

## evlistcomb

April 16, 2023

### Abstract

Merge event lists from all CCD/nodes into a single event file.

## 1 Instruments/Modes

Instrument	Mode
EPIC MOS	IMAGING, TIMING
EPIC PN	IMAGING, TIMING, BURST
RGS	SPECTROSCOPY, HIGH TIME RESOLUTION

## 2 Use

pipeline processing	yes
interactive analysis	yes

## 3 Description

The MOS, PN or RGS chains are applied separately to event lists attached to a single CCD (or CCD/node for MOS). **evlistcomb** builds a global calibrated event list (PPS product) for one EPIC or RGS camera from their outputs. This is done by taking in all input files the extension whose name is specified by the `maintable` parameter (called 'merged extension' in what follows) and merging the columns into a single output extension of the same name. A `CCDNR` column is added to the extension to keep track of all events' origin. Its contents is taken from the `CCDID` keyword (and `QUADRANT` for EPIC PN). For EPIC MOS only (not RGS) the node (`CCDNODE` keyword) is coded into the CCD number by adding 10 if the redundant node is used.

Actually two calibrated event lists are built if all CCDs are not operated in the same mode. The mode is recognized by the `DATAMODE` keyword, which must be one of both values specified in the `xxxdatamodes` parameter. The first `DATAMODE` keyword is associated with the `imagingset`, `xxximgcolnames`) and `xxximgcoltypes` parameters (it need not be IMAGING, for example it is used for RGS SPECTROSCOPY mode). The second keyword in `xxxdatamodes` is associated with the `timingset`, `xxxtimcolnames`) and `xxxtimcoltypes` parameters.

The `xxxdatamodes` parameter is only a way to tell **evlistcomb** the name of the modes. It cannot be



used to select which mode you want in output, and should not be set differently in the various instrument modes.

When used in default mode, **evlistcomb** propagates only that subset of the original columns, specified in the Data Products ICD. The columns are converted into the type of the ICD if need be. This is done by specifying the **instrument** parameter to 'emos', 'epn' or 'rgs'. The task will then use the default list of modes (**xxxdatamodes**), column names (**xxxyyycolnames**) and types (**xxxyyycoltypes**), where **xxx** is the 3 or 4-letter instrument symbol and **yyy** the mode symbol ('img' or 'tim'). The columns appearing in the list but not present in the input files are not created. When transtyping **evlistcomb** checks for overflow and sets to null the data which overflow the output type.

In order to generate an output file with other columns, one needs to specify by hand the **xxxyyycolnames** and **xxxyyycoltypes** parameters for the instrument and mode(s) one is interested in. The correspondance between the column names and types is done simply by order of appearance.

The task also copies over the secondary extensions specified by the **othertables** parameter for all files into extensions with the same name (truncated to 6 characters) followed by nn (the 2-digit CCDNR). This works both for tables and arrays. Except their name, those extensions are copied without change and entirely (data and keywords).

The compatibility of the files is checked through a number of primary keywords, specified by the **primarychecks** parameter. Those keywords must exist in all files. All files in the list which do not share the first file's setting are rejected. All keywords (not only those in **primarychecks**) present in the primary header of any of the input files are propagated to the primary header of the output file, except **FILENAME** which is clearly file-specific. In practice this means a keyword takes the value it has in the last file of the list (of that mode) where it is present. All those (global) keywords are also copied to all output extensions, except those specified in **primaryonly**.

Some keywords in the merged extensions (**extensionchecks** parameter) may also be checked for compatibility between files. Those do not have to exist, but will be propagated if they do. Other keywords (specified by the **mainattributes** parameter) may also be propagated to the merged extensions. Those will take the value they have in the last file of the list where they are present. Yet other keywords in the merged extensions may be maximised (**maxattributes**) or minimised (**minattributes**).  
The four sets of parameters (**extensionchecks**, **mainattributes**, **maxattributes**, **minattributes**) may include column specific keywords as well.

All keywords in the merged extensions are not automatically propagated, as those keywords are usually different for each CCD/node. If CCD-dependent keywords are needed down the line, they must be propagated by means of one of the secondary extensions (**evlistcomb** does not do that automatically).

The standard column specific keywords (**TNULL**, **TUNIT**) are taken from the first valid file where they are set. All subsequent files which have those keywords set to a different value are rejected (files with keywords not set are accepted). To propagate other column specific keywords, they must be specified manually via the **extensionchecks**, **mainattributes**, **maxattributes** and **minattributes** parameters (see above).

It is possible to merge several extensions (**maintable** may be a list). In that case all keyword operations (**extensionchecks**, **mainattributes**, **maxattributes**, **minattributes**) are done on all extensions. It is not possible to specify a specific list of columns for each of the extensions to merge. All columns to be merged (in all extensions) must appear in the **xxxyyycolnames** and **xxxyyycoltypes** parameters (but they don't have to exist).

**evlistcomb** will also accept in input files generated by a previous call to **evlistcomb**. In that case the **CCDNR** column will be propagated as a normal column (but need not be specified in the list of



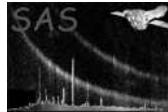
columns to propagate), and all the secondary extensions whose first 6 characters are common with one of **othertables** will be propagated.

In the PPS, **evlistcomb** must be followed by a call to **evselect** which will apply the selection on Good Time intervals and add the **EXPOSURE** keyword. **evlistcomb** can be applied as is to slew data.

## 4 Parameters

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

Parameter	Mand	Type	Default	Constraints
<b>eventsets</b>	yes	dataset list	' '	none
list of input events files				
<b>instrument</b>	yes	string	emos	emos/epn/rgs
select parameter name				
<b>imagingset</b>	no	dataset	'merged.img'	none
name of output event file for IMAGING or SPECTROSCOPY mode				
<b>timingset</b>	no	dataset	'merged.tim'	none
name of output event file for TIMING, BURST or HTR mode				
<b>maintable</b>	no	list of upper-case strings	EVENTS	none
names of tables to be merged				
<b>othertables</b>	no	list of upper-case strings	BADPIX EXPOSURE STDGTI	none
names of secondary tables or arrays to propagate				
<b>primarychecks</b>	no	list of strings	TELESCOP INSTRUME OBS_ID EXP_ID	none
primary attributes to check for compatibility				
<b>primaryonly</b>	no	list of strings	ORIGIN	none
primary attributes which should not be propagated to extensions				
<b>extensionchecks</b>	no	list of strings	TIMESYS MJ-DREF TIMEUNIT TIMEREF TASSIGN DET_SYST TCRPX TCTYP TCRVL TCDLT TCROT TCUNI	none



attributes to check for compatibility of the merged extensions

<b>minattributes</b>	no	list of strings	TSTART TLMIN TD-MIN	none
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attributes to minimise in the merged extensions

<b>maxattributes</b>	no	list of strings	TSTOP TLMAX TD-MAX	none
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attributes to maximise in the merged extensions

<b>mainattributes</b>	no	list of strings		none
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attributes to propagate to the merged extensions

<b>emosdatamodes</b>	no	list of strings	IMAGING TIMING	none
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modes (DATAMODE keyword) to distinguish among input files

<b>emosimgcolnames</b>	no	list of upper-case strings	TIME RAWX RAWY DETX DETY X Y PHA PI FLAG PATTERN OFFSETX OFFSETY	none
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columns to propagate in merged extensions (Imaging mode)

<b>emosimgcoltypes</b>	no	list of strings	double int16 int16 int16 int16 int32 int32 int16 int16 int32 int8 int16 int16 int16	int8/int16/int32/single/double/boolean
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output type of Imaging mode columns

<b>emostimcolnames</b>	no	list of upper-case strings	TIME RAWX PHA PI FLAG PATTERN OFFSETX	none
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columns to propagate in merged extensions (Timing mode)

<b>emostimcoltypes</b>	no	list of strings	double int16 int16 int16 int32 int8 int16	int8/int16/int32/single/double/boolean
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output type of Timing mode columns

<b>epndatamodes</b>	no	list of strings	IMAGING TIMING	none
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modes (DATAMODE keyword) to distinguish among input files

<b>epnimgcolnames</b>	no	list of upper-case strings	TIME RAWX RAWY DETX DETY X Y PHA PI FLAG PATTERN PAT_ID PAT_SEQ OFFSETX	none
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columns to propagate in merged extensions (Imaging mode)

<b>epnimgcoltypes</b>	no	list of strings	double int16 int16 int16 int16 int32 int32 int16 int16 int32 int8 int16 int8 int16	int8/int16/int32/single/double/boolean
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output type of Imaging mode columns

<b>epntimcolnames</b>	no	list of upper-case strings	TIME RAWX PHA PI FLAG PATTERN	none
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columns to propagate in merged extensions (Timing mode)

<b>epntimcoltypes</b>	no	list of strings	double int16 int16 int8/int16/int32/single	double/boolean
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output type of Timing mode columns

<b>rgsdatamodes</b>	no	list of strings	SPECTROSCOPY 'HIGH TIME RESOLUTION'	none
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modes (DATAMODE keyword) to distinguish among input files

<b>rgsimgcolnames</b>	no	list of upper-case strings	TIME CHIPX CHIPY BETA XDSP BETA_CORR XDSP_CORR BETA_CHANNEL XDSP_CHANNEL PHA PI FLAG SHAPE GRADE	none
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columns to propagate in merged extensions (Spectroscopy mode)

<b>rgsimgcoltypes</b>	no	list of strings	double int16 int16 single single single int16 int16 int16 int32 int8 int8	int8/int16/int32/single double/boolean
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output type of Spectroscopy mode columns

<b>rgstimcolnames</b>	no	list of upper-case strings	TIME CHIPX BETA BETA_CORR BETA_CHANNEL PHA PI FLAG	none
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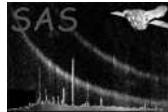
columns to propagate in merged extensions (HTR mode)

<b>rgstimcoltypes</b>	no	list of strings	double int16 single single int16 int16 int16 int32	int8/int16/int32/single double/boolean
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output type of HTR mode columns

## 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.

**main02** (*error*)

no valid input event file

**readColParams05** (*error*)

lists of columns and of types do not have the same length

**getGoodFiles10** (*warning*)

missing, invalid or incompatible input event file. Skip that file  
*corrective action:* check that file

**testColKeywords12** (*warning*)

column units, keywords or null values in input event file not compatible with previous files. Skip that file  
*corrective action:* check that file

**testMode11** (*warning*)

unrecognized data mode. Skip that file  
*corrective action:* check the DATAMODE keyword in that file

**sortFiles13** (*warning*)

not same unit for TSTART and TSTOP. Continue, but do not compute TELAPSE  
*corrective action:* check those keywords

**sortFiles14** (*warning*)

the output event list is empty. Continue anyway  
*corrective action:* check nothing went wrong

**copyData10** (*warning*)

One column does not exist in one of the input files. Continue, set to null in output  
*corrective action:* check input file

**copyData11** (*warning*)

It was asked to change an input boolean or string column to some other type, or some other type into boolean or string. Continue, set to Null in output  
*corrective action:* modify output type for that column

**copyCcdExtension10** (*warning*)

CCD number could not be retrieved from an extension. Continue, do not copy that extension to the output file  
*corrective action:* check keywords in that extension

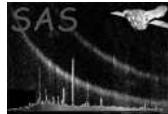
**copyCcdExtension12** (*warning*)

two extensions would have the same name in output file. Continue, keep only the first one  
*corrective action:* check how that conflict could happen

## 6 Input Files

- EPIC MOS event files (from **emenergy**, format described in **emevents**).
- EPIC PN event files (from **epevents**).
- RGS event files (from **rgsevents**).
- Already merged files (from **evlistcomb**).

Uses keywords



1. INSTRUME, DATAMODE (if present) from primary header.
2. TSTART, TSTOP, DATATYPE (if no DATAMODE) from merged extension.
3. INSTRUME, CCDID, CCDNODE (MOS only) from secondary tables.

## 7 Output Files

Imaging (or Spectroscopy) and Timing (or HTR) event files (for PRODUCT: EPIC or RGS event list and **evselect**, [1]) with following items:

- primary header propagated from input files, with additional DATAMODE (if not already present) and keyword.
- merged extension(s) (**maintable** parameter) with columns defined by the **xxxxyycolnames** and **xxxxyycoltypes** parameters (xxx is the instrument symbol and yyy the mode symbol), an additional CCDNR column, some keywords (**extensionchecks**, **mainattributes**, **maxattributes** and **minattributes** parameters), plus the **XMMEA\_nn** keywords identifying the flags and the column-specific keywords. TELAPSE is recomputed if need be.
- secondary extensions (**othertables** parameter) with names truncated to 6 characters and CCDNR added at the end of the name.

## 8 Algorithm

```
subroutine evlistcomb

Read the file names of event files (input and output)
Read all parameters.

Open files
Sort them according to DATAMODE

Loop over input event files
  Open merged extension
  Get keyword values
  Read selected columns
  Write them to output file and add CCDNR (= nn)
  Copy secondary extensions, adding CCDNR to their name.
end loop

close files

end subroutine evlistcomb
```

## 9 Comments

None.



## 10 Future developments

Could allow merging files irrespective of their mode.

## References

- [1] SSC. XMM Survey Science Centre to Science Operations ICD for SSC Products. Technical Report XMM-SOC-ICD-0006-SSC Issue 2.1, SSC, Mar 2000.