



epicspeccombine

April 16, 2023

Abstract

Combines a list of spectrum files to create one combined source spectrum, background spectrum and response file.

1 Instruments/Modes

Instrument	Mode
EPIC MOS	IMAGING
EPIC PN	IMAGING

2 Use

pipeline processing	no
interactive analysis	yes

3 Description

The **epicspeccombine** is a SAS implementation of the “Combining the spectra of the 3 EPIC cameras” thread that can be found on the XMM-Newton web site. For convenience, this task should be used in combination with **multixmmselect** and **multiespecget** tasks.

epicspeccombine task requires as an input a set of source spectra, background spectra, plus the corresponding response and effective area files of the three EPIC cameras as produced by the **multiespecget**. Although, it is not mandatory the use of **multiespecget** task prior to **epicspeccombine** execution, it is highly recommended because **multiespecget** task sets accordingly all the parameters related to spectral range or energy binning. Nevertheless, the user can use their own files, but in this case, the user has to ensure that the spectral files have a common spectral range and common binning. Also, the user has to provide the response and ancillary files with the same energy binning.

epicspeccombine task assumes that the spectral extraction regions are identical for all the EPIC input files. If this is not the case then the background merged from different instruments will not be accurate.



Firstly, this task merges together the source+background and background spectra files into a single set of merged source+background spectrum and background spectrum. Then, the redistribution matrix and effective area vector files are also combined together into a single response file.

The files for each of the input parameters: **pha**, **bkg**, **rmf** and **arf** have to be introduced in order. Meaning that **epicspeccombine** assumes that the first source spectrum, first background spectrum, first ARF and first RMF go together. The same for the second files etc.

3.1 Adding short and long spectra

To allow data from different length spectra to be added the option **allowHEdiff=yes** should be used. For example, this will allow a standard EPIC-MOS spectrum from 0-12 keV to be added to an EPIC-pn spectrum from 0-15 keV. This is allowed as long as the starting channel of the spectra are the same and the bin width of each spectrum is the same. It is essential that the order of spectra and response matrices is consistent. e.g.

```
epicspeccombine pha='pnspec15k.fits m1spec12k.fits'  
bkg='pnbck15k.fits m1bck12k.fits' rmf='pnspec15k.rmfm1spec12k.rmfm'  
arf='pnspec15k.arf m1spec12k.arf' filepha=epic_src_152k_p1.ds  
filebkg=epic_bkg_152k_p1.ds filersp=epic_src_152k_p1.rsp allowHEdiff=yes
```

3.2 Algorithm

The input files are combined such that the output files contain:

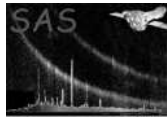
- Source Spectrum: the sum of the counts in all of the input source spectra.
- Background Spectrum: the sum of the counts in all of the background spectra.
- Exposure time: the exposure time is set to the mean of the sum of the exposure times for each instrument. i.e. exposure time is added for spectra of a given instrument and then averaged over the instruments.
- the response matrix contains the sum of the exposure-weighted average of the individual responses. e.g. if each instrument has the same total exposure time then the output effective area will be the sum of the individual instrument effective areas.
- the backscale value is the sum of the exposure-weighted averages of the individual instrument BACKSCAL values.
- Background Spectrum: the sum of the counts in all of the input background spectra.

Mathematically this is given by:

$$S = \sum_i S_i$$

$$Exposure = \sum_i exp_i / number_of_insts$$

$$Resp = number_of_insts \times \sum_i R_i \times exp_i / \sum_i exp_i$$



$$BACKSCAL = number_of_insts \times \sum_i BACKSCAL_i \times exp_i / \sum_i exp_i$$

$$B = \sum_i B_i$$

where i is the instrument, o is the observation, S_i are the source counts in each spectrum (i), R_i are the response elements for each spectrum (i), $BACKSCAL_i$ are the backscale values for each spectrum, $number_of_insts$ is the number of independent cameras contained in the source spectra and exp_i is the exposure time of each spectrum. B_i are the background counts in each background spectrum (i),

4 Parameters

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

Parameter	Mand	Type	Default	Constraints
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pha	yes	list		
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A list of source+background spectrum files. It has to share with the background spectrum files a common spectral range and a common binning.

bkg	yes	list		
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A list of background spectrum files. It has to share with the source+background spectrum files a common spectral range and a common binning.

rmf	yes	list		
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A list of redistribution matrix files.

arf	yes	list		
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A list of effective area files.

filepha	no	file	epic_spc_src.ds	
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The file name for the output source+backgroundcombined spectrum.

filebkg	no	file	epic_spc_bkg.ds	
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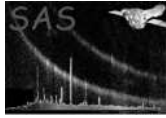
The file name for the output combined background spectrum.

filersp	no	file	epic_rsp.ds	
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The file name for the output combined response matrix.

allowHEdiff	no	boolean	no	
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Whether to allow short and long spectra to be added. This is set to "No" by default to catch user errors.



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.

pairing (*error*)

The number of events files does not match the number of rmf or bkg files. There must be a one-to-one pairing.

specChannelIntervalError (*error*)

Different PI channel interval found in spectrum files. Make sure that all the spectra are created with the same PI range and binning.

rmfEnergiesError (*error*)

Different energies were found in the response matrices. Run rmfgen with the same energymmin, energymax and nenergybins for each spectrum.

6 Input Files

- 1.

7 Output Files

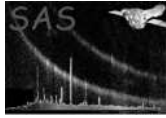
- 1.

8 Algorithm

See Section 3.2.

9 Comments

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References