especplot

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Abstract

especplot produces plots of the net source and background spectra.

1 Instruments/Modes

Instrument	Mode
EPIC MOS	IMAGING, TIMING
EPIC PN	IMAGING, TIMING

2 Use

pipeline processing	yes
interactive analysis	yes

3 Description

especplot produces a plot in log-log space of the net source and background spectrum as measured by EPIC. The source spectrum is produced by **evselect** and the background spectrum can be produced either by **evselect** or **evselect** followed by **backcorr**. They are both supplied in FITS format, where the spectrum is in channel and counts.

The binning scheme is defined by the user or automatically set to a geometric binning scheme, such that it ensures that each data point of the binned spectrum is statistically significant. In the present version, the statistical criteria is more than 10 counts in each bin (with a minimum of 25 spectral bins)

In a PPS run, the device by default is postscript. Nevertheless, **especplot** allows the user, in an IAS run, to choose from several device types (e.g. XWINDOW, GIF) for the output.

The user can bin the data by channels using a constant rebinning (positive values of the parameter 'binsize') or geometrically (negative values of the parameter 'binsize'). Alternatively, the user can bin by a minimum number of counts per channel.

3.1 Examples

To create a postscript plot, called plot.ps, of the net and background counts, from the source and background spectra, spectrum.ds and background.ds, where the channel energy is geometrically rebinned with a modulus of 2.0 before being plotted on the x-axis, a command such as,

```
especplot srcspectrumset="spectrum.ds" bkgspectrumset="background.ds" withbinning=yes binsize=-2.0 plotdevice="/VPS" plotfile="plot.ps"
```

can be used.

4 Parameters

This section documents the parameters recognized by this task (if any).

Parameter	Mand	Type	Default	Constraints
srcspectrumset	yes	dataset	No default	less than 1024 char.

Name of the FITS file containing the EPIC source spectrum, case sensitive

bkgspectrumset	yes	dataset	No default	less than 1024 char.

Name of the FITS file containing the EPIC background spectrum, case sensitive

withbinning	no	Boolean	no	'yes' or 'no'

no=Automatic binning. yes=The binning scheme is defined by the user.

binsize	no	Real	1.0	No constraints

The spectrum can be rebinned either with a constant rebinning factor or as a geometric series (to produce nearly equispaced bins in a logX representation). The default value (1) is not to rebin the spectrum. Values greater than 1 indicate a constant rebinning factor (nearest integer of binsize). Geometric series rebinning is obtained by entering a value less than -1, whose modulus represents the step of the geometric series

plotdevice	no	String	"/PS"	Constraint : valid device name

Name of the output device which must belong to the following list : /PS, /CPS, /VPS, /VCPS, /GIF , /VGIF, /XWINDOW, not case sensitive

plotfile	no	String	"plot.ps"	less than 1024 char.

Name of the file containing the plot, case sensitive

5 Errors

This section documents warnings and errors generated by this task (if any). Note that warnings and errors can also be generated in the SAS infrastructure libraries, in which case they would not be documented here. Refer to the index of all errors and warnings available in the HTML version of the SAS documentation.

Parameters missing *(error)*
Parameters missing (exit properly, no action)

Invalid input file *(error)*
Input file invalid or invalid file format (exit properly, no action)

Invalid output file *(error)*
Output file invalid (exit properly, no action)

Incorrect spectrum extension *(error)*
Source or background spectrum extension not correct (exit properly, no action)

No valid data points to plot *(error)*
No valid data points to plot on logarithmic scale (exit properly, no action)

Energy bin width negative *(error)*
At least one energy bin has a negative or null width (exit properly, no action)

Device not supported *(error)*
Device type not recognized by the task (exit properly, no action)

Existing file cannot be overwritten *(error)*
Already existing file cannot be overwritten as clobber=false

Invalid binning size *(warning)*
The binning size is invalid
corrective action: set to the default value : binsize=1 (no rebinning)

Already existing output file overwritten *(warning)*
The existing file will be overwritten
corrective action: The existing file will be overwritten

6 Input Files

1. EPIC FITS Source Spectrum File (generated by **evselect**).
2. EPIC FITS Source Background Spectrum File (generated by **evselect** or **evselect** followed by **backcorr**).

7 Output Files

1. EPIC Source Spectrum Plot (plot of the net source and the background spectra together with their information).

8 Algorithm

```
Subroutine especplot


  Recover parameters (Filenames, Binning mode, Device type)

  Read source (Src) and background (Bkg) spectrum FITS files :
       Get dataset and table.
       Check if important keywords exist and are correct.
       Call an error if not.
       Recover counts and channel columns.

  Get energy boundaries (Emin, Emax) using 1PI=1eV

  Open plot :
      Create view surface in specified device format.
      Write labels on it.

  Allocate six vectors with Emin&Emax size :
       Emed = (Emin + Emax)/2
       Edelta = (Emin - Emax)/2
       Net_Counts = Src_Counts -
             Bkg_Counts*Src_Exposure_Time/Bkg_Exposure_Time
       Net_Counts_Err = sqrt(Src_Counts + Bkg_Counts*
             ((Src_Exposure_Time/Bkg_Exposure_Time)**2))
       Bkg_Counts which yet exists
       Bkg_Counts_Err = sqrt(Bkg_Counts)

  For Net_Counts and Bkg_Counts do :

       Rebin Emed, Edelta, Counts, Counts_Err following the specified
       binning scheme (auto, size).

       Normalize Counts and Counts_Err.

       In the new vectors, eliminate each value where :
             (Emed-Edelta<=0) or (Counts-Counts_Err<=0)

       Plot Y=log(Counts) as a function of X=log(Emed)

       Draw errors on plotted points :
               log(Counts_Err) for Y-axis
               log(Edelta) for X-axis
  End for

  Return plot on device selected.

  Release memory.

  Close plot.

End subroutine  especplot
```

9 Comments

- The X-axis lower/upper limit of the plots is fixed to the value of 0.1/10.0 keV so that the net source and background spectral shapes can be compared easily.
- If a Y-ΔY value of a spectral point is negative or null, the point is not plotted.
- If the device is /XWINDOW, the plot is displayed until the carriage return is hit.
- The following device types are recognized by the task and need an output file :
  - /PS (monochrome landscape mode, long edge of paper horizontal)
  - /CPS (color landscape mode, long edge of paper horizontal)
  - /VPS (monochrome portrait mode, short edge of paper horizontal)
  - /VCPS (color portrait mode, short edge of paper horizontal)
  - /GIF (landscape orientation)
  - /VGIF (portrait orientation)
- The following device type is also recognized by the task and does not need an output file :
  - /XWINDOW (X-window for workstations)

10 Future developments

11 Developer's notes

The task first reads the files containing the input source and background EPIC spectra FITS files. Then it checks some of the keywords existence and validity : `INSTRUMENT` = 'EMOS1' , 'EMOS2' OR 'EPN' ; `HDUCLASS` = 'OGIP' ; `HDUCLAS1` = 'SPECTRUM' ; `HDUCLAS2` = 'TOTAL' (for source) and 'BKG' (for background) ; `HDUCLAS3` = 'COUNT' ; `CHANTYPE` = 'PI'. If necessary an error is raised and the task exits properly.

To determine whether the background spectrum file corresponds to the source spectrum file, the only checks performed are about number of PI channels and instrument names which must be the same for the source and background spectral file.

The net source spectrum is computed by subtracting channel by channel, the normalized background spectrum from the source spectrum. The net source and background spectra are rebinned using the same binning scheme and then normalized. They are drawn logarithmically with their error bars on the same page. The X-axis and Y-axis are labelled as Energy (keV) and counts/s/keV respectively.

If the device selected is not valid (i.e. does not belong to the list of devices supported by the task), the task exits properly. The same happens if the device selected is one of the devices requesting an output file and the output file is invalid. If the output file already exists, the task issues a warning and overwrites the output file, providing that the environment variable SAS_CLOBBER is set to 1 or is unset.

The following information is added to the plot: the telescope name; the instrument; its mode of operation; the date of the observation (start, stop); the source; and the background exposure time. The XMM observation ID, the name of the target object, and name of the PI are also indicated on the plot. If some of this information is not available, a blank string is used.

11.1 CAL usage

- CAL_openCCF
- CAL_setState

References