  27    3   relxill    gamma              1.81364      = p11
  28    3   relxill    logxi              0.988028     = p12
  29    3   relxill    Afe                0.500000     = p13
  30    3   relxill    Ecut      keV      224.858      = p14
  31    3   relxill    refl_frac          4.25646      = p15
  32    3   relxill    norm               8.95778E-03  = p16
```

Fit statistic : Chi-Squared 1427.14 using 1389 bins.
Chi-Squared 1540.56 using 1382 bins.
Total fit statistic ***2967.70 with 2759 d.o.f.***

Test statistic : Chi-Squared 2967.70 using 2771 bins.
Null hypothesis probability of 2.97e-03 with 2759 degrees of freedom

error

3 7.62326 9.39303 (-0.355726,1.41404)

4 1.57322 1.02294 (0.996736,0.446459)\

5 3.89914 7.09985 (-1.07998,2.12073)

6 0.99536 0 (-0.00263831,-0.997999) hit hard limit 0.998

7 75.2413 79.2152 (-2.61749,1.35635)

11 1.80262 1.85855 (-0.0110243,0.044908)

12 0.493237 1.31418 (-0.494791,0.326151)

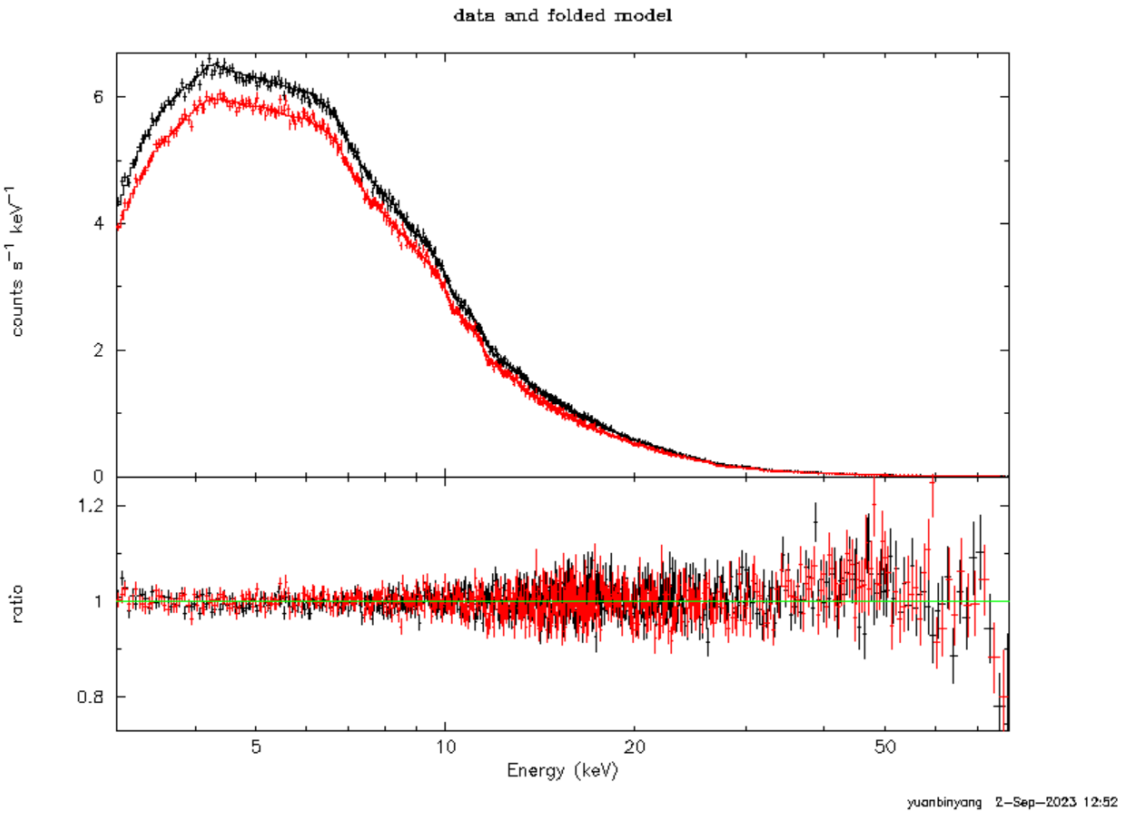
13 0 0.517383 (-0.5,0.017383) hit hard limit 0.5

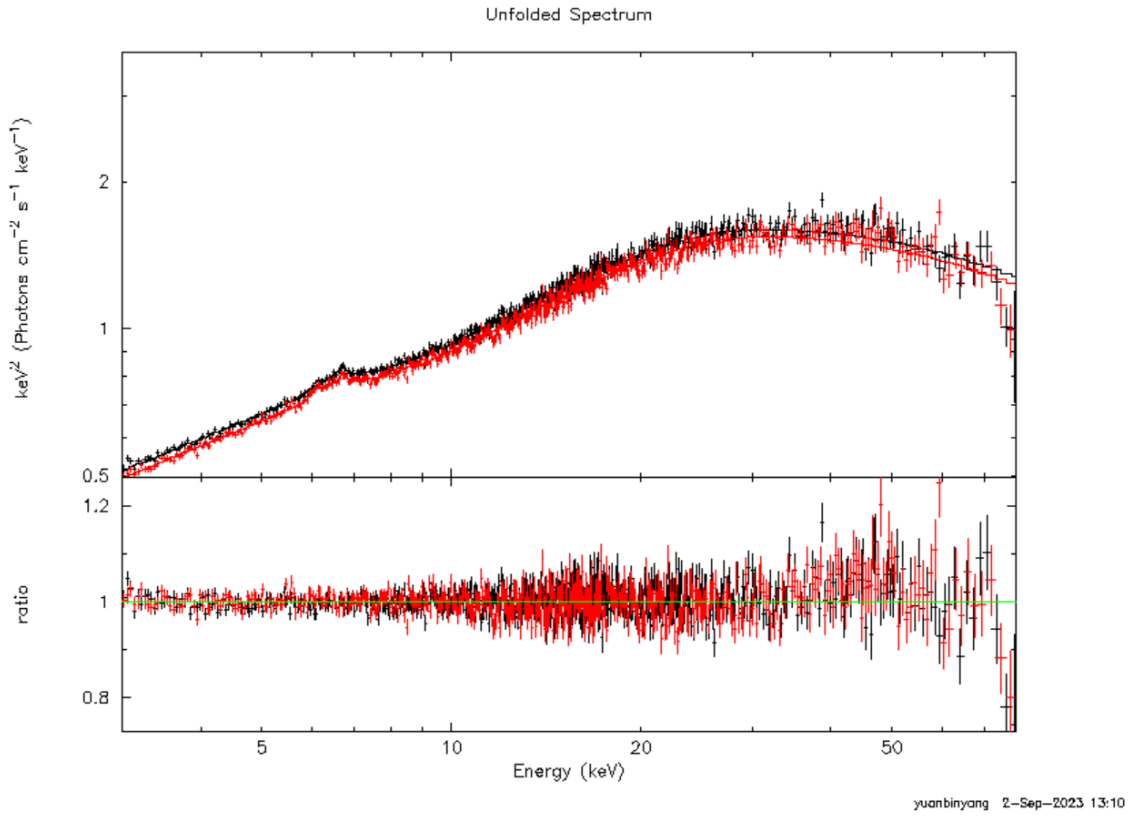
14 207.703 262.064 (-17.1546,37.2061)

15 3.94907 4.80541 (-0.307392,0.54895)

16 0.00880707 0.00906719 (-0.000150711,0.000109413)

17 0.96464 0.96824 (-0.00179147,0.0018083)





B. two corona model

model0: relxill_cutoffpl

saved as: relxill_cutoffpl

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Model constant<1>*TBabs<2>(relxill<3> + cutoffpl<4>) Source No.: 1 Active/On

Model Model Component Parameter Unit Value

par comp

Data group: 1

1	1	constant	factor		1.00000 frozen
2	2	TBabs	nH	10^22	0.700000 frozen
3	3	relxill	Index1		10.0000 +/- 27.9316
4	3	relxill	Index2		2.33806 +/- 0.174539
5	3	relxill	Rbr		2.73761 +/- 1.38896
6	3	relxill	a		0.997793 +/- 0.256714
7	3	relxill	Incl	deg	33.8277 +/- 2.42096
8	3	relxill	Rin		-1.00000 frozen
9	3	relxill	Rout		400.000 frozen
10	3	relxill	z		0.0 frozen
11	3	relxill	gamma		1.00000 +/- 0.455500
12	3	relxill	logxi		3.13997 +/- 8.87161E-02
13	3	relxill	Afe		1.09715 +/- 0.796752
14	3	relxill	Ecut	keV	49.9742 +/- 11.6000
15	3	relxill	refl_frac		0.858862 +/- 1.73848
16	3	relxill	norm		6.03373E-03 +/- 1.10057E-02
17	4	cutoffpl	PhoIndex		2.30490 +/- 1.42291

```
 18   4  cutoffpl  HighECut  keV     57.8911      +/-  2742.23
 19   4  cutoffpl  norm              0.469601     +/-  0.369837
                    Data group: 2
 20   1  constant  factor            0.966432     +/-  1.09472E-03
 21   2  TBabs     nH        10^22    0.700000     = p2
 22   3  relxill   Index1             10.0000      = p3
 23   3  relxill   Index2             2.33806      = p4
 24   3  relxill   Rbr                2.73761      = p5
 25   3  relxill   a                  0.997793     = p6
 26   3  relxill   Incl      deg      33.8277      = p7
 27   3  relxill   Rin               -1.00000      = p8
 28   3  relxill   Rout               400.000      = p9
 29   3  relxill   z                  0.0          = p10
 30   3  relxill   gamma              1.00000      = p11
 31   3  relxill   logxi              3.13997      = p12
 32   3  relxill   Afe                1.09715      = p13
 33   3  relxill   Ecut      keV      49.9742      = p14
 34   3  relxill   refl_frac          0.858862     = p15
 35   3  relxill   norm               6.03373E-03  = p16
 36   4  cutoffpl  PhoIndex           2.30490      = p17
 37   4  cutoffpl  HighECut  keV      57.8911      = p18
 38   4  cutoffpl  norm               0.469601     = p19
```

Fit statistic : Chi-Squared 1396.29 using 1389 bins.
Chi-Squared 1522.38 using 1382 bins.
Total fit statistic ***2918.67 with 2756 d.o.f.***

Test statistic : Chi-Squared 2918.67 using 2771 bins.
Null hypothesis probability of 1.55e-02 with 2756 degrees of freedom

error

3 7.38896 0 (-2.61104,-10) hit hard limit 10

4 2.06127 2.54707 (-0.27679,0.20901)

5 2.57418 3.48487 (-0.163435,0.747261)

6 0.786647 0 (-0.211147,-0.997793) hit hard limit 0.998

7 30.1425 37.0394 (-3.68527,3.21162)

11 0 1.07784 (-1,0.0778357) hit hard limit 1

12 3.09545 3.21189 (-0.0445212,0.0719171)

13 0.80969 1.90008 (-0.287455,0.802938)

14 48.5191 52.0955 (-1.45509,2.12128)

15 0.524865 1.07806 (-0.333997,0.219196)

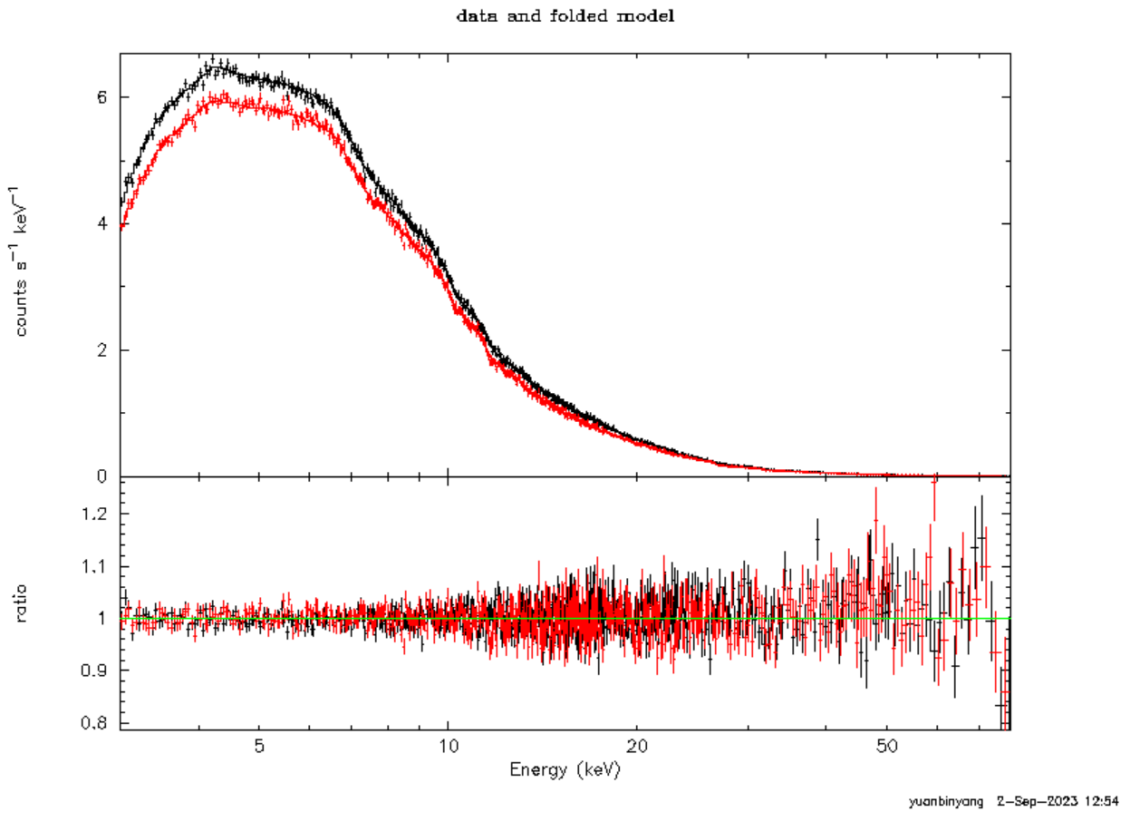
16 0.00547676 0.00661655 (-0.000556976,0.000582818)

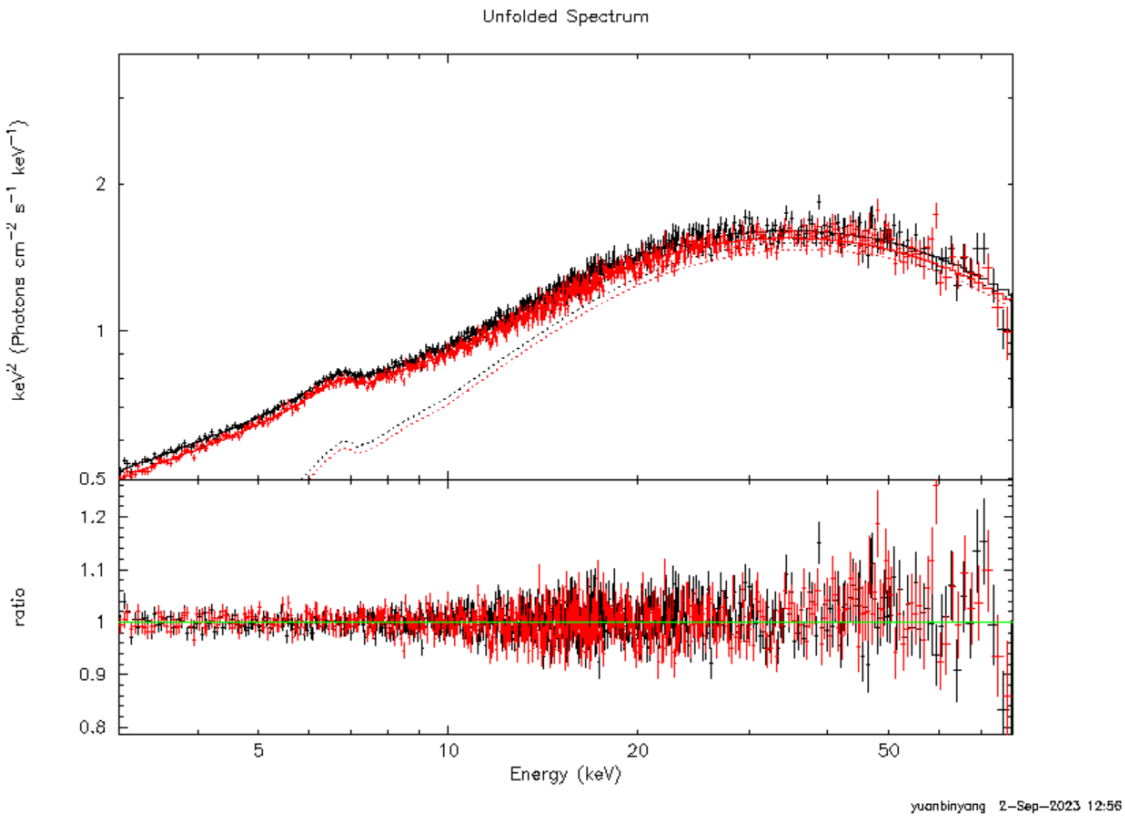
17 2.11941 2.45898 (-0.185492,0.154086)

18 0.0102907 0 (-57.8809,-57.8911) hit hard limit 500

19 0.406378 0.518143 (-0.0632227,0.0485425)

20 0.964634 0.968233 (-0.00179863,0.00180024)





fixed gamma: saved as relxill_cutoffpl_gammafixed

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========================================================================
Model constant<1>*TBabs<2>(relxill<3> + cutoffpl<4>) Source No.: 1   Active/On
Model Model Component  Parameter  Unit     Value
 par  comp
                   Data group: 1
   1    1   constant   factor            1.00000      frozen
   2    2   TBabs      nH        10^22    0.700000     frozen
   3    3   relxill    Index1             9.99885      +/-  4.60408
   4    3   relxill    Index2             2.66865E-02  +/-  1.23690
   5    3   relxill    Rbr               5.23916      +/-  2.13327
   6    3   relxill    a                 0.995902     +/-  7.94640E-03
   7    3   relxill    Incl      deg     76.9532      +/-  1.60098
   8    3   relxill    Rin               -1.00000     frozen
   9    3   relxill    Rout              400.000      frozen
  10    3   relxill    z                 0.0          frozen
  11    3   relxill    gamma             1.60000      frozen
  12    3   relxill    logxi             1.99793      +/-  0.152517
  13    3   relxill    Afe               0.858751     +/-  0.167279
  14    3   relxill    Ecut      keV     105.233      +/-  4.32418
  15    3   relxill    refl_frac         2.31878      +/-  0.291288
  16    3   relxill    norm              8.76524E-03  +/-  1.93411E-04
  17    4   cutoffpl   PhoIndex          3.79275      +/-  6.98175
  18    4   cutoffpl   HighECut   keV    2.83186      +/-  18.2569
  19    4   cutoffpl   norm              1.13286      +/-  1.55037

                  Data group: 2

  20    1   constant   factor            0.966425     +/-  1.09471E-03
  21    2   TBabs      nH        10^22    0.700000     = p2
  22    3   relxill    Index1             9.99885      = p3
  23    3   relxill    Index2             2.66865E-02  = p4
  24    3   relxill    Rbr               5.23916      = p5
  25    3   relxill    a                 0.995902     = p6
  26    3   relxill    Incl      deg     76.9532      = p7
  27    3   relxill    Rin               -1.00000     = p8
  28    3   relxill    Rout              400.000      = p9
  29    3   relxill    z                 0.0          = p10
  30    3   relxill    gamma             1.60000      = p11
  31    3   relxill    logxi             1.99793      = p12
  32    3   relxill    Afe               0.858751     = p13
  33    3   relxill    Ecut      keV     105.233      = p14
  34    3   relxill    refl_frac         2.31878      = p15
  35    3   relxill    norm              8.76524E-03  = p16
  36    4   cutoffpl   PhoIndex          3.79275      = p17
  37    4   cutoffpl   HighECut   keV    2.83186      = p18
  38    4   cutoffpl   norm              1.13286      = p19
```

```
Fit statistic  : Chi-Squared              1403.38     using 1389 bins.
                 Chi-Squared              1530.47     using 1382 bins.
Total fit statistic                       2933.85     with 2757 d.o.f.

Test statistic : Chi-Squared              2933.85     using 2771 bins.
 Null hypothesis probability of 9.60e-03 with 2757 degrees of freedom
```

error:

3 9.1393 0 (-0.859548,-9.99885) hit hard limit 10

4 1.33041 1.26191 (1.30372,1.23523)

5 3.18948 6.82474 (-2.04968,1.58558)

6 0.991039 0 (-0.00486258,-0.995902) hit hard limit 0.998

7 71.94 78.943 (-5.01318,1.98976)

12 1.79521 2.07504 (-0.202715,0.0771092)

13 0.72381 1.38196 (-0.13494,0.523213)

14 100.765 109.735 (-4.46708,4.50261)

15 1.65557 2.81824 (-0.663214,0.499462)

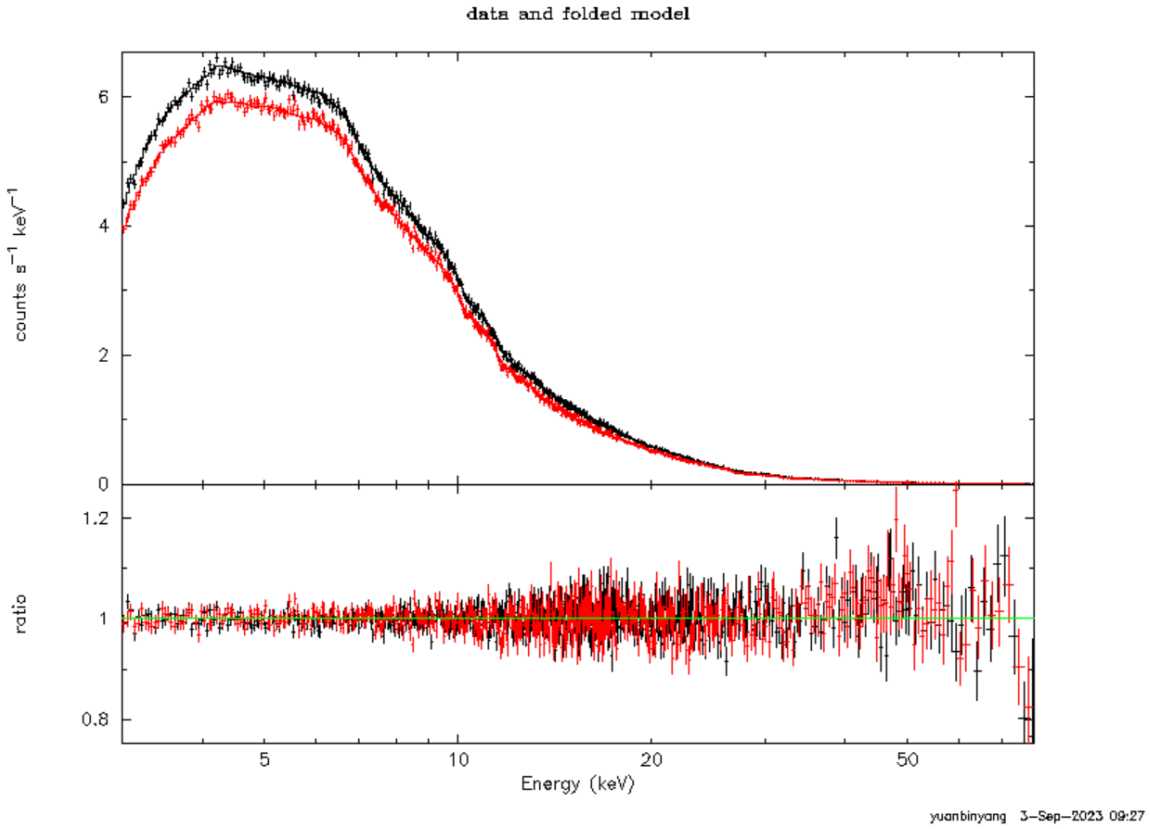
16 0.00863938 0.00893667 (-0.000125867,0.00017143)

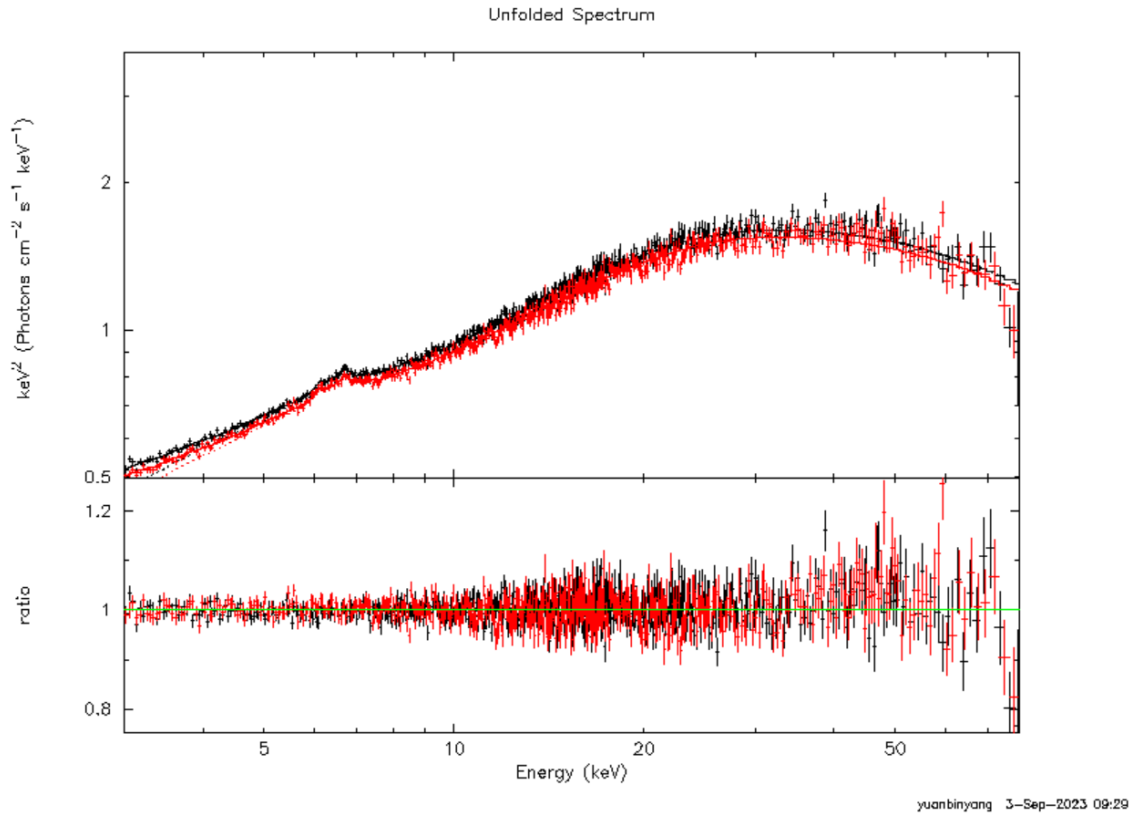
17 1.98873 6.1688 (-1.80403,2.37605)

18 0.426377 0 (-2.40548,-2.83186) hit hard limit 500

19 0.384687 8.39294 (-0.748168,7.26009)

20 0.964626 0.968229 (-0.00179963,0.00180379)





model1: index1=index2(both)

[1.1]same logxi

saved as: model1_samelogxi_err3

```
========================================================================
Model constant<1>*TBabs<2>(relxill<3> + relxill<4>) Source No.: 1   Active/On
Model Model Component  Parameter  Unit     Value
 par  comp
                    Data group: 1
   1    1  constant   factor           1.00000      frozen
   2    2  TBabs      nH        10^22   0.700000     frozen
   3    3  relxill    Index1            10.0000      +/-  3.52360E+06
   4    3  relxill    Index2            10.0000      = p3
   5    3  relxill    Rbr               400.000      frozen
   6    3  relxill    a                 0.890203     +/-  0.154360
   7    3  relxill    Incl      deg     57.2595      +/-  13.5304
   8    3  relxill    Rin               -1.00000     frozen
   9    3  relxill    Rout              400.000      frozen
  10    3  relxill    z                 0.0          frozen
  11    3  relxill    gamma             2.65643      +/-  0.754233
  12    3  relxill    logxi             2.99148      +/-  0.200934
  13    3  relxill    Afe               1.58973      +/-  0.892321
  14    3  relxill    Ecut      keV     43.8205      +/-  1410.22
  15    3  relxill    refl_frac         1.00369E-05  +/-  1.42252
  16    3  relxill    norm              6.64325E-03  +/-  8.65604E-03
  17    4  relxill    Index1            10.0000      +/-  15.8893
  18    4  relxill    Index2            10.0000      = p17
```

```
 19   4  relxill   Rbr              400.000      = p5
 20   4  relxill   a               0.890203     = p6
 21   4  relxill   Incl      deg    57.2595      = p7
 22   4  relxill   Rin             -1.00000     = p8
 23   4  relxill   Rout             400.000      = p9
 24   4  relxill   z               0.0          = p10
 25   4  relxill   gamma            1.15276      +/-  0.258837
 26   4  relxill   logxi            2.99148      = p12
 27   4  relxill   Afe              1.58973      = p13
 28   4  relxill   Ecut      keV    49.5461      +/-  10.0058
 29   4  relxill   refl_frac        0.517564     +/-  0.301865
 30   4  relxill   norm             7.74884E-03  +/-  4.28056E-03

                Data group: 2

 31   1  constant  factor           0.966425     +/-  1.09471E-03
 32   2  TBabs     nH       10^22   0.700000     = p2
 33   3  relxill   Index1           10.0000      = p3
 34   3  relxill   Index2           10.0000      = p4
 35   3  relxill   Rbr              400.000      = p5
 36   3  relxill   a               0.890203     = p6
 37   3  relxill   Incl      deg    57.2595      = p7
 38   3  relxill   Rin             -1.00000     = p8
 39   3  relxill   Rout             400.000      = p9
 40   3  relxill   z               0.0          = p10
 41   3  relxill   gamma            2.65643      = p11
 42   3  relxill   logxi            2.99148      = p12
 43   3  relxill   Afe              1.58973      = p13
 44   3  relxill   Ecut      keV    43.8205      = p14
 45   3  relxill   refl_frac        1.00369E-05  = p15
 46   3  relxill   norm             6.64325E-03  = p16
 47   4  relxill   Index1           10.0000      = p17
 48   4  relxill   Index2           10.0000      = p18
 49   4  relxill   Rbr              400.000      = p19
 50   4  relxill   a               0.890203     = p20
 51   4  relxill   Incl      deg    57.2595      = p21
 52   4  relxill   Rin             -1.00000     = p22
 53   4  relxill   Rout             400.000      = p23
 54   4  relxill   z               0.0          = p24
 55   4  relxill   gamma            1.15276      = p25
 56   4  relxill   logxi            2.99148      = p26
 57   4  relxill   Afe              1.58973      = p27
 58   4  relxill   Ecut      keV    49.5461      = p28
 59   4  relxill   refl_frac        0.517564     = p29
 60   4  relxill   norm             7.74884E-03  = p30
```

Fit statistic : Chi-Squared 1393.15 using 1389 bins.
Chi-Squared 1519.97 using 1382 bins.
Total fit statistic ***2913.12 with 2756 d.o.f.***

Test statistic : Chi-Squared 2913.12 using 2771 bins.
Null hypothesis probability of 1.85e-02 with 2756 degrees of freedom

error

3 0 0 (-10,-10) hit hard limit 1E-5 10

6 0.777156 0.939634 (-0.112261,0.0502172)

7 48.3176 68.3151 (-8.9032,11.0943)

11 2.05437 2.81955 (-0.601826,0.16335)

12 2.88954 3.04883 (-0.104548,0.0547468)

13 1.13646 1.8971 (-0.421448,0.339195)

14 0 0 (-42.5312,-42.5312) hit hard limit 5 1000

15 0 0.613591 (-1.00001e-05,0.613581) hit hard limit 1E-5

16 0.003369 0.00896706 (-0.00327821,0.00231985)

17 8.6218 0 (-1.3782,-10) hit hard limit 10

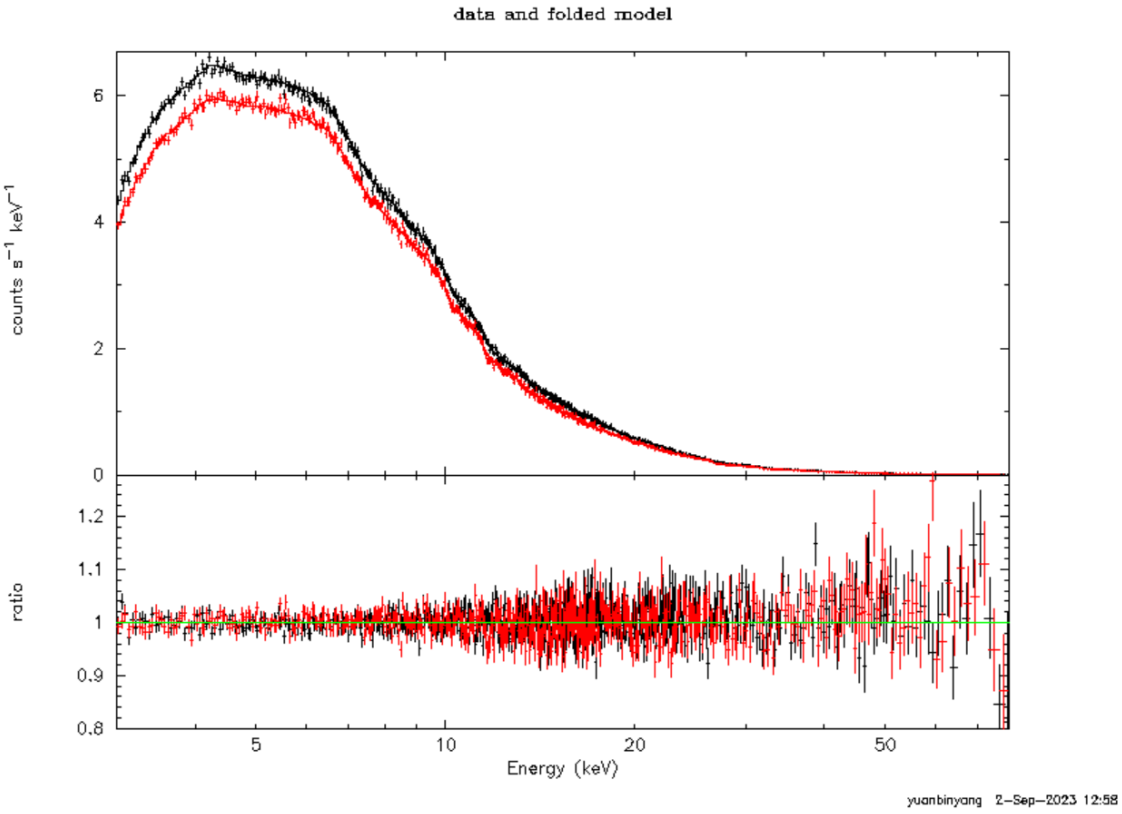
25 0 1.20421 (-1.15291,0.0513016) hit hard limit 1

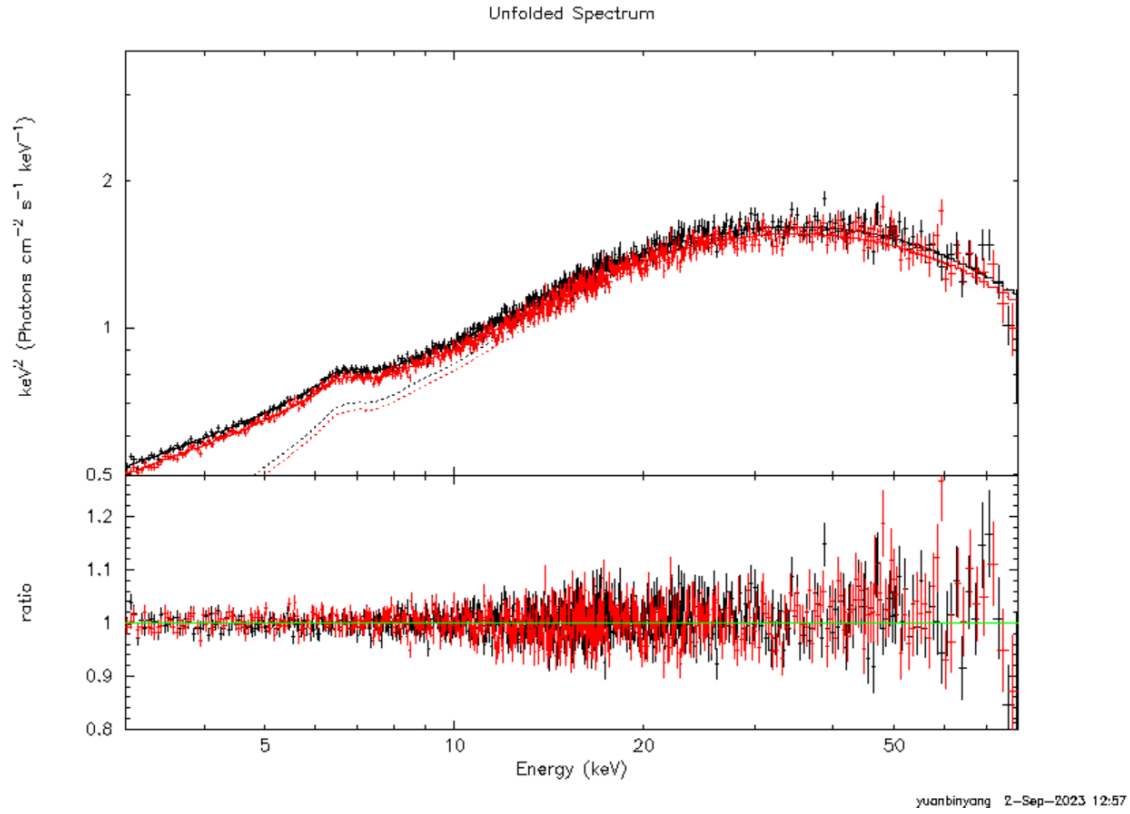
28 41.0861 54.4086 (-8.48566,4.83676)

29 0.437584 0.612368 (-0.0821373,0.092647)

30 0.007171 0.00827747 (-0.00056887,0.0005376)

31 0.964632 0.968232 (-0.00179341,0.00180691)





[1.2]different logxi

saved as: model1_differentlogxi

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Model constant<1>*TBabs<2>(relxill<3> + relxill<4>) Source No.: 1 Active/On

Model Model Component Parameter Unit Value

par comp

Data group: 1

1	1	constant	factor		1.00000	frozen
2	2	TBabs	nH	10^22	0.700000	frozen
3	3	relxill	Index1		1.00000E-05	+/- 3.18644
4	3	relxill	Index2		1.00000E-05	= p3
5	3	relxill	Rbr		400.000	frozen
6	3	relxill	a		0.985963	+/- 2.20244E-02
7	3	relxill	Incl	deg	68.5015	+/- 4.58633
8	3	relxill	Rin		-1.00000	frozen
9	3	relxill	Rout		400.000	frozen
10	3	relxill	z		0.0	frozen
11	3	relxill	gamma		2.31957	+/- 0.676837
12	3	relxill	logxi		2.01583	+/- 0.323942
13	3	relxill	Afe		0.855236	+/- 0.260614
14	3	relxill	Ecut	keV	79.7474	+/- 563.676
15	3	relxill	refl_frac		1.16268	+/- 1.10169
16	3	relxill	norm		5.10203E-03	+/- 3.14573E-03
17	4	relxill	Index1		7.20344	+/- 2.69971
18	4	relxill	Index2		7.20344	= p17
19	4	relxill	Rbr		400.000	= p5
20	4	relxill	a		0.985963	= p6
21	4	relxill	Incl	deg	68.5015	= p7

22 4 relxill Rin -1.00000 = p8
23 4 relxill Rout 400.000 = p9
24 4 relxill z 0.0 = p10
25 4 relxill gamma 1.00000 +/- 0.664500
26 4 relxill logxi 3.18711 +/- 0.271172
27 4 relxill Afe 0.855236 = p13
28 4 relxill Ecut keV 47.2867 +/- 12.0948
29 4 relxill refl_frac 1.00440 +/- 0.410049
30 4 relxill norm 6.15284E-03 +/- 1.37205E-03
Data group: 2
31 1 constant factor 0.966434 +/- 1.09472E-03
32 2 TBabs nH 10^22 0.700000 = p2
33 3 relxill Index1 1.00000E-05 = p3
34 3 relxill Index2 1.00000E-05 = p4
35 3 relxill Rbr 400.000 = p5
36 3 relxill a 0.985963 = p6
37 3 relxill Incl deg 68.5015 = p7
38 3 relxill Rin -1.00000 = p8
39 3 relxill Rout 400.000 = p9
40 3 relxill z 0.0 = p10
41 3 relxill gamma 2.31957 = p11
42 3 relxill logxi 2.01583 = p12
43 3 relxill Afe 0.855236 = p13
44 3 relxill Ecut keV 79.7474 = p14
45 3 relxill refl_frac 1.16268 = p15
46 3 relxill norm 5.10203E-03 = p16
47 4 relxill Index1 7.20344 = p17
48 4 relxill Index2 7.20344 = p18
49 4 relxill Rbr 400.000 = p19
50 4 relxill a 0.985963 = p20
51 4 relxill Incl deg 68.5015 = p21
52 4 relxill Rin -1.00000 = p22
53 4 relxill Rout 400.000 = p23
54 4 relxill z 0.0 = p24
55 4 relxill gamma 1.00000 = p25
56 4 relxill logxi 3.18711 = p26
57 4 relxill Afe 0.855236 = p27
58 4 relxill Ecut keV 47.2867 = p28
59 4 relxill refl_frac 1.00440 = p29
60 4 relxill norm 6.15284E-03 = p30

Fit statistic : Chi-Squared 1393.53 using 1389 bins.
Chi-Squared 1515.51 using 1382 bins.
Total fit statistic ***2909.04 with 2755 d.o.f.***

Test statistic : Chi-Squared 2909.04 using 2771 bins.
Null hypothesis probability of 2.03e-02 with 2755 degrees of freedom

error

3 0 2.62085 (-1e-05,2.62084) hit hard limit 1E-5

6 0.931043 0.996556 (-0.05492,0.0105933)

7 58.1984 76.2786 (-10.3031,7.77707)

11 2.08541 2.81464 (-0.234158,0.49507)

12 1.71222 2.23826 (-0.303598,0.22244)

13 0.7366 1.24396 (-0.118638,0.388718)

14 11.865 0 (-67.8823,-79.7473) hit hard limit 1000

15 0.796761 2.05578 (-0.365913,0.893105)

16 0.0035795 0.00716416 (-0.00152254,0.00206212)

17 4.08562 0 (-3.11789,-7.20351) hit hard limit 10

25 0 1.10356 (-1,0.103561) hit hard limit 1

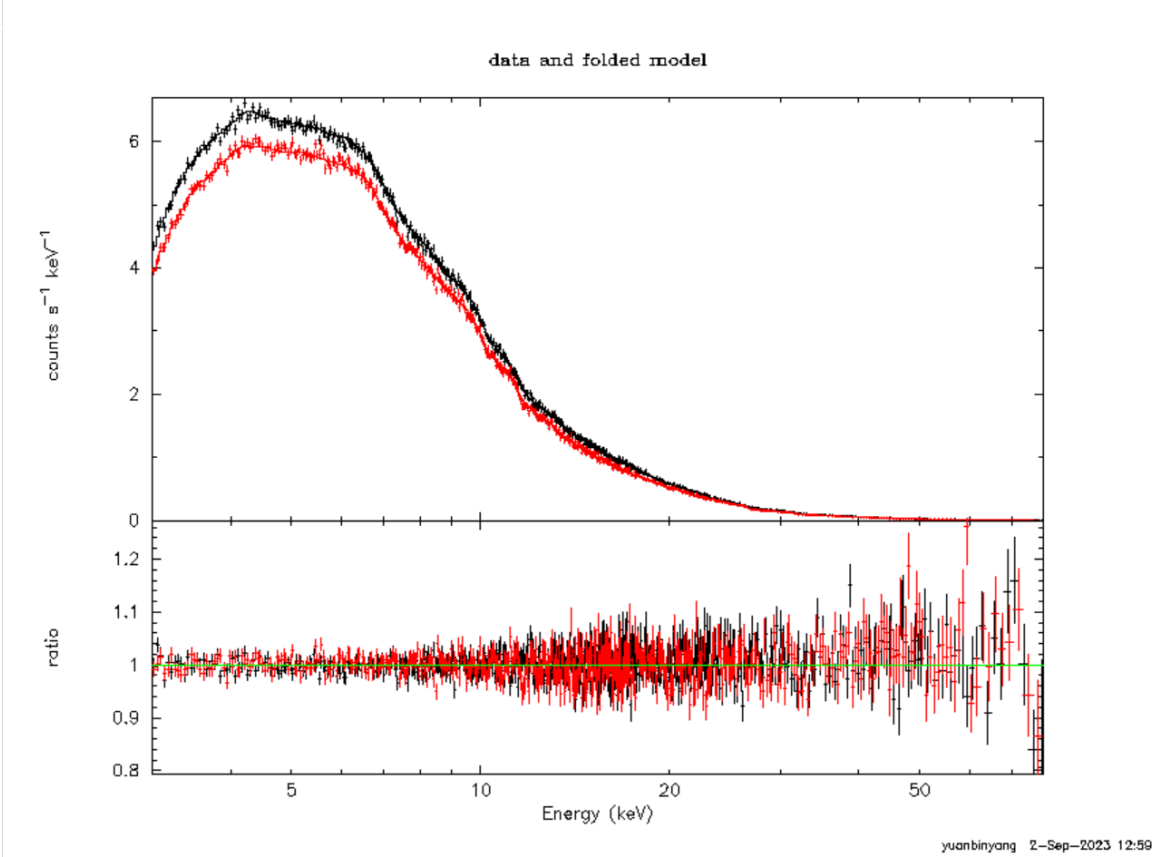
26 2.97175 3.47656 (-0.215359,0.289448)

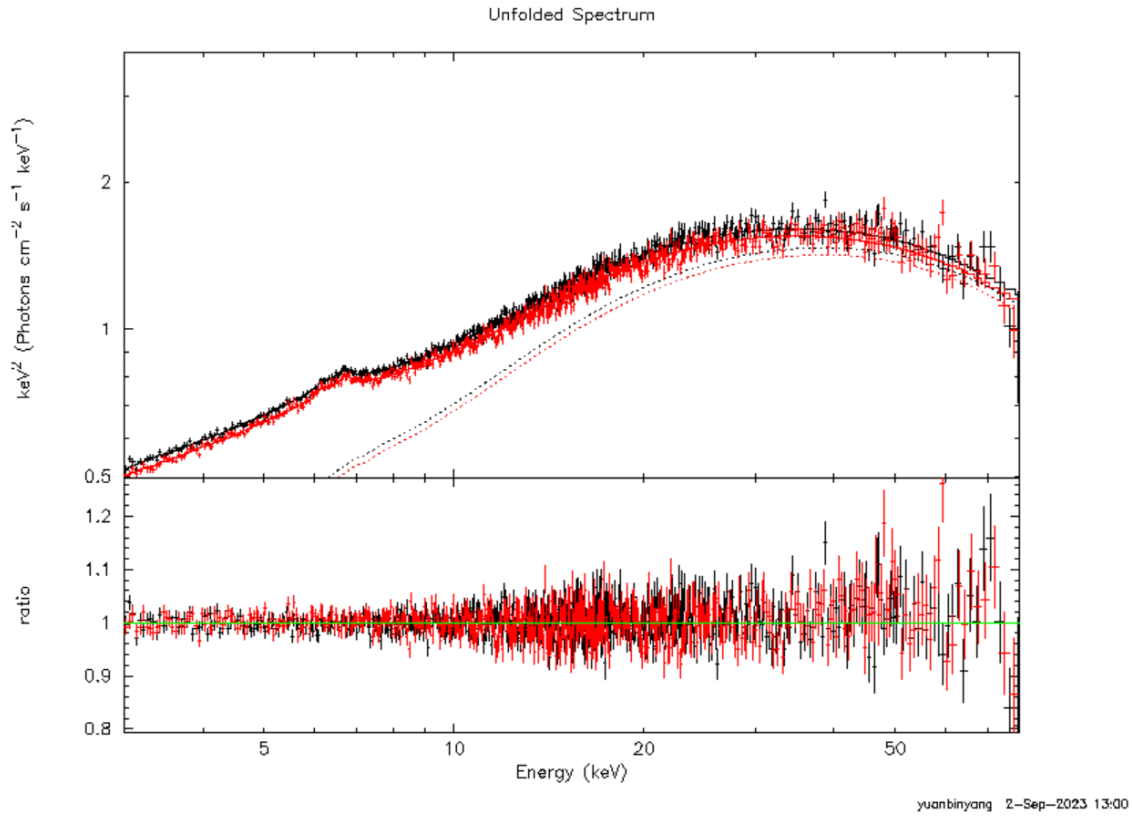
28 43.7821 56.532 (-3.5046,9.24529)

29 0.485453 2.55579 (-0.518945,1.55139)

30 0.00512398 0.00719794 (-0.00102886,0.0010451)

31 0.964634 0.968237 (-0.00179993,0.00180363)





model2: relxill2 index1=index2 relxill1 free

[2.1]same logxi

saved as: model2_samelogxi

```
========================================================================
Model constant<1>*TBabs<2>(relxill<3> + relxill<4>) Source No.: 1   Active/On
Model Model Component  Parameter  Unit     Value
 par  comp
                    Data group: 1
   1    1   constant   factor            1.00000      frozen
   2    2   TBabs      nH        10^22    0.700000     frozen
   3    3   relxill    Index1             10.0000      +/-  19.5986
   4    3   relxill    Index2             4.12283      +/-  11.2385
   5    3   relxill    Rbr               2.48929      +/-  3.38607
   6    3   relxill    a                 0.974000     +/-  2.15535E-02
   7    3   relxill    Incl       deg    64.0137      +/-  4.93378
   8    3   relxill    Rin               -1.00000     frozen
   9    3   relxill    Rout              400.000      frozen
  10    3   relxill    z                 0.0          frozen
  11    3   relxill    gamma             1.96065      +/-  0.429416
  12    3   relxill    logxi             2.84254      +/-  0.101041
  13    3   relxill    Afe               0.500000     +/-  0.479336
  14    3   relxill    Ecut       keV    37.5871      +/-  150.609
  15    3   relxill    refl_frac         1.22144      +/-  0.830441
  16    3   relxill    norm              3.28798E-03  +/-  2.34160E-03
  17    4   relxill    Index1            0.257510     +/-  1.45969
  18    4   relxill    Index2            0.257510     = p17
```

```
 19   4  relxill   Rbr              400.000      frozen
 20   4  relxill   a               0.974000     = p6
 21   4  relxill   Incl      deg    64.0137      = p7
 22   4  relxill   Rin             -1.00000     = p8
 23   4  relxill   Rout             400.000      = p9
 24   4  relxill   z               0.0          = p10
 25   4  relxill   gamma            1.01813      +/-  0.365633
 26   4  relxill   logxi            2.84254      = p12
 27   4  relxill   Afe              0.500000     = p13
 28   4  relxill   Ecut      keV    49.6969      +/-  19.3702
 29   4  relxill   refl_frac        0.677359     +/-  0.232413
 30   4  relxill   norm             5.91058E-03  +/-  1.15790E-03

                Data group: 2

 31   1  constant  factor           0.966430     +/-  1.09472E-03
 32   2  TBabs     nH       10^22   0.700000     = p2
 33   3  relxill   Index1           10.0000      = p3
 34   3  relxill   Index2           4.12283      = p4
 35   3  relxill   Rbr              2.48929      = p5
 36   3  relxill   a               0.974000     = p6
 37   3  relxill   Incl      deg    64.0137      = p7
 38   3  relxill   Rin             -1.00000     = p8
 39   3  relxill   Rout             400.000      = p9
 40   3  relxill   z               0.0          = p10
 41   3  relxill   gamma            1.96065      = p11
 42   3  relxill   logxi            2.84254      = p12
 43   3  relxill   Afe              0.500000     = p13
 44   3  relxill   Ecut      keV    37.5871      = p14
 45   3  relxill   refl_frac        1.22144      = p15
 46   3  relxill   norm             3.28798E-03  = p16
 47   4  relxill   Index1           0.257510     = p17
 48   4  relxill   Index2           0.257510     = p18
 49   4  relxill   Rbr              400.000      = p19
 50   4  relxill   a               0.974000     = p20
 51   4  relxill   Incl      deg    64.0137      = p21
 52   4  relxill   Rin             -1.00000     = p22
 53   4  relxill   Rout             400.000      = p23
 54   4  relxill   z               0.0          = p24
 55   4  relxill   gamma            1.01813      = p25
 56   4  relxill   logxi            2.84254      = p26
 57   4  relxill   Afe              0.500000     = p27
 58   4  relxill   Ecut      keV    49.6969      = p28
 59   4  relxill   refl_frac        0.677359     = p29
 60   4  relxill   norm             5.91058E-03  = p30
```

Fit statistic : Chi-Squared 1393.65 using 1389 bins.
Chi-Squared 1519.05 using 1382 bins.
Total fit statistic ***2912.69 with 2754 d.o.f.***

Test statistic : Chi-Squared 2912.69 using 2771 bins.
Null hypothesis probability of 1.75e-02 with 2754 degrees of freedom

error

3 6.89583 0 (-3.10417,-10)

4 2.80353 5.44214 (-1.31931,1.31931)

5 0 4.43112 (-2.48929,1.94184) hit hard limit 1

6 0.938544 0.985607 (-0.0354553,0.0116074)

7 58.6557 68.807 (-5.358,4.79337)

11 1.60746 2.12499 (-0.353193,0.164342)

12 2.7653 2.9202 (-0.077236,0.077661)

13 0 0.620197 (-0.5,0.120197) hit hard limit 0.5

14 19.0716 165.249 (-18.5155,127.662)

15 0.714012 1.81511 (-0.507428,0.593669)

16 0.00229832 0.004155 (-0.000989658,0.000867017)

17 0 1.00968 (-0.25751,0.752174) hit hard limit 1e-5

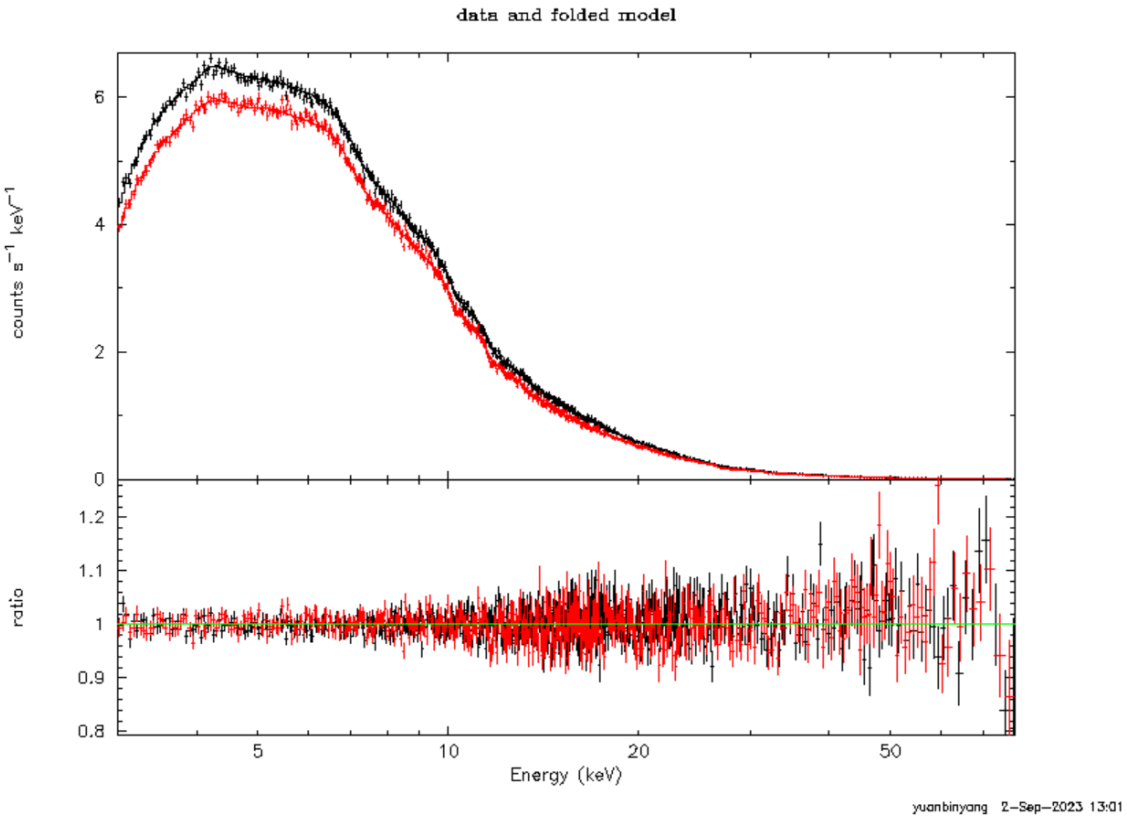
25 0 1.07908 (-1.01813,0.0609455) hit hard limit 1

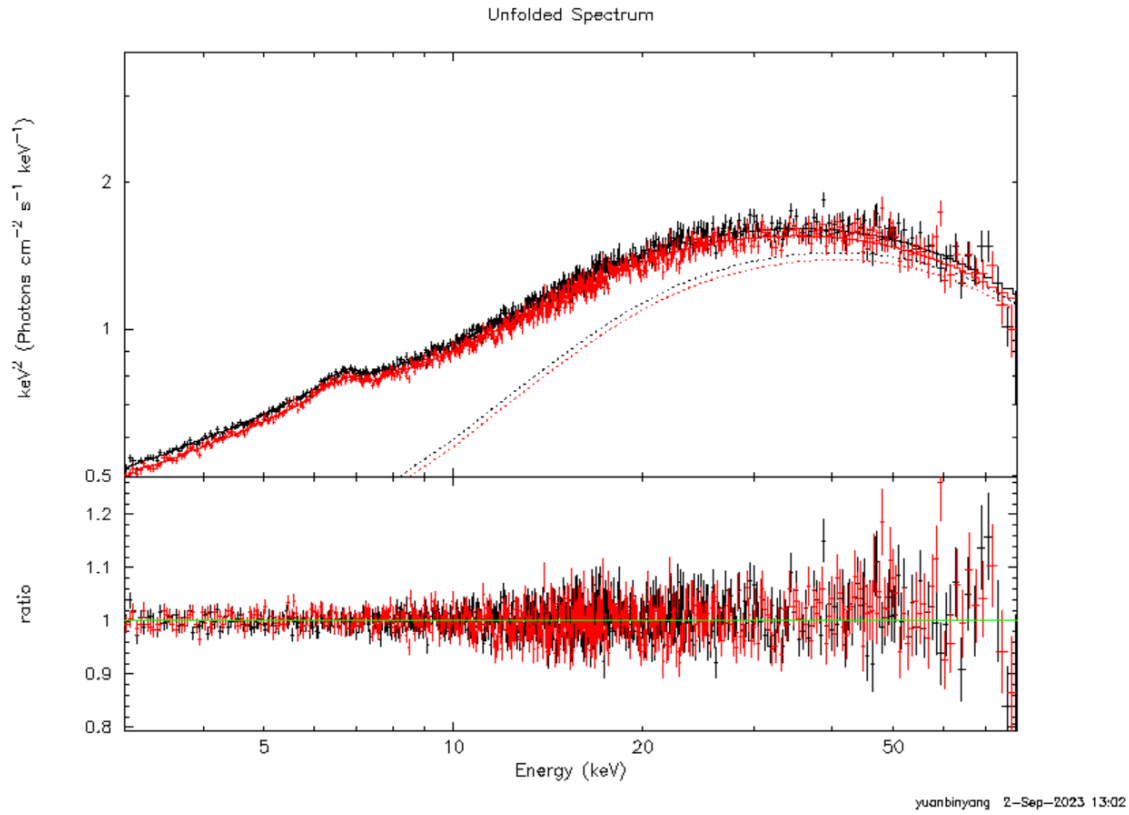
28 46.1941 53.9634 (-3.50281,4.2665)

29 0.493663 1.01127 (-0.183696,0.333913)

30 0.00448015 0.00722057 (-0.00143042,0.00131)

31 0.964631 0.968234 (-0.00179828,0.00180447)





[2.2]different logxi

saved as: model2_differentlogxi

==========

Model constant<1>*TBabs<2>(relxill<3> + relxill<4>) Source No.: 1 Active/On

Model Model Component Parameter Unit Value

par comp

Data group: 1

1	1	constant	factor		1.00000 frozen
2	2	TBabs	nH	10^22	0.700000 frozen
3	3	relxill	Index1		10.00000 +/- 44.0726
4	3	relxill	Index2		1.00000E-05 +/- 8.73503
5	3	relxill	Rbr		7.27793 +/- 23.6213
6	3	relxill	a		0.948540 +/- 6.88463E-02
7	3	relxill	Incl	deg	56.7970 +/- 12.1920
8	3	relxill	Rin		-1.00000 frozen
9	3	relxill	Rout		400.000 frozen
10	3	relxill	z		0.0 frozen
11	3	relxill	gamma		2.16301 +/- 0.351420
12	3	relxill	logxi		2.07951 +/- 0.333770
13	3	relxill	Afe		0.601516 +/- 0.495336
14	3	relxill	Ecut	keV	82.3035 +/- 818.794
15	3	relxill	refl_frac		1.22128 +/- 1.65376
16	3	relxill	norm		4.71398E-03 +/- 5.60284E-03
17	4	relxill	Index1		1.86477 +/- 0.654784
18	4	relxill	Index2		1.86477 = p17
19	4	relxill	Rbr		400.000 frozen
20	4	relxill	a		0.948540 = p6

```
 21   4  relxill   Incl      deg     56.7970      = p7
 22   4  relxill   Rin              -1.00000     = p8
 23   4  relxill   Rout              400.000      = p9
 24   4  relxill   z               0.0          = p10
 25   4  relxill   gamma            1.00000      +/-  0.962887
 26   4  relxill   logxi            3.13277      +/-  0.531294
 27   4  relxill   Afe              0.601516     = p13
 28   4  relxill   Ecut      keV     48.8143      +/-  31.5570
 29   4  relxill   refl_frac         0.533959     +/-  0.286656
 30   4  relxill   norm              5.74086E-03  +/-  5.43736E-03
                  Data group: 2
 31   1  constant  factor           0.966427     +/-  1.09471E-03
32    2  TBabs     nH        10^22   0.700000     = p2
 33   3  relxill   Index1            10.00000     = p3
 34   3  relxill   Index2            1.00000E-05  = p4
 35   3  relxill   Rbr               7.27793      = p5
 36   3  relxill   a                0.948540     = p6
 37   3  relxill   Incl      deg     56.7970      = p7
 38   3  relxill   Rin              -1.00000     = p8
 39   3  relxill   Rout              400.000      = p9
 40   3  relxill   z               0.0          = p10
 41   3  relxill   gamma            2.16301      = p11
 42   3  relxill   logxi            2.07951      = p12
 43   3  relxill   Afe              0.601516     = p13
 44   3  relxill   Ecut      keV     82.3035      = p14
 45   3  relxill   refl_frac         1.22128      = p15
 46   3  relxill   norm              4.71398E-03  = p16
 47   4  relxill   Index1            1.86477      = p17
 48   4  relxill   Index2            1.86477      = p18
 49   4  relxill   Rbr               400.000      = p19
 50   4  relxill   a                0.948540     = p20
 51   4  relxill   Incl      deg     56.7970      = p21
 52   4  relxill   Rin              -1.00000     = p22
 53   4  relxill   Rout              400.000      = p23
 54   4  relxill   z               0.0          = p24
 55   4  relxill   gamma            1.00000      = p25
 56   4  relxill   logxi            3.13277      = p26
 57   4  relxill   Afe              0.601516     = p27
 58   4  relxill   Ecut      keV     48.8143      = p28
 59   4  relxill   refl_frac         0.533959     = p29
 60   4  relxill   norm              5.74086E-03  = p30
```

```
Fit statistic  : Chi-Squared              1392.82     using 1389 bins.
                 Chi-Squared              1515.94     using 1382 bins.
Total fit statistic                   ***2908.76     with 2753 d.o.f.***

Test statistic : Chi-Squared              2908.76     using 2771 bins.
 Null hypothesis probability of 1.92e-02 with 2753 degrees of freedom
```

error

```
3      5.44504          0    (-4.55496,-10) hit hard limit 10
```

4 0 1.11089 (-1e-05,1.11088) hit hard limit 1e-5

5 4.88853 27.2724 (-2.3894,19.9945)

6 0.832168 0.975722 (-0.116372,0.0271821)

7 44.5038 69.829 (-12.2932,13.0319)

11 1.79789 2.50276 (-0.365122,0.339751)

12 1.56935 2.38579 (-0.510162,0.306274)

13 0.551833 0.895996 (-0.0496829,0.294481)

14 31.8332 199.065 (-50.4703,116.761)

15 0.460679 3.26206 (-0.760599,2.04078)

16 0.00403758 0.0053934 (-0.000676401,0.000679422)

17 1.07262 3.37479 (-0.792152,1.51002)

25 0 1.06352 (-1,0.0635182) hit hard limit 1

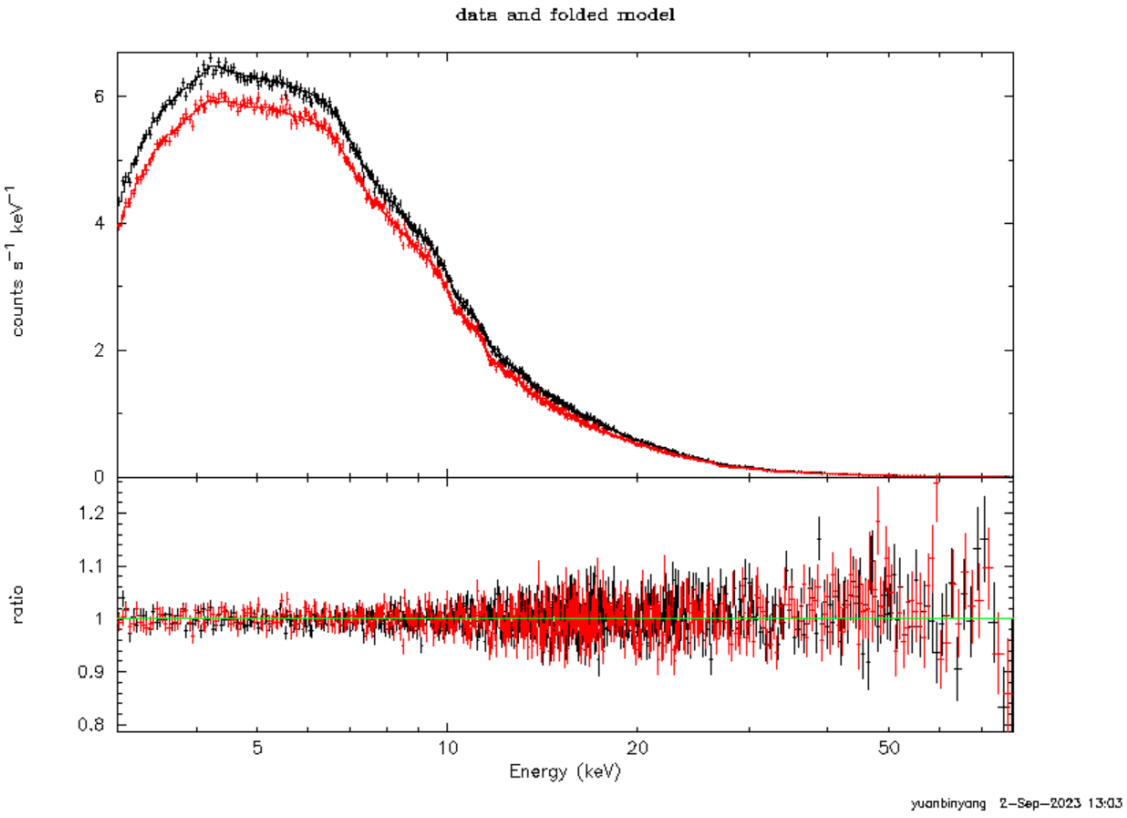
26 2.85192 3.57324 (-0.280843,0.440476)

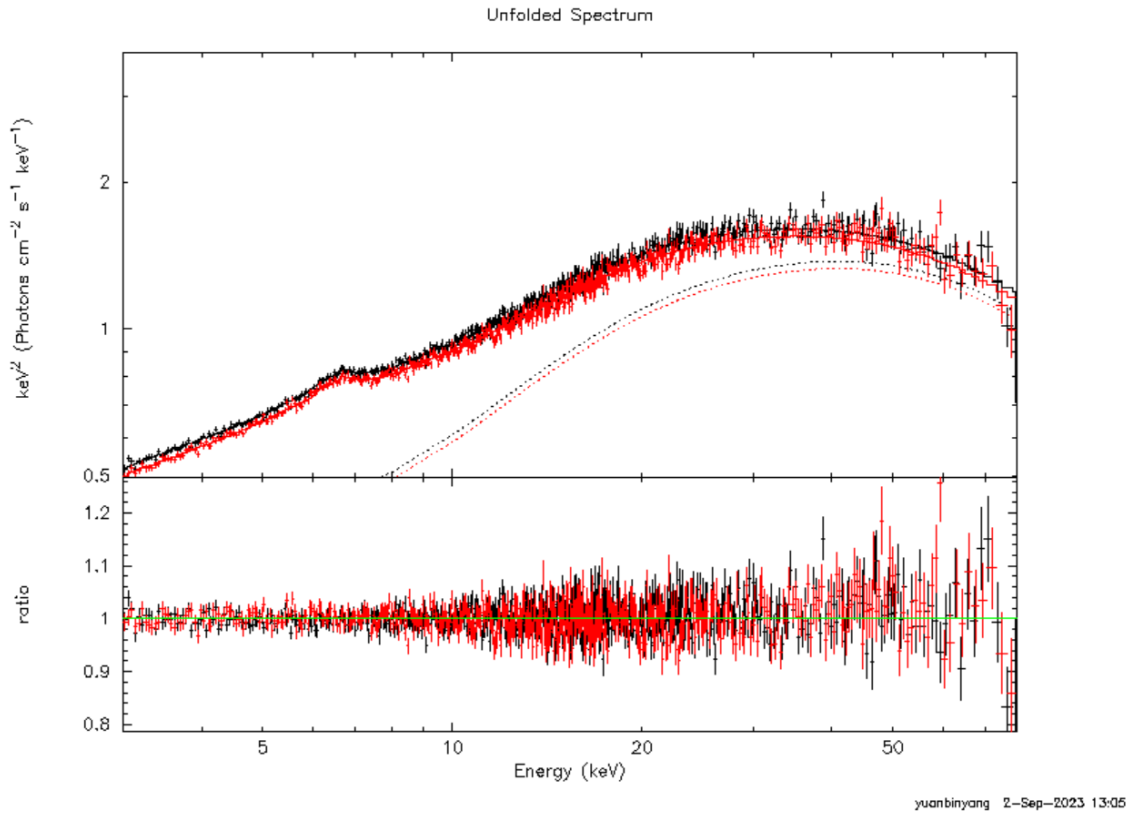
28 45.4694 52.1737 (-3.34495,3.35934)

29 0.394685 0.854671 (-0.139274,0.320713)

30 0.00464245 0.00640535 (-0.00109841,0.000664486)

31 0.964633 0.968233 (-0.00179401,0.00180674)





model3: const * tbabs * (relxill+relxilllp)

[3.1]same logxi

saved as: model3_samelogxi_final

==========

Model constant<1>*TBabs<2>(relxill<3> + relxilllp<4>) Source No.: 1 Active/On

Model Model Component Parameter Unit Value

par comp

Data group: 1

1	1	constant	factor		1.00000	frozen
2	2	TBabs	nH	10^22	0.700000	frozen
3	3	relxill	Index1		10.00000	+/- 16.4769
4	3	relxill	Index2		4.04671	+/- 13.7262
5	3	relxill	Rbr		2.51132	+/- 3.76240
6	3	relxill	a		0.975057	+/- 1.99198E-02
7	3	relxill	Incl	deg	64.3385	+/- 4.48495
8	3	relxill	Rin		-1.00000	frozen
9	3	relxill	Rout		400.000	frozen
10	3	relxill	z		0.0	frozen
11	3	relxill	gamma		1.96308	+/- 0.421590
12	3	relxill	logxi		2.85266	+/- 9.99660E-02
13	3	relxill	Afe		0.501632	+/- 0.346400
14	3	relxill	Ecut	keV	38.7507	+/- 137.991
15	3	relxill	refl_frac		1.19128	+/- 0.835364
16	3	relxill	norm		3.33717E-03	+/- 2.02901E-03
17	4	relxilllp	h	GM/c^2	491.885	+/- 1164.27
18	4	relxilllp	beta	c	0.0	frozen

```
 19   4  relxilllp  a                    0.975057     = p6
 20   4  relxilllp  Incl      deg       64.3385      = p7
 21   4  relxilllp  Rin                 -1.00000     frozen
 22   4  relxilllp  Rout                400.000      frozen
 23   4  relxilllp  z                   0.0          frozen
 24   4  relxilllp  gamma               1.01059      +/-  0.367134
 25   4  relxilllp  logxi               2.85266      = p12
 26   4  relxilllp  Afe                 0.501632     = p13
 27   4  relxilllp  Ecut      keV       49.0512      +/-  17.2420
 28   4  relxilllp  refl_frac           2.98014      +/-  9.64891
 29   4  relxilllp  switch_returnrad    1            frozen
 30   4  relxilllp  switch_reflfrac_boost  1         frozen
 31   4  relxilllp  norm                5.89295E-03  +/-  1.00120E-03

                Data group: 2

 32   1  constant   factor              0.966433     +/-  1.09472E-03
 33   2  TBabs      nH        10^22     0.700000     = p2
 34   3  relxill    Index1              10.00000     = p3
 35   3  relxill    Index2              4.04671      = p4
 36   3  relxill    Rbr                 2.51132      = p5
 37   3  relxill    a                   0.975057     = p6
 38   3  relxill    Incl      deg       64.3385      = p7
 39   3  relxill    Rin                 -1.00000     = p8
 40   3  relxill    Rout                400.000      = p9
 41   3  relxill    z                   0.0          = p10
 42   3  relxill    gamma               1.96308      = p11
 43   3  relxill    logxi               2.85266      = p12
 44   3  relxill    Afe                 0.501632     = p13
 45   3  relxill    Ecut      keV       38.7507      = p14
 46   3  relxill    refl_frac           1.19128      = p15
 47   3  relxill    norm                3.33717E-03  = p16
 48   4  relxilllp  h         GM/c^2    491.885      = p17
 49   4  relxilllp  beta      c         0.0          = p18
 50   4  relxilllp  a                   0.975057     = p19
 51   4  relxilllp  Incl      deg       64.3385      = p20
 52   4  relxilllp  Rin                 -1.00000     = p21
 53   4  relxilllp  Rout                400.000      = p22
 54   4  relxilllp  z                   0.0          = p23
 55   4  relxilllp  gamma               1.01059      = p24
 56   4  relxilllp  logxi               2.85266      = p25
 57   4  relxilllp  Afe                 0.501632     = p26
 58   4  relxilllp  Ecut      keV       49.0512      = p27
 59   4  relxilllp  refl_frac           2.98014      = p28
 60   4  relxilllp  switch_returnrad    1            = p29
 61   4  relxilllp  switch_reflfrac_boost  1         = p30
 62   4  relxilllp  norm                5.89295E-03  = p31
```

```
Fit statistic  : Chi-Squared              1393.47     using 1389 bins.
                 Chi-Squared              1519.23     using 1382 bins.
Total fit statistic                       2912.70     with 2754 d.o.f.
```

Test statistic : Chi-Squared 2912.70 using 2771 bins.
Null hypothesis probability of 1.75e-02 with 2754 degrees of freedom

error:

3 6.95649 0 (-3.04351,-10) hit hard limit 10

4 2.99217 5.60518 (-1.05454,1.55847)

5 2.1392 5.97982 (-0.37212,3.46849)

6 0.916963 0.984193 (-0.0580948,0.00913601)

7 56.6173 67.8914 (-7.72112,3.55291)

11 1.56321 2.08673 (-0.399868,0.123651)

12 2.77168 2.93047 (-0.0809786,0.077811)

13 0 0.613509 (-0.501632,0.111877) hit hard limit

14 22.1319 176.427 (-16.6188,137.676)

15 0.653207 1.79171 (-0.53807,0.60043)

16 0.00281153 0.00424524 (-0.000525636,0.000908067)

17 259.66 0 (-232.221,-491.881) hit hard limit 500

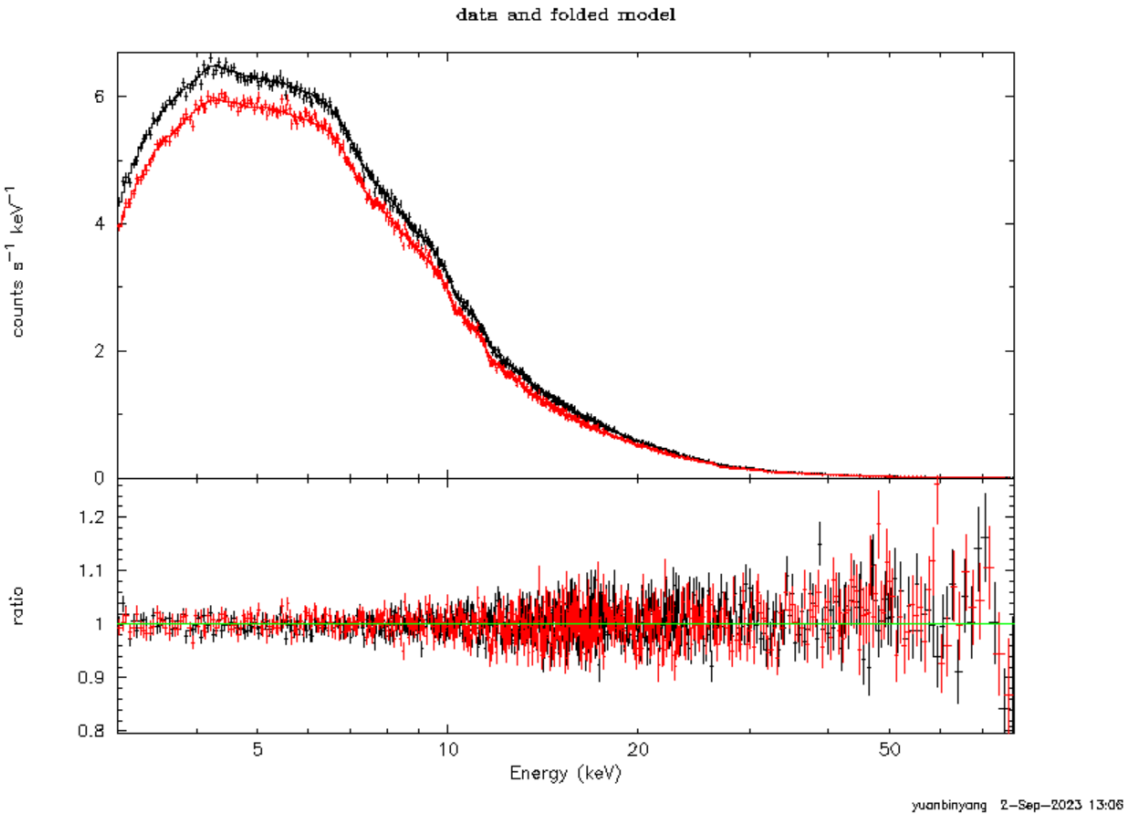
24 0 1.06102 (-1.01059,0.0504375) hit hard limit 1

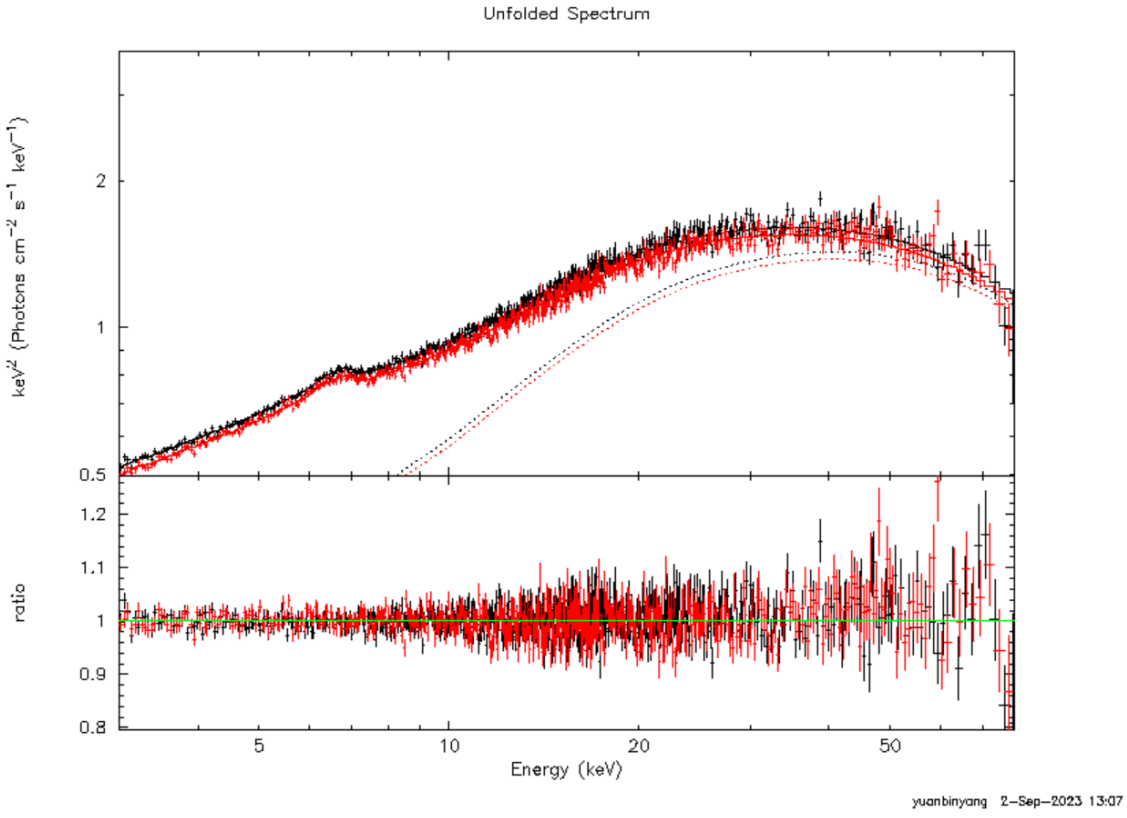
27 46.8568 54.0415 (-2.19436,4.99037)

28 2.31089 6.82341 (-0.669254,3.84327)

31 0.00477546 0.00641802 (-0.00111749,0.000525073)

32 0.964634 0.968234 (-0.00179899,0.00180077)





[3.2]different logxi

saved as: model3_differentlogxi_final

```
========================================================================
Model constant<1>*TBabs<2>(relxill<3> + relxilllp<4>) Source No.: 1   Active/On
Model Model Component  Parameter  Unit     Value
 par  comp
                    Data group: 1
  1    1   constant   factor            1.00000      frozen
  2    2   TBabs      nH        10^22    0.700000     frozen
  3    3   relxill    Index1             0.165582     +/-  4.62874E+04
  4    3   relxill    Index2             5.46655      +/-  16.5089
  5    3   relxill    Rbr                2.21122      +/-  150.193
  6    3   relxill    a                  0.922160     +/-  1.80409
  7    3   relxill    Incl      deg      55.1365      +/-  33.0993
  8    3   relxill    Rin                -1.00000     frozen
  9    3   relxill    Rout               400.000      frozen
 10    3   relxill    z                  0.0          frozen
 11    3   relxill    gamma              1.33512      +/-  0.325315
 12    3   relxill    logxi              3.61713      +/-  0.172956
 13    3   relxill    Afe                0.629399     +/-  0.445674
 14    3   relxill    Ecut      keV      225.418      +/-  179.525
 15    3   relxill    refl_frac          -46.0328     +/-  -1.00000
 16    3   relxill    norm               4.05133E-04  +/-  -1.00000
 17    4   relxilllp  h         GM/c^2   209.085      +/-  445.393
 18    4   relxilllp  beta      c        0.0          frozen
 19    4   relxilllp  a                  0.922160     = p6
 20    4   relxilllp  Incl      deg      55.1365      = p7
 21    4   relxilllp  Rin                -1.00000     frozen
 22    4   relxilllp  Rout               400.000      frozen
 23    4   relxilllp  z                  0.0          frozen
 24    4   relxilllp  gamma              1.86417      +/-  1.15192
 25    4   relxilllp  logxi              2.24646      +/-  0.723214
 26    4   relxilllp  Afe                0.629399     = p13
 27    4   relxilllp  Ecut      keV      11.6206      +/-  13.1059
 28    4   relxilllp  refl_frac          5.35933      +/-  10.2279
 29    4   relxilllp  switch_returnrad   1            frozen
 30    4   relxilllp  switch_reflfrac_boost  1        frozen
 31    4   relxilllp  norm               1.20736E-03  +/-  1.53724E-03
                    Data group: 2
 32    1   constant   factor            0.966433     +/-  1.09472E-03
 33    2   TBabs      nH        10^22    0.700000     = p2
 34    3   relxill    Index1             0.165582     = p3
 35    3   relxill    Index2             5.46655      = p4
 36    3   relxill    Rbr                2.21122      = p5
 37    3   relxill    a                  0.922160     = p6
 38    3   relxill    Incl      deg      55.1365      = p7
 39    3   relxill    Rin                -1.00000     = p8
 40    3   relxill    Rout               400.000      = p9
 41    3   relxill    z                  0.0          = p10
 42    3   relxill    gamma              1.33512      = p11
 43    3   relxill    logxi              3.61713      = p12
 44    3   relxill    Afe                0.629399     = p13
 45    3   relxill    Ecut      keV      225.418      = p14
```

```
 46   3  relxill    refl_frac          -46.0328     = p15
 47   3  relxill    norm               4.05133E-04  = p16
 48   4  relxilllp  h         GM/c^2   209.085      = p17
 49   4  relxilllp  beta      c        0.0          = p18
 50   4  relxilllp  a                  0.922160     = p19
 51   4  relxilllp  Incl      deg      55.1365      = p20
 52   4  relxilllp  Rin                -1.00000     = p21
 53   4  relxilllp  Rout               400.000      = p22
 54   4  relxilllp  z                  0.0          = p23
 55   4  relxilllp  gamma              1.86417      = p24
 56   4  relxilllp  logxi              2.24646      = p25
 57   4  relxilllp  Afe                0.629399     = p26
 58   4  relxilllp  Ecut      keV      11.6206      = p27
 59   4  relxilllp  refl_frac          5.35933      = p28
 60   4  relxilllp  switch_returnrad   1            = p29
 61   4  relxilllp  switch_reflfrac_boost  1        = p30
 62   4  relxilllp  norm               1.20736E-03  = p31
```

Fit statistic : Chi-Squared 1393.51 using 1389 bins.
Chi-Squared 1515.53 using 1382 bins.
Total fit statistic ***2909.04 with 2753 d.o.f.***

Test statistic : Chi-Squared 2909.04 using 2771 bins.
Null hypothesis probability of 1.91e-02 with 2753 degrees of freedom

error

3 0 0 (-0.165582,-0.165582) hit hard limit 1e-5 10

4 5.31924 5.61128 (-0.147314,0.144729)

5 0 2.38839 (-2.21122,0.177167) hit hard limit 1

6 0.915894 0.939773 (-0.00626591,0.0176139)

7 54.7758 55.5318 (-0.360744,0.395318)

11 1.33299 1.33717 (-0.00213375,0.00205131)

12 3.60749 3.6266 (-0.00963692,0.00947272)

13 0.614833 0.644436 (-0.0145658,0.0150365)

14 221.58 229.478 (-3.83716,4.06062)

15 0.750061 -464.737 (46.7829,-418.704)

16 0.822901 0 (0.822496,-0.000405133)

17 192.357 226.511 (-16.7288,17.4252)

24 1.85157 1.87695 (-0.0125989,0.0127717)

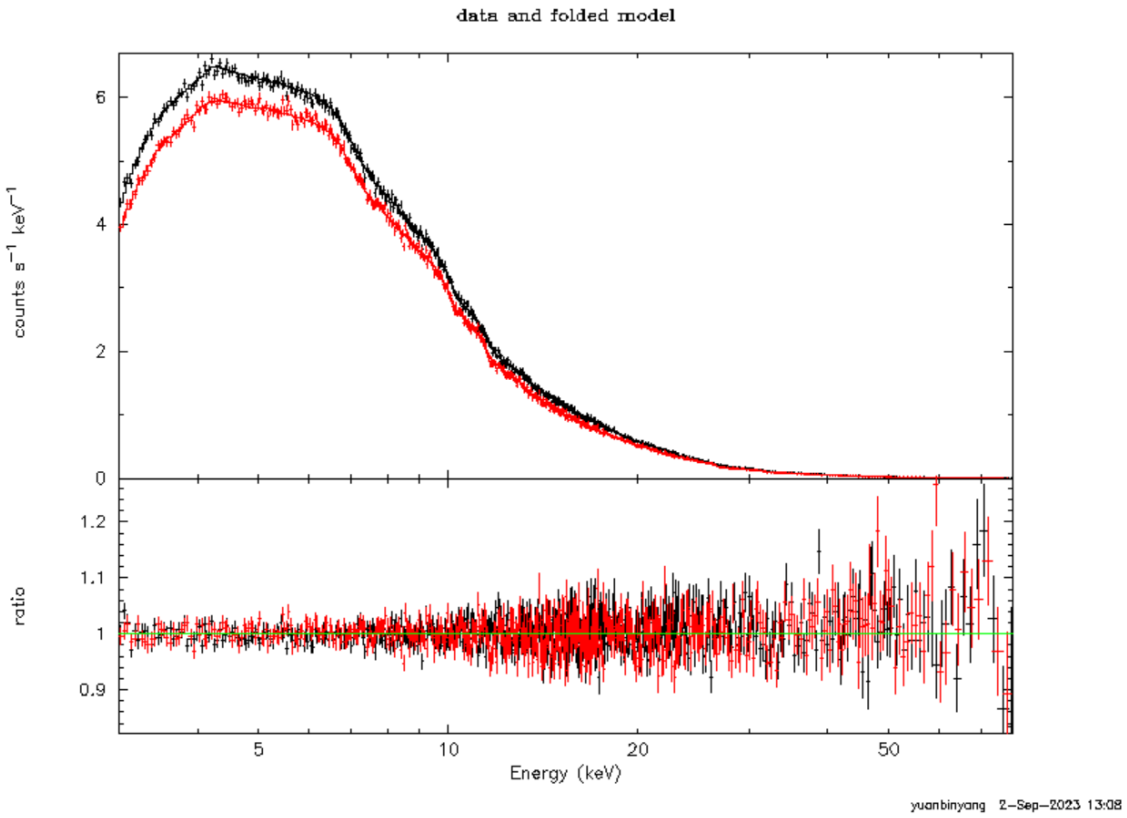
25 2.21032 2.28273 (-0.0361427,0.0362679)

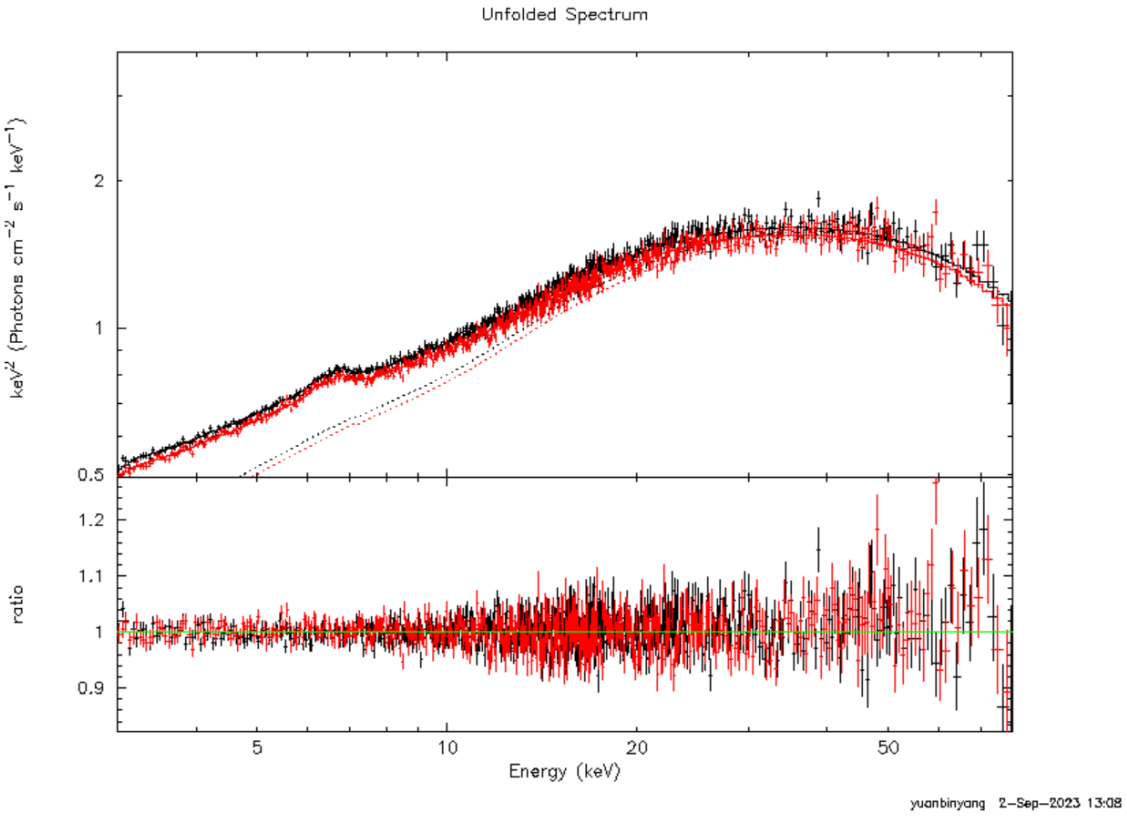
27 11.2647 11.9731 (-0.355901,0.352445)

28 5.08762 5.63032 (-0.271702,0.270998)

31 0.00119528 0.00122111 (-1.20728e-05,1.37566e-05)

32 0.964634 0.968237 (-0.00179898,0.00180424)





C. summary of AICc

one corona model: 2991.81

two corona model:

model 0: 2948.84 2962.00 (gamma=1.6)

	same logxi	different logxi
model 1	2943.29	2941.24
model 2	2946.91	2945.01
model 3	2946.92	2945.29

Results of EXO1846-031

Summary of AICc

	n_H fixed	n_H not fixed
one relxill(standard case)	2716.32	2708.99
relxillion+cutoffpl	2718.22	2703.20

one relxill

saved as: standard_case.xcm

logfile: standard_case.txt

```
========================================================================
Model constant<1>*TBabs<2>(diskbb<3> + relxillion_nk<4>) Source No.: 1   Active/On
Model Model Component  Parameter  Unit     Value
 par  comp
                   Data group: 1
  1    1   constant   factor            1.00000      frozen
  2    2   TBabs      nH        10^22    4.66970      +/-  0.407699
  3    3   diskbb     Tin       keV      0.425886     +/-  2.53607E-02
  4    3   diskbb     norm              1.60573E+04  +/-  5551.50
  5    4   relxillion_nkIndex1           9.98494      +/-  6.55157
  6    4   relxillion_nkIndex2           1.22591E-03  +/-  1.00367
  7    4   relxillion_nkIndex3           1.22591E-03  = p6
  8    4   relxillion_nkRbr1             7.78477      +/-  4.69841
  9    4   relxillion_nkRbr2             400.000      = p13
 10    4   relxillion_nka                0.977148     +/-  1.64441E-02
 11    4   relxillion_nkIncl       deg   66.0527      +/-  5.22629
 12    4   relxillion_nkRin              -1.00000     frozen
 13    4   relxillion_nkRout             400.000      frozen
 14    4   relxillion_nkz                0.0          frozen
 15    4   relxillion_nkgamma            1.78074      +/-  2.95339E-02
 16    4   relxillion_nklogxi            4.70000      +/-  0.371975
 17    4   relxillion_nkAfe              7.19247      +/-  3.18710
 18    4   relxillion_nkEcut       keV   140.098      +/-  9.59182
 19    4   relxillion_nkrefl_frac        1.03854      +/-  0.259628
 20    4   relxillion_nkxi_index         2.06143      +/-  0.829314
 21    4   relxillion_nkdef_par_type     1.00000      frozen
 22    4   relxillion_nkdef_par_value    0.0          frozen
 23    4   relxillion_nkmdot_type        0.0          frozen
 24    4   relxillion_nknorm             6.98848E-03  +/-  1.05547E-03
                   Data group: 2
 25    1   constant   factor            1.01519      +/-  8.27696E-04
 26    2   TBabs      nH        10^22    4.66970      = p2
 27    3   diskbb     Tin       keV      0.425886     = p3
 28    3   diskbb     norm              1.60573E+04  = p4
```

```
 29   4   relxillion_nkIndex1            9.98494      = p5
 30   4   relxillion_nkIndex2            1.22591E-03  = p6
 31   4   relxillion_nkIndex3            1.22591E-03  = p7
 32   4   relxillion_nkRbr1              7.78477      = p8
 33   4   relxillion_nkRbr2              400.000      = p9
 34   4   relxillion_nka                 0.977148     = p10
 35   4   relxillion_nkIncl      deg     66.0527      = p11
 36   4   relxillion_nkRin               -1.00000     = p12
 37   4   relxillion_nkRout              400.000      = p13
 38   4   relxillion_nkz                 0.0          = p14
 39   4   relxillion_nkgamma             1.78074      = p15
 40   4   relxillion_nklogxi             4.70000      = p16
 41   4   relxillion_nkAfe               7.19247      = p17
 42   4   relxillion_nkEcut      keV     140.098      = p18
 43   4   relxillion_nkrefl_frac         1.03854      = p19
 44   4   relxillion_nkxi_index          2.06143      = p20
 45   4   relxillion_nkdef_par_type      1.00000      = p21
 46   4   relxillion_nkdef_par_value     0.0          = p22
 47   4   relxillion_nkmdot_type         0.0          = p23
 48   4   relxillion_nknorm              6.98848E-03  = p24
```

Fit statistic : Chi-Squared 1329.67 using 1313 bins, spectrum 1, group 1.
Chi-Squared 1347.11 using 1303 bins, spectrum 2, group 2.
Total fit statistic ***2676.78 with 2600 d.o.f.***

Test statistic : Chi-Squared 2676.78 using 2616 bins.
Null hypothesis probability of 1.44e-01 with 2600 degrees of freedom

error

2 4.11743 5.16257 (-0.552269,0.492873)

3 0.389214 0.451116 (-0.0366722,0.0252295)

4 10441.6 29755.7 (-5615.71,13698.4)

5 9.06435 9.15375 (-0.920588,-0.831184)

6 0 1.17593 (-0.00122591,1.17471) hit hard limit 1e-5

8 7.16199 13.5561 (-0.622781,5.77132)

10 0.952013 0.988568 (-0.0251356,0.0114199)

11 60.1566 67.5583 (-5.89608,1.50565)

15 1.74804 1.82075 (-0.0327001,0.0400116)

16 4.39405 4.10771 (-0.305946,-0.592291)

17 5.92936 9.807 (-1.26311,2.61452)

18 123.284 152.089 (-16.8139,11.9913)

19 0.71616 1.30438 (-0.322381,0.26584)

20 1.37935 2.50966 (-0.682083,0.448231)

24 0.00652016 0.00806364 (-0.000468318,0.00107516)

25 1.01383 1.01656 (-0.00136135,0.00136301)

one_relxill(initial condition from askar's paper)

saved as: standard_case_ini.xcm

```
========================================================================
Model constant<1>*TBabs<2>(diskbb<3> + relxillion_nk<4>) Source No.: 1   Active/On
Model Model Component  Parameter  Unit     Value
 par  comp
                   Data group: 1
  1    1   constant   factor            1.00000      frozen
  2    2   TBabs      nH        10^22    4.66415      +/-  0.402387
  3    3   diskbb     Tin       keV      0.424314     +/-  2.55774E-02
  4    3   diskbb     norm              1.64631E+04  +/-  5895.33
  5    4   relxillion_nkIndex1           10.0000      +/-  7.42565
  6    4   relxillion_nkIndex2           1.20748E-02  +/-  1.00114
  7    4   relxillion_nkIndex3           1.20748E-02  = p6
  8    4   relxillion_nkRbr1             7.59800      +/-  4.20449
  9    4   relxillion_nkRbr2             400.000      = p13
 10    4   relxillion_nka                0.979952     +/-  1.34069E-02
 11    4   relxillion_nkIncl      deg    66.6627      +/-  5.28032
 12    4   relxillion_nkRin              -1.00000     frozen
 13    4   relxillion_nkRout             400.000      frozen
 14    4   relxillion_nkz                0.0          frozen
 15    4   relxillion_nkgamma            1.78132      +/-  3.00115E-02
 16    4   relxillion_nklogxi            4.70000      +/-  0.362475
 17    4   relxillion_nkAfe              7.08566      +/-  3.19148
 18    4   relxillion_nkEcut      keV    139.437      +/-  10.0124
 19    4   relxillion_nkrefl_frac        1.03777      +/-  0.277470
 20    4   relxillion_nkxi_index         2.10984      +/-  0.953823
 21    4   relxillion_nkdef_par_type     1.00000      frozen
 22    4   relxillion_nkdef_par_value    0.0          frozen
 23    4   relxillion_nkmdot_type        0.0          frozen
 24    4   relxillion_nknorm             7.04176E-03  +/-  1.08353E-03
                   Data group: 2
 25    1   constant   factor            1.01519      +/-  8.27693E-04
 26    2   TBabs      nH        10^22    4.66415      = p2
 27    3   diskbb     Tin       keV      0.424314     = p3
 28    3   diskbb     norm              1.64631E+04  = p4
 29    4   relxillion_nkIndex1           10.0000      = p5
 30    4   relxillion_nkIndex2           1.20748E-02  = p6
 31    4   relxillion_nkIndex3           1.20748E-02  = p7
 32    4   relxillion_nkRbr1             7.59800      = p8
 33    4   relxillion_nkRbr2             400.000      = p9
 34    4   relxillion_nka                0.979952     = p10
 35    4   relxillion_nkIncl      deg    66.6627      = p11
```

```
 36    4   relxillion_nkRin              -1.00000     = p12
 37    4   relxillion_nkRout              400.000     = p13
 38    4   relxillion_nkz                 0.0         = p14
 39    4   relxillion_nkgamma             1.78132     = p15
 40    4   relxillion_nklogxi             4.70000     = p16
 41    4   relxillion_nkAfe               7.08566     = p17
 42    4   relxillion_nkEcut       keV    139.437     = p18
 43    4   relxillion_nkrefl_frac         1.03777     = p19
 44    4   relxillion_nkxi_index          2.10984     = p20
 45    4   relxillion_nkdef_par_type      1.00000     = p21
 46    4   relxillion_nkdef_par_value     0.0         = p22
 47    4   relxillion_nkmdot_type         0.0         = p23
 48    4   relxillion_nknorm              7.04176E-03 = p24
```

Fit statistic : Chi-Squared 1329.77 using 1313 bins, spectrum 1, group 1.
Chi-Squared 1346.90 using 1303 bins, spectrum 2, group 2.
Total fit statistic ***2676.67 with 2600 d.o.f.***

Test statistic : Chi-Squared 2676.67 using 2616 bins.
Null hypothesis probability of 1.44e-01 with 2600 degrees of freedom

error

2 4.1247 5.1576 (-0.539454,0.493446)

3 0.390315 0.450996 (-0.0339989,0.0266817)

4 10219.8 34810.3 (-6243.34,18347.2)

5 9.14631 0 (-0.853685,-10) hit hard limit 10

6 0.373273 0.885368 (0.361198,0.873293)

8 6.53127 11.3267 (-1.06673,3.72874)

10 0.957898 0.988644 (-0.0220542,0.00869197)

11 62.3196 67.2452 (-4.34317,0.582521)

15 1.74924 1.82684 (-0.0320809,0.0455112)

16 4.40187 0 (-0.298133,-4.7) hit hard limit 4.7

17 4.6612 9.74624 (-2.42447,2.66058)

18 125.362 151.367 (-14.0748,11.9295)

19 0.837666 1.31095 (-0.200106,0.273178)

20 1.12685 2.56026 (-0.982989,0.450417)

24 0.00581228 0.0079798 (-0.00122947,0.000938043)

25 1.01383 1.01656 (-0.00135973,0.00136379)

one relxill(n_H fixed)

saved as: standard_case_nhfixed

logfile:standard_case.txt

NICER detection of QPOs from EXO 1846-031

BY Bult, P. M. [1]; Gendreau, K. C. [1]; Arzoumanian, Z. [1]; Strohmayer, T. E. [1]; Ray, P. S. [2]; Guillot, S. [3]; Iwakiri, W. [4]; Homan, J. [5]; Altamirano, D. [6]; Jaisawal, G. K. [7,8]; ...and 1 more show

FROM NASA Goddard Space Flight Center [1], Naval Research Laboratory [2], CNRS [3], Chuo University [4], SRON Netherlands Institute for Space Research [5], University of Southampton [6], Astrophysics and Atmospheric Physics [7], National Space Institute [8], University of Michigan [9] details

Referred to by ATel #: 12977, 12992, 13012, 13036, 13037, 13255, 13344 Following reports of renewed activity from the X-ray transient EXO 1846-031 (ATel #12969, ATel #12968), NICER executed rapid follow-up observations. Pointed observations with NICER began on 2019 July 31 14:10 UTC, collecting a total exposure of 3.4 ks.

We clearly detect the source at an average 0.5-10 keV count rate of ~210 c/s, well over the estimated background rate of 0.5 c/s in the same energy band. A preliminary spectral analysis indicates the source spectrum could be reasonably well described using an absorbed power-law model with a column density of N_H = (5.8 +/- 0.1)E22 cm^-2 and photon-index of Gamma = 1.52 +/- 0.01.

==========

Model constant<1>*TBabs<2>(diskbb<3> + relxillion_nk<4>) Source No.: 1 Active/On

Model par	Model comp	Component	Parameter	Unit	Value		
			Data group: 1				
1	1	constant	factor		1.00000		frozen
2	2	TBabs	nH	10^22	5.80000		frozen
3	3	diskbb	Tin	keV	0.443198	+/-	1.18275E-02
4	3	diskbb	norm		1.96644E+04	+/-	3770.76
5	4	relxillion_nk	Index1		9.91379	+/-	4.06690
6	4	relxillion_nk	Index2		1.00003E-05	+/-	1.16168
7	4	relxillion_nk	Index3		1.00003E-05	=	p6
8	4	relxillion_nk	Rbr1		7.97850	+/-	4.59104
9	4	relxillion_nk	Rbr2		400.000	=	p13
10	4	relxillion_nk	a		0.977951	+/-	1.32533E-02
11	4	relxillion_nk	Incl	deg	66.6462	+/-	4.70647
12	4	relxillion_nk	Rin		-1.00000		frozen
13	4	relxillion_nk	Rout		400.000		frozen
14	4	relxillion_nk	z		0.0		frozen
15	4	relxillion_nk	gamma		1.81902	+/-	3.50827E-02
16	4	relxillion_nk	logxi		4.70000	+/-	0.373799
17	4	relxillion_nk	Afe		6.13106	+/-	3.32371
18	4	relxillion_nk	Ecut	keV	157.078	+/-	13.6839
19	4	relxillion_nk	refl_frac		1.04971	+/-	0.230343
20	4	relxillion_nk	xi_index		2.42878	+/-	1.07849
21	4	relxillion_nk	def_par_type		1.00000		frozen
22	4	relxillion_nk	def_par_value		0.0		frozen
23	4	relxillion_nk	mdot_type		0.0		frozen
24	4	relxillion_nk	norm		7.27068E-03	+/-	1.04465E-03
			Data group: 2				
25	1	constant	factor		1.01520	+/-	8.27700E-04
26	2	TBabs	nH	10^22	5.80000	=	p2
27	3	diskbb	Tin	keV	0.443198	=	p3
28	3	diskbb	norm		1.96644E+04	=	p4
29	4	relxillion_nk	Index1		9.91379	=	p5
30	4	relxillion_nk	Index2		1.00003E-05	=	p6
31	4	relxillion_nk	Index3		1.00003E-05	=	p7

```
 32   4   relxillion_nkRbr1             7.97850      = p8
 33   4   relxillion_nkRbr2             400.000      = p9
 34   4   relxillion_nka                0.977951     = p10
 35   4   relxillion_nkIncl      deg    66.6462      = p11
 36   4   relxillion_nkRin              -1.00000     = p12
 37   4   relxillion_nkRout             400.000      = p13
 38   4   relxillion_nkz                0.0          = p14
 39   4   relxillion_nkgamma            1.81902      = p15
 40   4   relxillion_nklogxi            4.70000      = p16
 41   4   relxillion_nkAfe              6.13106      = p17
 42   4   relxillion_nkEcut      keV    157.078      = p18
 43   4   relxillion_nkrefl_frac        1.04971      = p19
 44   4   relxillion_nkxi_index         2.42878      = p20
 45   4   relxillion_nkdef_par_type     1.00000      = p21
 46   4   relxillion_nkdef_par_value    0.0          = p22
 47   4   relxillion_nkmdot_type        0.0          = p23
 48   4   relxillion_nknorm             7.27068E-03  = p24
```

Fit statistic : Chi-Squared 1336.32 using 1313 bins, spectrum 1, group 1.
Chi-Squared 1349.82 using 1303 bins, spectrum 2, group 2.
Total fit statistic ***2686.14 with 2601 d.o.f.***

Test statistic : Chi-Squared 2686.14 using 2616 bins.
Null hypothesis probability of 1.20e-01 with 2601 degrees of freedom

error

3 0.430151 0.454858 (-0.0130478,0.0116598)

4 15905.1 25322.3 (-3759.28,5657.91)

5 8.70594 0 (-1.20785,-9.91379) hit hard limit 10

6 0 0.438511 (-1.00003e-05,0.438501) hit hard limit 1e-5

8 6.81512 10.0089 (-1.16338,2.03039)

10 0.939438 0.98773 (-0.0385124,0.00977951)

11 62.7748 67.9954 (-3.87135,1.34924)

15 1.80662 1.86359 (-0.0124014,0.0445702)

16 4.29106 0 (-0.408937,-4.7) hit hard limit 4.7

17 3.82147 7.22132 (-2.30959,1.09025)

18 148.104 164.504 (-8.9736,7.42551)

19 0.815801 1.29507 (-0.233907,0.245359)

20 1.54171 2.80109 (-0.887065,0.372316)

24 0.00578832 0.00838364 (-0.00148236,0.00111296)

25 1.01384 1.01656 (-0.00136038,0.00136124)

two corona

1、n_H fixed

saved as: relxillion_cutoffpl_nHfixed

```
========================================================================
Model constant<1>*TBabs<2>(diskbb<3> + cutoffpl<4> + relxillion_nk<5>) Source No.: 1
Active/On
Model Model Component  Parameter  Unit     Value
 par  comp
                    Data group: 1
   1    1   constant   factor           1.00000      frozen
   2    2   TBabs      nH         10^22    5.80000      frozen
   3    3   diskbb     Tin        keV      0.465847     +/-  2.66918E-02
   4    3   diskbb     norm               1.45306E+04  +/-  5349.54
   5    4   cutoffpl   PhoIndex           1.33729E-02  +/-  6.73521
   6    4   cutoffpl   HighECut   keV     3.01563      +/-  6.67917
   7    4   cutoffpl   norm               3.78421E-02  +/-  0.383018
   8    5   relxillion_nkIndex1            9.51919      +/-  3.50229
   9    5   relxillion_nkIndex2            1.00000E-05  +/-  2.94136
  10    5   relxillion_nkIndex3            1.00000E-05  = p9
  11    5   relxillion_nkRbr1              7.88299      +/-  4.53428
  12    5   relxillion_nkRbr2              400.000      = p16
  13    5   relxillion_nka                 0.988548     +/-  2.82767E-02
  14    5   relxillion_nkIncl       deg    68.5455      +/-  4.35199
  15    5   relxillion_nkRin               -1.00000     frozen
  16    5   relxillion_nkRout              400.000      frozen
  17    5   relxillion_nkz                 0.0          frozen
  18    5   relxillion_nkgamma             1.77372      +/-  5.55063E-02
  19    5   relxillion_nklogxi             4.49045      +/-  1.06348
  20    5   relxillion_nkAfe               4.51552      +/-  8.11842
  21    5   relxillion_nkEcut       keV    151.463      +/-  66.9803
  22    5   relxillion_nkrefl_frac         1.47301      +/-  1.37964
  23    5   relxillion_nkxi_index          2.11872      +/-  1.22189
  24    5   relxillion_nkdef_par_type      1.00000      frozen
  25    5   relxillion_nkdef_par_value     0.0          frozen
  26    5   relxillion_nkmdot_type         0.0          frozen

  27    5   relxillion_nknorm              5.47285E-03  +/-  5.26789E-03
                    Data group: 2
  28    1   constant   factor           1.01519      +/-  8.27694E-04
  29    2   TBabs      nH         10^22    5.80000      = p2
  30    3   diskbb     Tin        keV      0.465847     = p3
  31    3   diskbb     norm               1.45306E+04  = p4
  32    4   cutoffpl   PhoIndex           1.33729E-02  = p5
  33    4   cutoffpl   HighECut   keV     3.01563      = p6
  34    4   cutoffpl   norm               3.78421E-02  = p7
  35    5   relxillion_nkIndex1            9.51919      = p8
  36    5   relxillion_nkIndex2            1.00000E-05  = p9
  37    5   relxillion_nkIndex3            1.00000E-05  = p10
  38    5   relxillion_nkRbr1              7.88299      = p11
```

```
 39   5  relxillion_nkRbr2              400.000      = p12
 40   5  relxillion_nka                 0.988548     = p13
 41   5  relxillion_nkIncl      deg     68.5455      = p14
 42   5  relxillion_nkRin               -1.00000     = p15
 43   5  relxillion_nkRout              400.000      = p16
 44   5  relxillion_nkz                 0.0          = p17
 45   5  relxillion_nkgamma             1.77372      = p18
 46   5  relxillion_nklogxi             4.49045      = p19
 47   5  relxillion_nkAfe               4.51552      = p20
 48   5  relxillion_nkEcut      keV     151.463      = p21
 49   5  relxillion_nkrefl_frac         1.47301      = p22
 50   5  relxillion_nkxi_index          2.11872      = p23
 51   5  relxillion_nkdef_par_type      1.00000      = p24
 52   5  relxillion_nkdef_par_value     0.0          = p25
 53   5  relxillion_nkmdot_type         0.0          = p26
 54   5  relxillion_nknorm              5.47285E-03  = p27
```

Fit statistic : Chi-Squared 1330.57 using 1313 bins, spectrum 1, group 1.
Chi-Squared 1351.39 using 1303 bins, spectrum 2, group 2.
Total fit statistic ***2681.96 with 2598 d.o.f.***

Test statistic : Chi-Squared 2681.96 using 2616 bins.
Null hypothesis probability of 1.23e-01 with 2598 degrees of freedom

error

3 0.444325 0.484735 (-0.0215218,0.0188887)

4 8484.16 20071.8 (-6046.44,5541.17)

5 0 1.29726 (-0.0133729,1.28388) hit hard limit 1e-5

6 0.371653 5.64709 (-2.64398,2.63146)

7 0.0257326 0.129443 (-0.0121095,0.0916013)

8 8.47196 0 (-1.04722,-9.51919) hit hard limit 10

9 0 0.527066 (-1e-05,0.527056) hit hard limit 1e-5

11 6.47054 12.4241 (-1.41245,4.54111)

13 0.968857 0.993166 (-0.0196913,0.00461784)

14 67.1004 72.4819 (-1.44511,3.93637)

18 1.73997 1.85955 (-0.033753,0.085832)

19 3.54146 0 (-0.948984,-4.49045) hit hard limit 4.7

20 2.05763 0 (-2.45789,-4.51552) hit hard limit 10

21 136.439 182.5 (-15.0236,31.0366)

22 1.00165 2.86761 (-0.471363,1.39461)

23 1.62663 2.61544 (-0.492086,0.496726)

27 0.00372154 0.00667646 (-0.00175131,0.00120362)

28 1.01383 1.01655 (-0.00136056,0.00136333)

2、n_H not fixed

saved as: relxillion_cutoffpl

```
========================================================================
Model constant<1>*TBabs<2>(diskbb<3> + cutoffpl<4> + relxillion_nk<5>) Source No.: 1
Active/On
Model Model Component  Parameter  Unit     Value
 par  comp
                    Data group: 1
   1    1   constant   factor           1.00000      frozen
   2    2   TBabs      nH       10^22    4.67992      +/-  0.435578
   3    3   diskbb     Tin      keV      0.465456     +/-  8.30888E-02
   4    3   diskbb     norm             9488.32      +/-  1.01783E+04
   5    4   cutoffpl   PhoIndex         0.781669     +/-  0.850880
   6    4   cutoffpl   HighECut  keV     10.5163      +/-  5.86203
   7    4   cutoffpl   norm             0.110494     +/-  0.161176
   8    5   relxillion_nkIndex1          7.68420      +/-  10.0647
   9    5   relxillion_nkIndex2          9.34111E-04  +/-  5.06344
  10    5   relxillion_nkIndex3          9.34111E-04  = p9
  11    5   relxillion_nkRbr1            21.6831      +/-  22.2832
  12    5   relxillion_nkRbr2            400.000      = p16
  13    5   relxillion_nka               0.541769     +/-  0.593761
  14    5   relxillion_nkIncl     deg    41.3489      +/-  18.7228
  15    5   relxillion_nkRin             -1.00000     frozen
  16    5   relxillion_nkRout            400.000      frozen
  17    5   relxillion_nkz               0.0          frozen
  18    5   relxillion_nkgamma           1.80485      +/-  8.95444E-02
  19    5   relxillion_nklogxi           4.23110      +/-  0.305670
  20    5   relxillion_nkAfe             10.0000      +/-  17.1492
  21    5   relxillion_nkEcut     keV    1000.00      +/-  2103.90
  22    5   relxillion_nkrefl_frac       1.80878      +/-  2.97547
  23    5   relxillion_nkxi_index        0.493205     +/-  0.136515
  24    5   relxillion_nkdef_par_type    1.00000      frozen
  25    5   relxillion_nkdef_par_value   0.0          frozen
  26    5   relxillion_nkmdot_type       0.0          frozen
  27    5   relxillion_nknorm            3.85963E-03  +/-  5.13761E-03

                    Data group: 2

  28    1   constant   factor           1.01519      +/-  8.27697E-04
  29    2   TBabs      nH       10^22    4.67992      = p2
  30    3   diskbb     Tin      keV      0.465456     = p3
  31    3   diskbb     norm             9488.32      = p4
  32    4   cutoffpl   PhoIndex         0.781669     = p5
  33    4   cutoffpl   HighECut  keV     10.5163      = p6
  34    4   cutoffpl   norm             0.110494     = p7
  35    5   relxillion_nkIndex1          7.68420      = p8
  36    5   relxillion_nkIndex2          9.34111E-04  = p9
  37    5   relxillion_nkIndex3          9.34111E-04  = p10
```

```
 38    5   relxillion_nkRbr1             21.6831      = p11
 39    5   relxillion_nkRbr2             400.000      = p12
 40    5   relxillion_nka               0.541769     = p13
 41    5   relxillion_nkIncl      deg     41.3489      = p14
 42    5   relxillion_nkRin             -1.00000     = p15
 43    5   relxillion_nkRout             400.000      = p16
 44    5   relxillion_nkz               0.0          = p17
 45    5   relxillion_nkgamma            1.80485      = p18
 46    5   relxillion_nklogxi            4.23110      = p19
 47    5   relxillion_nkAfe             10.0000      = p20
 48    5   relxillion_nkEcut      keV     1000.00      = p21
 49    5   relxillion_nkrefl_frac        1.80878      = p22
 50    5   relxillion_nkxi_index         0.493205     = p23
 51    5   relxillion_nkdef_par_type      1.00000      = p24
 52    5   relxillion_nkdef_par_value     0.0          = p25
 53    5   relxillion_nkmdot_type         0.0          = p26
 54    5   relxillion_nknorm             3.85963E-03  = p27
```

Fit statistic : Chi-Squared 1327.25 using 1313 bins, spectrum 1, group 1.

Chi-Squared 1337.66 using 1303 bins, spectrum 2, group 2.

Total fit statistic ***2664.91 with 2597 d.o.f.***

Test statistic : Chi-Squared 2664.91 using 2616 bins.
Null hypothesis probability of 1.73e-01 with 2597 degrees of freedom

error

2 4.16571 5.21022 (-0.514213,0.5303)

3 0.428608 0.48959 (-0.0368487,0.0241334)

4 6520.33 17859.9 (-2967.99,8371.59)

5 0.250687 1.17643 (-0.530982,0.394763)

6 9.79842 11.8249 (-0.717923,1.30854)

7 0.0504624 0.200091 (-0.0600316,0.0895973)

8 4.54261 0 (-3.14159,-7.6842) hit hard limit 10

9 0 1.20839 (-0.000934111,1.20746) hit hard limit 1e-5

11 13.3346 51.8109 (-8.3485,30.1278)

13 0 0.800586 (-0.541769,0.258817) hit hard limit 0

14 23.5259 48.208 (-17.8231,6.85909)

18 1.78037 1.84871 (-0.0244728,0.0438664)

19 4.16111 4.35168 (-0.0699975,0.120578)

20 7.23959 0 (-2.76041,-10) hit hard limit 10

21 646.927 0 (-353.073,-1000) hit hard limit 1000

22 1.20511 3.60909 (-0.603676,1.80031)

23 0.411586 0.918952 (-0.0816196,0.425747)

27 0.00332703 0.00453238 (-0.000532602,0.000672744)

28 1.01383 1.01656 (-0.0013607,0.00136333)