CIAO2.0 Science Threads

Estimating Source Counts in Imaging Observations (12/19/00)

Radial Projections

DS9 provides a powerful means for defining multiple concentric annuli, which can be useful for generating radial projections of extended sources. In this section we show how you can use these regions, together with the get_rproj script, to calculate the radial profile of a source.

After displaying an image, select Region->Shape->Annulus from the DS9 menu bar, position the cursor at the desired source location and click once with the left mouse button. A singular annular region will appear. To edit the region, make it "active" and select Region->Get Info... A region editing window (see Fig. 1) will appear, in which one can adjust the number of annuli, and their sizes. Fifteen equal-radii annuli, with minimium and maximum of 0 and 45 pixels respectively, look like Fig. 2.

Once the annuli are defined, the get_rproj script will compute the radial projection, where the background is calculated from the outer annulus. The script may be run in two ways. If no arguments are given, the region information is taken from the DS9 display:

```
unix% get_rproj
Source              Source Region              Background Region
------              -------------              -----------------
     1       annulus(510,532,0,3)          annulus(510,532,42,45)
     2       annulus(510,532,3,6)          annulus(510,532,42,45)
     3       annulus(510,532,6,9)          annulus(510,532,42,45)
     4      annulus(510,532,9,12)          annulus(510,532,42,45)
     5     annulus(510,532,12,15)          annulus(510,532,42,45)
     6     annulus(510,532,15,18)          annulus(510,532,42,45)
     7     annulus(510,532,18,21)          annulus(510,532,42,45)
     8     annulus(510,532,21,24)          annulus(510,532,42,45)
     9     annulus(510,532,24,27)          annulus(510,532,42,45)
    10     annulus(510,532,27,30)          annulus(510,532,42,45)
    11     annulus(510,532,30,33)          annulus(510,532,42,45)
    12     annulus(510,532,33,36)          annulus(510,532,42,45)
    13     annulus(510,532,36,39)          annulus(510,532,42,45)
    14     annulus(510,532,39,42)          annulus(510,532,42,45)


  Source    Counts      Area       Bgd  Bgd Area    Net/pix    Err/pix
  ------    ------      ----       ---  --------    -------    -------
       1  9514.000    27.562   334.000   820.044  3.448e+02  3.539e+00
```

```
 2  9670.000    84.750   334.000   820.044  1.137e+02  1.161e+00
 3  4494.000   141.500   334.000   820.044  3.135e+01  4.743e-01
 4   977.000   197.750   334.000   820.044  4.533e+00  1.596e-01
 5   543.000   255.000   334.000   820.044  1.722e+00  9.406e-02
 6   522.000   310.250   334.000   820.044  1.275e+00  7.694e-02
 7   669.000   368.500   334.000   820.044  1.408e+00  7.364e-02
 8   725.000   424.250   334.000   820.044  1.302e+00  6.727e-02
 9   710.000   482.000   334.000   820.044  1.066e+00  5.960e-02
10   740.000   537.750   334.000   820.044  9.688e-01  5.528e-02
11   612.000   592.500   334.000   820.044  6.256e-01  4.733e-02
12   656.000   650.750   334.000   820.044  6.008e-01  4.523e-02
13   508.000   708.000   334.000   820.044  3.102e-01  3.886e-02
14   376.000   764.729   334.000   820.044  8.438e-02  3.376e-02
```

If an argument is supplied, it is assumed to be the name of a region file, saved from DS9. Be sure to select Region->Format->DS9 and Region->Coord->Image before saving the region: for this example we saved the file to rprof.ds9.reg (Fig. 3).

```
unix% get_rproj rprof.ds9.reg

... same output as above ...
```

Because of DS9 buffer limitations, it is recommended that the region data be saved to a file if the number of regions is large.

The profile can be plotted in ChIPS. We saved the output to a file and edited it to remove the header lines and replace the source column by a radius (we used the mid-point of each annulus in pixels), which gave rprof.dat (Fig. 4). The following:

```
unix% chips
chips> curve rprof.dat x 1 y 6 yerr 7
chips> log x
chips> log y
chips> limits 1 50 0.03 500
chips> xlabel "Radius (pixels)"
chips> xlabel size 1.5
chips> ylabel "Counts/pixel"
chips> ylabel size 1.5
```

produced Fig. 5.

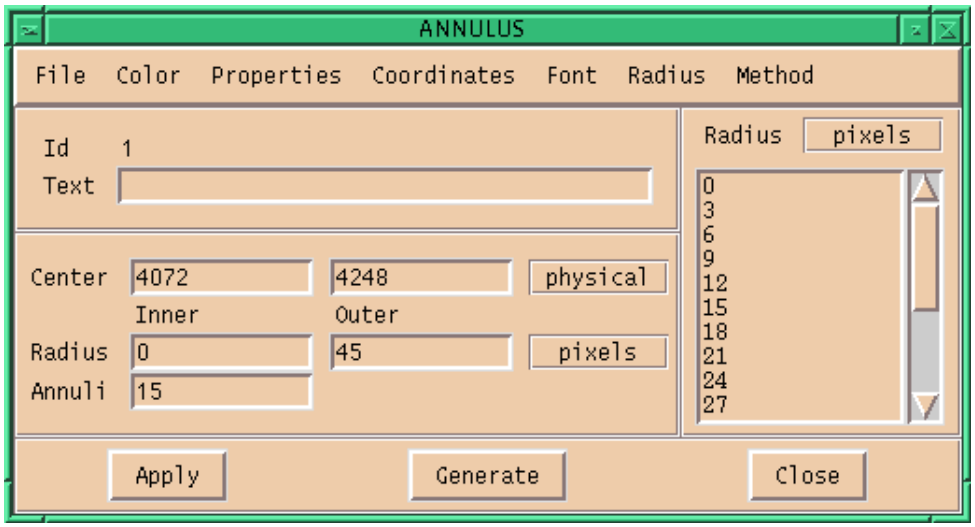
ANNULUS
File
Color
Properties
Coordinates
Font
Radius
Method
Id
1
Text
Radius
pixels
0
3
6
9
12
15
18
21
24
27
Center
4072
4248
physical
Inner
Outer
Radius
0
45
pixels
Annuli
15
Apply
Generate
Close

Figure 1

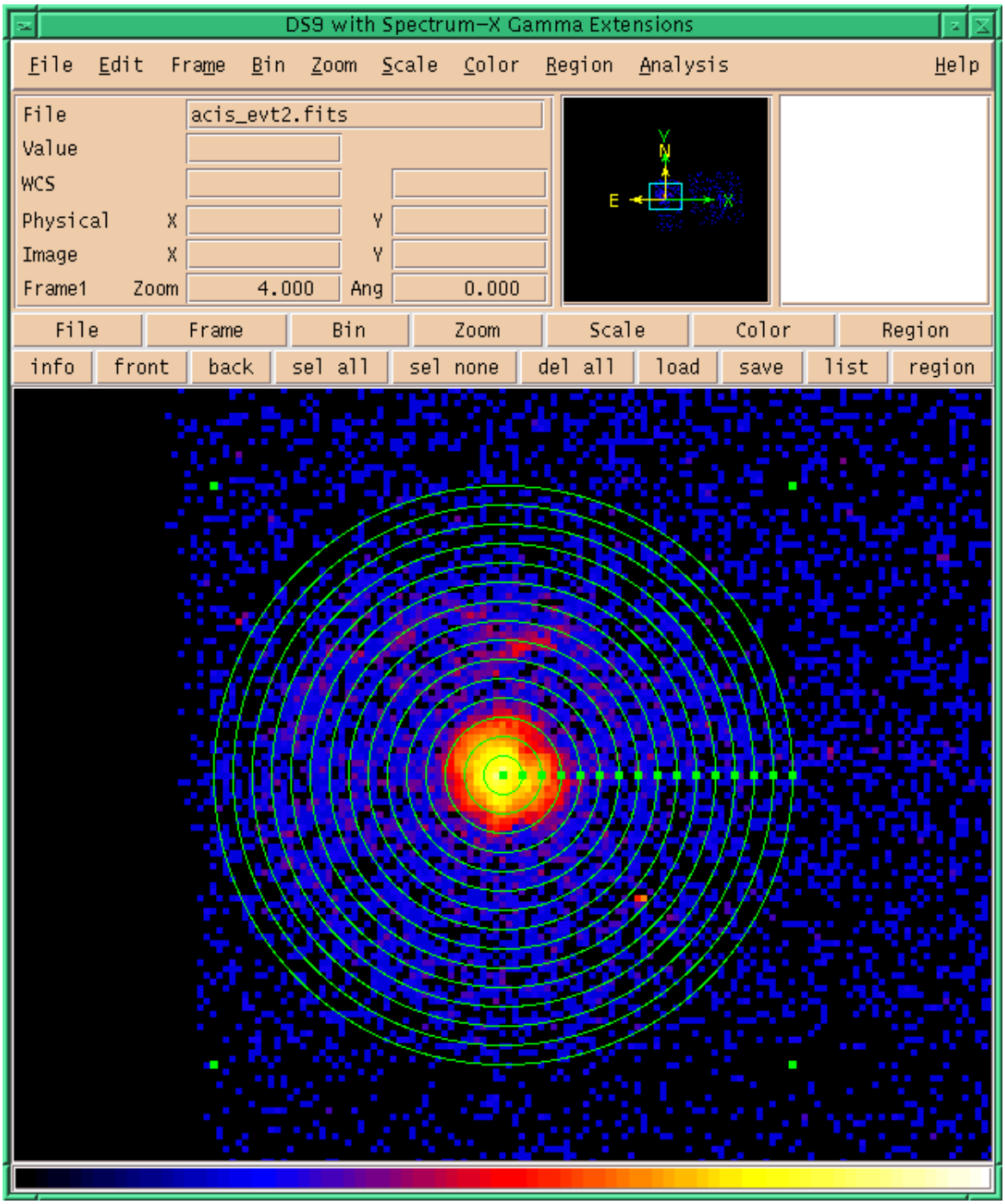
DS9 with Spectrum-X Gamma Extensions
File Edit Frame Bin Zoom Scale Color Region Analysis Help
File acis_evt2.fits
Value
WCS
Physical X Y
Image X Y
Frame1 Zoom 4.000 Ang 0.000
N
E
File Frame Bin Zoom Scale Color Region
info front back sel all sel none del all load save list region

Figure 2

Region file format: DS9 version 3.0
global color=green font="helvetica 10 normal" select=1 edit=1 move=1 delete=1 include=1 fixed=0
image;annulus(510,532,0,3,6,9,12,15,18,21,24,27,30,33,36,39,42,45)

Figure 3

# Radius	Counts	Area	Bgd	Bgd Area	Net/pix	Err/pix
1.5	9514.000	27.562	334.000	820.044	3.448e+02	3.539e+00
4.5	9670.000	84.750	334.000	820.044	1.137e+02	1.161e+00
7.5	4494.000	141.500	334.000	820.044	3.135e+01	4.743e-01
10.5	977.000	197.750	334.000	820.044	4.533e+00	1.596e-01
13.5	543.000	255.000	334.000	820.044	1.722e+00	9.406e-02
16.5	522.000	310.250	334.000	820.044	1.275e+00	7.694e-02
19.5	669.000	368.500	334.000	820.044	1.408e+00	7.364e-02
22.5	725.000	424.250	334.000	820.044	1.302e+00	6.727e-02
25.5	710.000	482.000	334.000	820.044	1.066e+00	5.960e-02
28.5	740.000	537.750	334.000	820.044	9.688e-01	5.528e-02
31.5	612.000	592.500	334.000	820.044	6.256e-01	4.733e-02
34.5	656.000	650.750	334.000	820.044	6.008e-01	4.523e-02
37.5	508.000	708.000	334.000	820.044	3.102e-01	3.886e-02
40.5	376.000	764.729	334.000	820.044	8.438e-02	3.376e-02

Figure 4

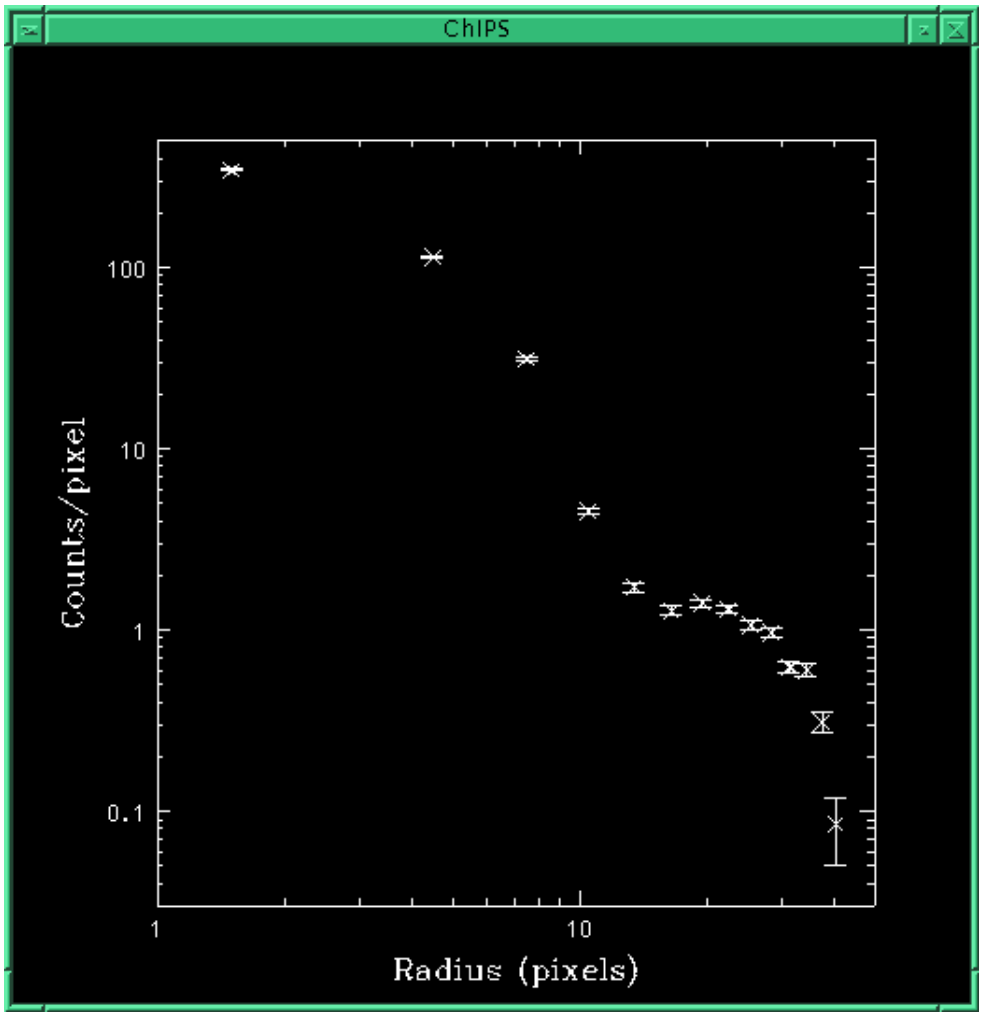

Figure 5

Coming in DMEXTRACT in CIAO 2.1:

```
srg-41: cat tenannuli.reg
annulus(4071,4249,0,10)
annulus(4071,4249,10,20)
annulus(4071,4249,20,30)
annulus(4071,4249,30,40)
annulus(4071,4249,40,50)
annulus(4071,4249,50,60)
annulus(4071,4249,60,70)
annulus(4071,4249,70,80)
annulus(4071,4249,80,90)
annulus(4071,4249,90,100)
srg-42: cat  tenannulibgd.reg
annulus(4071,4249,110,140)
srg-45: dmextract infile="indir/t1838evt2.fits[bin sky=@tenannuli.reg]" \
                                  outfile=/tmp/newdme.fits clobber+ \
                                   bkg="indir/t1838evt2.fits[bin sky=@tenannulibgd.reg]"
srg-46: dmlist "/tmp/newdme.fits[cols counts,err_counts,bg_counts,bg_err,net_counts,net_err]" data
--------------------------------------------------------------------------------
Data for Table Block HISTOGRAM
--------------------------------------------------------------------------------
ROW    COUNTS     ERR_COUNTS      BG_COUNTS    BG_ERR         NET_COUNTS           NET_ERR
     1       4156        65.4728625082              1071.0        33.7375930697      4141.7215536758
     2       3603        61.0312418662              1071.0        33.7375930697      3560.1845501103
     3       4620        68.9760987407              1071.0        33.7375930697      4548.5196818858
     4       3895        63.4159434760              1071.0        33.7375930697      3795.0707608238
     5       2887        54.7377893107              1071.0        33.7375930697      2758.3945256993
     6       2325        49.2260303156              1071.0        33.7375930697      2167.8433224857
     7       1403        38.4666518387              1071.0        33.7375930697      1217.3148371130
     8        730         28.0323879818              1071.0        33.7375930697         515.7067954093
     9        407         21.1928205063              1071.0        33.7375930697         164.2578823268
    10        343        19.5404962177              1071.0        33.7375930697           71.4566073120
```