MIT Kavli Institute   # Chandra X-Ray Center
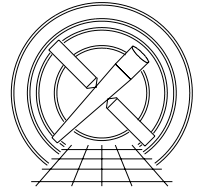
MEMORANDUM
February 2, 2017

To: Jonathan McDowell, SDS Group Leader

From: Glenn E. Allen, SDS

Subject: Temperature-dependent RMF spec

Revision: 1.00

URL: http://space.mit.edu/CXC/docs/docs.html#trmf

File: /nfs/inconceivable/d0/sds/specs/mkacisrmf/trmf_spec_1.00.tex

1 Description

This spec is a high-level description of how a script could be used to create a temperature-dependent RMF.

2 Parameters

The parameters for the script are identical to the parameters for the tool `mkacisrmf`, except the script includes the two additional parameters:

1. `gtifile`,f,a,“ ”,,,“Input GTI file (e.g. the evt2 file)”

2. `mtlfile`,f,a,“ ”,,,“Input mission timeline file”

3 Processing

1. The start and stop times for each one of the N_{gti} good-time intervals for the CCD_ID of interest are read from the appropriate GTI HDU of the `gtifile`. Hereafter these times for the ith interval are referred to as $\mathtt{START}[i]$ and $\mathtt{STOP}[i]$, respectively.

2. The N_{mtl} sets of values for the time and focal-plane temperature are read from the `mtlfile`. Hereafter, the jth time and temperature are referred to as $\mathtt{TIME}_{\mathrm{mtl}}[j]$ and $\mathtt{FP\_TEMP}_{\mathrm{mtl}}[j]$, respectively. The header of the `mtlfile` is read to obtain the values of the keywords TIMEDEL and TIMEPIXR, which are hereafter referred to as $\mathtt{TIMEDEL}_{\mathrm{mtl}}$ and $\mathtt{TIMEPIXR}_{\mathrm{mtl}}$, respectively.

3. The CALDB is queried to obtain the N_{resp} response files associated with the time of the observation. There is one file for each temperature range calibrated. Hereafter, the kth response file is referred to as $\mathtt{respfile}[k]$.

4. The minimum and maximum focal-plane temperatures for each `respfile` are obtained from header keywords in the file. Hereafter these temperatures for the kth file are referred to as, $\texttt{FP\_TEMP}_{\text{min}}[k]$ and $\texttt{FP\_TEMP}_{\text{max}}[k]$, respectively.

5. For each good-time interval $i = 0, 1, \ldots, N_{\text{gti}} - 1$:

    (a) For each focal-plane temperature $j = 0, 1, \ldots, N_{\text{mtl}} - 1$:

        i.

    $$t_0 \;=\; \texttt{TIME}_{\text{mtl}}[j] - \texttt{TIMEPIXR}_{\text{mtl}} \times \texttt{TIMEDEL}_{\text{mtl}}. \tag{1}$$

        ii. If

    $$t_0 \;<\; \texttt{START}[i], \tag{2}$$

        then

    $$t_0 \;=\; \texttt{START}[i]. \tag{3}$$

        iii. If

    $$t_0 \;\geq\; \texttt{STOP}[i], \tag{4}$$

        then

    $$t_0 \;=\; \texttt{STOP}[i]. \tag{5}$$

        iv. If

    $$j \;=\; 0, \tag{6}$$

        then

    $$t_0 \;=\; \texttt{START}[i]. \tag{7}$$

        v.

    $$t_1 \;=\; \texttt{TIME}_{\text{mtl}}[j] + (1 - \texttt{TIMEPIXR}_{\text{mtl}}) \times \texttt{TIMEDEL}_{\text{mtl}}. \tag{8}$$

        vi. If

    $$t_1 \;<\; \texttt{START}[i], \tag{9}$$

        then

    $$t_1 \;=\; \texttt{START}[i]. \tag{10}$$

        vii. If

    $$t_1 \;\geq\; \texttt{STOP}[i], \tag{11}$$

        then

    $$t_1 \;=\; \texttt{STOP}[i]. \tag{12}$$

viii. If

$$j = N_{\mathrm{mtl}} - 1, \tag{13}$$

then

$$t_1 = \mathtt{STOP}[i]. \tag{14}$$

ix.

$$\Delta t = t_1 - t_0. \tag{15}$$

x. For each temperature interval $k = 0, 1, \ldots, N_{\mathrm{resp}} - 1$:

A. If

$$\mathtt{FP\_TEMP}_{\mathrm{mtl}}[j] \geq \mathtt{FP\_TEMP}_{\mathrm{min}}[k] \text{ and} \tag{16}$$

$$\mathtt{FP\_TEMP}_{\mathrm{mtl}}[j] < \mathtt{FP\_TEMP}_{\mathrm{max}}[k], \tag{17}$$

then

$$\tau[k] = \tau[k] + \Delta t, \tag{18}$$

where $\tau[k]$ is the exposure time associated with temperature interval k.

6. The ARF A is computed using the entire set of good-time intervals.

7. The good-time intervals $\mathrm{GTI}[k]$ are obtained for each temperature interval k.

8. A WMAP is obtained for each temperature interval k.

9. The RMF R_k is obtained for each temperature interval k using $\mathtt{respfile}[k]$ and the appropriate WMAP.

10. The ARF A_k is obtained for each temperature interval k using the appropriate WMAP.

11. The temperature-weighted RMF is given by[1]

$$R = \frac{\sum_{k=0}^{N_{\mathrm{resp}}-1} \tau[k] A_k R_k}{A \sum_{k=0}^{N_{\mathrm{resp}}-1} \tau[k]}. \tag{19}$$

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[1]The source spectrum is assumed to be the same for each temperature interval.