epspatialcti

January 27, 2025

Abstract

Corrects an EPIC-pn event file for spatially and epoch dependent CTI effects

1 Instruments/Modes

Instrument	Mode
EPIC PN	IMAGING

2 Use

pipeline processing	no
interactive analysis	yes

3 Description

Corrects an EPIC-pn event list for spatial variations in the charge-transfer-inefficiency (CTI). This task should be run on the event file produced after all of the other CTI and gain corrections have been applied.

Measurements of the spectra of bright extended sources have shown that there is a pixel-to-pixel variation in the energy scale which is mainly caused by CTI changes due to partial trap saturation [2]. These can be represented, and corrected for, by a spatial CTI correction.

The task implements two methods for spatial CTI corrections: the original method as described in details in [1] and available via setting task parameter `SD20method=N` and the method in [3], described in details in [2] and activated with SD20method=Y.

The spatial CTI correction in the original method is derived from ground-based tests with a number of laboratory X-ray lines, while the SD20 method is based on actual XMM-Newton observations using the fluorescent copper line Cu Kα at 8 keV (`element=CU`) and the manganese line Mn Kα at 6 keV (`element=MN`) from the internal iron-55 calibration source, available in *CalClosed* observations.

Due to the scarcity of *CalClosed* observations in Extended Full Frame (eFF) mode, it is not possible to derive a correction with `element=MN` for this mode. The results from copper indicate that the spatial

offsets in FF and eFF are rather different and it is not advisable to use the FF-derived MN correction for eFF mode.

To avoid the corrections being applied twice, a keyword *SPATCTIC* is set in the header of the EVENTS extension when the task terminates successfully.

4 Parameters

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

Parameter	Mand	Type	Default	Constraints
table	yes	dataset		events.ds

The event table to be corrected.

outset	yes	dataset		none

The output event table

SD20mode	no	boolean		true

Whether to use the Sanders et al. (2020) method

element	no	string		CU

Use the Cu Kα (CU) or Mn Kα (MN) derived spatial offsets

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.

AlreadyCorrected *(error)*
The header keyword SPATCTIC indicates that the events in this file have already had the spatial correction applied. No further correction will be made.

label *(warning)*
explanantion
corrective action: this is the corrective action

IncompatibleElementMode *(error)*
Wnen trying to apply spatial offsets with `element=MN` on event list from an observation in Extended Full Frame mode.

6 Input Files

1. An EPIC-pn events file with a PI column.

7 Output Files

1. The input EPIC-pn event file with modified PI column values.

8 Algorithm

```
Open the input event file
Read the observing mode from the input event file

if SD20mode is False

  Read from the EPN_CTI CCF coefficients and template values

  Loop over each event

    set coefficients(a,b,c) from the event CCD, RAWX, RAWY values
    set template value from the event CCD, RAWX, RAWY values

    h = log10(event_pi) - 3.0;
    f = a + (b + c * h) * h;

    event_pi = event_pi - template_value * f

  end of loop

else

  Read from the EPN_SPATIALCTI CCF offsets to apply to PI values

  Loop over each event

    set offset from the event epoch, CCD, RAWX, RAWY values

    event_pi = event_pi - offset

  end of loop

Add the keyword SPATCTIC = 'yes' into the EVENTS header
```

9 Comments

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10 developernotes

10.1 Future developments

10.2 CAL usage

- CAL_spatialCtiCorrect

11 References

1

Sanders, J. S., Dennerl, K., Russell, H. R., et al. 2020, A&A, 633, A42

2

Dennerl, K. and Saxton, R. 2012, CAL-SRN-0283-1-0.pdf, XMM SOC

3

Valtchanov I., 2022, CAL-SRN-0391-1-3.pdf, XMM SOC

References