pnback

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Abstract

This task creates model particle background spectra and images (if selected with a non-zero energy range) for the selected region from the intermediate files produced from *pnspectra*. The resultant image is in detector coordinates which is then transformed into sky coordinates by the SAS task rotdet2sky. *pnback* creates a QDP plot file which shows the source and model background spectra for the observation. Any enhancement of the data over the particle background model at higher energies probably indicates residual soft proton contamination, unless there are really hard and bright sources in the field. This task was originally a subtask of the SAS *esas* task named *pn_back* prior to SAS-21 and retains all of its functionality.

1 Instruments/Modes

Instrument	Mode
EPIC	Imaging

2 Use

pipeline processing	no
interactive analysis	yes

3 Description

This task creates model particle background spectra and images (if selected with a non-zero energy range) for the selected region from the intermediate files produced from *pnspectra*. The resultant image is in detector coordinates. The resultant image is in detector coordinates which is transformed into sky coordinates by the perl script *rotdet2sky*. *pnback* creates a QDP plot file which shows the source and model background spectra for the observation. Any enhancement of the data over the particle background model at higher energies probably indicates residual soft proton contamination, unless there are really hard and bright sources in the field.

Warning and requirements: *pnback* was part of the *esas* package integrated into SAS, but it is limited to work within the *esas* data reduction scheme. This is especially true wrt the structure and names of the input files. In particular, *pnback* assumes that another task from the package, *pnspectra* has been successfully run for the exposures to be used.

4 Parameters

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

Parameter	Mand	Type	Default	Constraints
inspecfile	yes	dataset		
Spectral file (e.g. pnS003-fovt.pi) from pnspectra.				
inspecoot	yes	dataset	'default'	
Spectral file (e.g. pnS003-fovtoot.pi) from pnspectra.				
outspecfile	no	dataset	'default'	
Output spectral file (will derive one if not given)				
outspecoot	no	dataset	'default'	
Output OOT spectral file (will derive one if not given)				
rmffile	no	dataset	'default'	default
Input response file (will derive one if not given)				
withplotfiles	no	boolean	yes	T/F
Diagnostic output control (write QDP plotfiles?)				
withimage	no	boolean	yes	T/F
Write output bkg image?				
inimgfile	no	dataset	'default'	
Input template image filename (will derive one if not given)				
inimgoot	no	dataset	'default'	
Input OOT template image filename (will derive one if not given)				
outimgfile	no	dataset	'default'	
Output bkg image filename (will derive one if not given)				
elow	yes	int	400	
Energy low limit (in eV) for the band.				
ehigh	yes	int	1250	
Energy high limit (in eV) for the band.				
quads	yes	boolean	yes	
Select quads to be included.				

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 docu-

mented here. Refer to the index of all errors and warnings available in the HTML version of the SAS documentation.

NotPN *(error)*
Input spectral file is not PN

chansNEchans *(error)*
Number of channels in OOT spectrum must be 4096

saslocateBad *(error)*
saslocate for QPB file failed

noRMF *(error)*
Derived RMF file does not exist

PATTnePATTOO *(error)*
PATTERN of PN not the same as PN OOT

softEQzero *(error)*
Soft band rate=0, giving infinite Hardness Ratio

noQPB *(error)*
CAL QPB file does not contain QPB extension

badColumn *(error)*
QPB file is missing critical column

noGoodRows *(error)*
No QPB file rows meet augmentation criteria

6 Input Files

Generally the input files are outputs from the sas task `pnspectra`

- Spectrum from pnspectra (e.g. pnS003-fovt.pi)
- Response file (e.g. pnS003.rmf)
- Template image if bkg image produced is desired.

7 Output Files

For the different values of `comp`, the output files are:

- A QDP plot of the augmented hardness ratio vs revolution, e.g., pnS003-aughardrev.qdp
- A QDP plot of the augmented count rate vs revolution, e.g. pnS003-augraterev.qdp
- A QDP plot of each quad selected's augmented spectrum, e.g. pnS003-augspec.qdp

- A QDP plot file showing the observed spectrum and the model background spectrum, e.g. pnS003-bkgspec.qdp
- A QDP plot file showing the the fit for the Al-Si bridge, e.g. pnS003-bridgefit.qdp
- A QDP plot file showing the accumulating background spectrum. Chip 1 at the bottom increasing upwards. E.g. pnS003-quadspec.qdp
- A QDP plot showing the selected region of hardness/count rate distributions for the various ccds. e.g. pnS003-ratehard.qdp
- The model particle background image for the given exposure, selected energy band (`elow` and `ehigh`), and the selected region. The image is in detector coordinates. E.g. pnS003-bkgimdet-elow-ehigh.fits.
- The model particle background spectrum for the *prefix* exposure and the selected region. E.g. pnS003-bkg.pi

8 Algorithm

```
Read parameters
Open and read input spectrum and spectrum OOT file header
Open and read QPB calibration file
if (withplotfiles) open LUNs for ASCII QDP output
if (withimg) open and read input template image file
get PN submode from spectrum header
Open and read RMF, get channel to energy conversion
Create the background spectrum by scaling the spectrum both by
the ratio of the exposure and the ratio of the backscale value,
as well as the OOT scale factor.
Subtract the OOT spectrum
Set channel ranges for some energy bands, total, soft, hard
Set channel ranges for the interpolation bridge
do i=1,4 (nQUADs)
 if (selected) then
  Read in FOV spec for QUADi (areafov(i) and expofov(i))
  Read in FOV OOT spec for QUADi (areafov(i) and expofov(i))
  Fill FOV by-quad spectrum
 endif
enddo
do i=1,4 (nQUADs)
 if (selected) then
  Read in FWC spec for QUADi (areafwc(i) and expofwc(i))
  Normalize specFWC(1:4096,i) and specFWCunc(1:4096,i)
 endif
enddo
Remove any chip's data that has less area than limiting area
do i=1,4 Object corner data
 if (selected) then
  Read in Obj Corner spec for QUADi (areacoro(i) and expocoro(i))
  Calculate hardness
  Calculate rate
  Normalize the count rate
  Set the search values for the augmentation spectrum
```

```
  Augment spectra
  Calculate augmented count rate
  Scale by count rate and then test the scaling of the background spectrum
  Write augmented spectra to output file
 endif
enddo
do i=1,4 FWC corner data
 if (selected) then
  Read in FWC Corner spec for QUADi (areafwcc(i) and expofwcc(i))
  Subtract the OOT events from the spectrum and normalize the result
 endif
enddo
Smooth the data
Exclude data if they are in a bridge region
Create the masks to remove strong instrumental lines
Remove the Al line from all spectra
if (withplotfiles) open and write output QDP file header
if (withimg) Create final image (check for bright pixels, reset if necessary)
Create output spectrum (mask if necessary)
if (withplotfiles) fill QDP plot, close several QDP files
Add in the OOT events for CSTAT background spectrum
if (withimage) fill opened final image (and OOT image), close images
if (withplotfiles) open bridgefit QDP file
Bridge the Al and high-energy gaps
Set a number of line-free windows
Extract the data from those windows
Fit a simple polynomial to the log of the data
Use the result to interpolate over the Al gap
Finish the bridge
Write bkg spectrum
if (withplotfiles) Write bkg spectrum QDP plot, close QDP file
Close bkg spectrum
```

9 Comments

The original code for this task appeared in the *esas* task 2009-2021 as the subtask *pn_back*. It was removed from the task *esas*, and modularized as a single task for SAS-21. The *esas* task was removed in SAS-21.

References