



# ebkgreg

February 1, 2016

## Abstract

EPIC background selection for Source Products extraction

## 1 Instruments/Modes

Instrument	Mode
EPIC PN	IMAGING

## 2 Use

pipeline processing	yes
interactive analysis	yes

## 3 Description

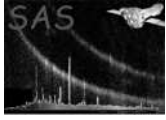
The task **ebkgreg** searches for the most suitable position of a circle region to get the background estimation of any source in an EPIC-pn image.

This task has two processing modes: multiple sources from an input source list file or single-source from command-line arguments.

In the multiple sources case the input source list has to contain the following basic parameters for each source: celestial coordinates (**RA**, **DEC**), EPIC-pn counts (**PN\_CTS**) and EPIC-pn offaxis information (**PN\_OFFAX**). The extraction region radius for each source is obtained from a tabulated table and it depends on the counts and the off-axis values of the source. All of that mandatory information is included in the 'EPIC summary source list' from the standard distribution of the pipe-line processing. Additionally that source list can be created from **srcmatch** (follow the link for further information).

Alternatively the extraction region radius for each source can be present in the input source list as **SRC\_RAD**. In this case this is the mandatory column in the input, but not **PN\_CTS** and **PN\_OFFAX**.

Only in the single-source mode the source basic information can be given via the command-line arguments, **x**, **y** and **r**, where **x**,**y** are the celestial coordinates of the source and **r** is the source extraction radius for

Table 1: **Input and Output quantities**

Value	Description	Units
x	Source RA or X Sky coord	deg. or 0.05 arcsec pixel
y	Source Dec or Y Sky coord	deg. or 0.05 arcsec pixel
r	Source extraction radius	arcsec
bkg_ra_out	Background region center RA	deg.
bkg_dec_out	Background region center Dec	deg.
bkg_rad_arcsec_out	Background region radius	arcsec
bkg_x_out	Background region center X sky coord	0.05 arcsec pixel
bkg_y_out	Background region center Y sky coord	0.05 arcsec pixel
bkg_rad_phys_out	Background region radius	0.05 arcsec pixel

Table 2: **Input Source List. Mandatory Columns (case 1)**

Src number	Right-ascension	Declination	PN counts	PN Off Axis
SRC_NUM	RA	DEC	PN_CTS	PN_OFFAX

source products in arcsec. Depending on the `coordtype` the source position could be RA,Dec or X,Y Sky coord.

The algorithm will search for that background position in the same CCD where the source is located.

The background extraction region always have a radius larger than 3 pixels, otherwise no background is calculated.

## 3.1 Input

### 3.1.1 Image

The source image may be input in detector or sky (X/Y) coordinates. The task expects to find astrometry keywords in a certain part of the primary header and will exit with an error if the keywords are not found. Standard images produced by `evselect` and `xmmselect` and the pipeline will process ok. The background spline maps produced by the pipeline source detection chain and the exposure maps produced by `eexppmap` need to be pre-processed before they can be used within `ebkgreg` (see `ecoordconv` task).

That image has to contain keywords `INSTRUME`, `DATE-OBS`, `RA_PNT`, `DEC_PNT` and `PA_PNT`. It also needs to contain the WCS keywords, `CRPIX1` etc. to allow conversion to image pixels. A further set of keywords, `REFXCRPX` etc. allow translation to an X/Y tangential plane coordinate system.

### 3.1.2 Source list

Source positions are read from the input source list file which has to contain celestial coordinates (RA, DEC), EPIC-pn counts (`PN_CTS`) and EPIC-pn offaxis information (`PN_OFFAX`). This is the default method.

Alternatively the extraction region radius for each source can be present in the input source list as `SRC_RAD`.



Table 3: Input Source List. Mandatory Columns (case 2)

Src number	Right-ascension	Declination	Source extraction radius
SRC_NUM	RA	DEC	SRC_RAD

Table 4: Source position + extraction radius

x	Source RA or X Sky coord	deg. or 0.05 arcsec pixel
y	Source DEC or Y Sky coord	deg. or 0.05 arcsec pixel
r	Source extraction radius	arcsec

The resulting Background information will be added to the input Source List in extra columns. (see Section 3.2 for information about those extra columns).

### 3.1.3 Source position

A single-source position can be given from the command-line arguments. Celestial coordinates plus a source extraction region radius is needed:

## 3.2 Output

In case of a single-source input the results are thrown to a stdout string.

The strings shown may be searched for in a script and every effort will be made to keep them constant between versions of this task.

```
ebkgreg withsrclist=no withcoords=yes imageset=pnimagexy.ds x=28521 y=22721 r=34 coordtype=POS
```

```
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#
# Instrument: EPN
#
# Source position RA, Dec (deg.) : 128.278, 35.0418
# Source extraction radius (arcsec): 34
#
Best background position estimation:
  RA, Dec (deg.)           : 128.246, 35.0276
  Extraction radius (arcsec) : 61.8675

  X,Y Sky Coord.           : 30398.9, 21701.8
  Extraction radius (X,Y Sky Coord.) : 1237.35
-----
```

In case of multiple-sources from a source list input file the results are included in the input file as extra columns:



Table 5: **Background information. Extra columns to the input file**

Column	Description	Units
BKG_DETX	Bkg Linearised Camera X-Coordinate	0.05 arcsec
BKG_DETY	Bkg Linearised Camera Y-Coordinate	0.05 arcsec
BKG_RA	Bkg Right-ascension	deg
BKG_DEC	Bkg Declination	deg
BKG_IMX	Bkg Image X	pixel
BKG_IMY	Bkg Image Y	pixel
BKG_X	Bkg X	0.05 arcsec
BKG_Y	Bkg Y	0.05 arcsec
BKG_RAD	Bkg extraction region radius	0.05 arcsec

### 3.3 Task requirements

Because this task performs several coordinates conversions by using **esky2det** and **edet2sky**, access to the CCF components relevant to the dates of observation and analysis is required. (follow the links for further information). This is achieved in the usual way by constructing a cif file with cifbuild and pointing to it with the environment variable SAS\_CCF.

## 4 Parameters

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

Parameter	Mand	Type	Default	Constraints
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<b>imageset</b>	yes	string	image	
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Input image FITS file (e.g., P0123456789PNS003IMAGE\_8000.FIT/FTZ).

<b>withsrclist</b>	no	boolean	true	
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Whether to use the source list in the observation.

<b>srclisttab</b>	yes	table		
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Mandatory if **withsrclist** is true. Source list (e.g., P0123456789EPX000OBSMLI0000.FIT/FTZ) in the observation.

<b>withsrcrad</b>	no	boolean	false	
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Extraction region radius for each source (**SRC\_RAD**) from input Source List, instead the tabulated **LOOKUP.FITS** table. This parameter is read if **withsrclist** is true.

<b>withcoords</b>	no	boolean	false	
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Whether to give the coordinates in the command-line arguments. This parameter is read if **withsrclist** is false.



<b>coordtype</b>	yes	string	eqpos	eqpos pos
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The coordinate system for which the source position, specified by the parameter **x** and **y**, is defined. If **coordtype** is set to **eqpos**, then **x**, **y** correspond to RA and DEC respectively in decimal degrees. If **coordtype** = **pos**, then **x**, **y** correspond to POS coordinates. (Note that the POS coordinates are defined relative to a nominal pointing position; this is taken from the global attributes **REFXCRVL** and **REFYCRVL** of the image dataset.)

<b>x</b>	yes	real		
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The X coordinate of the source position.

<b>y</b>	yes	real		
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The Y coordinate of the source position.

<b>r</b>	yes	real		
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Source extraction region radius in arcsec.

## 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.

### **invalidImageType** (*error*)

The DATAMODE keyword is not IMAGING in the image file header.

### **invalidModeType** (*error*)

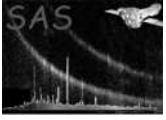
The INSTRUME keyword is not EPN in the image file header.

## 6 Input Files

1. An EPIC-pn image produced by `evselect` or `xmmselect` or the pipeline.
2. A Source list (optional).

## 7 Algorithm

The algorithm search for a background region in the same CCD where the source is located, avoiding the same source column because of the out-of-time events. That circular background always have a radius larger than 3 pixels, otherwise no background is calculated.



## References