OGIP Memo OGIP/96-001

The Format for WMAPs in Spectral Files

Keith A Arnaud

Code 662,
NASA/GSFC,
Greenbelt, MD20771

Version: 1998 Dec 4

SUMMARY

The format for a WMAP in a spectral file is described. This format provides a way of encoding information about the spatial distribution of X-rays accumulated in the spectrum and can be used by response matrix generation software.

Intended audience: Writers of software to create spectral files from imaging detectors.

1 INTRODUCTION

A spectral file can be created by accumulating all X-rays detected within some region on an imaging detector. This spectral file then retains no information about the distribution of the X-rays accumulated or of the size and shape of the region used. However, the instrumental response may depend on this information. For instance, the vignetting correction might vary across the region selected so that a proper calculation of the effective area requires a knowledge of the spatial distribution of the selected events. Another example is where the region used does not collect all the events from a point source. In this case a calculation of the effective area requires knowledge of the shape of the region used and the position of the point source.

One way of encoding the required information is to place an image of the selected region as the primary image in the spectral file. We refer to this as the WMAP and describe the required keywords below. To minimize the file size the image should be of the rectangle which bounds the selected region.

2 The WMAP format

The WMAP is the primary image and requires the following keywords in the primary header.

- OPTIC1 - the X-coordinate position of the optical axis in detector coordinates.
- OPTIC2 - the Y-coordinate position of the optical axis in detector coordinates.
- WMREBIN - the rebinning factor from detector pixels to WMAP bins (this should be the single axis binning factor eg a binning factor of 4 puts 16 detector pixels into each WMAP bin).
- CDELT1 - the X-axis increment for each WMAP bin in detector units.
- CDELT2 - the Y-axis increment for each WMAP bin in detector units.
- CRVAL1 - the X-coordinate position in WMREBIN detector pixels of the WMAP reference bin.
- CRVAL2 - the Y-coordinate position in WMREBIN detector pixels of the WMAP reference bin.
- CRPIX1 - the X-coordinate of the WMAP reference bin.
- CRPIX2 - the Y-coordinate of the WMAP reference bin.
- CTYPE1 - the name of the X-axis in the WMAP.
- CTYPE2 - the name of the Y-axis in the WMAP.

- CUNIT1 - the unit for the X-axis in the WMAP.
- CUNIT2 - the unit for the Y-axis in the WMAP.
- BLANK - the null value used in the WMAP to indicate a bin outside the selected region (usually -1).

It should also include the standard OGIP keywords :

```
HDUCLASS= 'OGIP    '           / Format conforms to OGIP/GSFC conventions
HDUCLAS1= 'IMAGE   '           / Extension contains an image
HDUCLAS2= 'WMAP    '           / Extension contains a weighted map
HDUVERS = '1.1.0   '           / Header version
HDUDOC  = 'OGIP/96-001'        / OGIP memo describing format
```

Note that the original version of this format had HDUVERS1 and HDUVERS2 keywords (both set to 1.0.0).

3 Example

Consider the example of an ASCA SIS spectrum extracted from a circular region of radius 80 detector pixels centered on the detector coordinate position (430.32,410.60). The rebinning factor used to make the WMAP is 8 (ie WMREBIN is set to 8). The event file specifies the ASCA SIS detector pixel has a size of 0.027 mm so the CDELT1 and CDELT2 are set to $0.027 * 8 = 0.216$. In terms of WMAP bins the selected region has a radius of 10 centered on (53.79,51.325). This makes the (1,1) bin in the stored WMAP correspond to (44,42), which defines CRVAL1 and CRVAL2. The event file specifies the optical axis lies at (662.72,559.02) in detector coordinates so these values are used for OPTIC1 and OPTIC2. The CTYPE# and CUNIT# keywords are set to be the values given in the TTYPE# and TUNIT# event file keywords for the detector coordinate columns (8 and 9 in this particular case). To summarize : this example requires the keywords :

```
WMREBIN =                            8 / Weighted Map rebinning
CRPIX1  =   1.00000000000000000000E+00 / X axis reference pixel
CRPIX2  =   1.00000000000000000000E+00 / Y axis reference pixel
CRVAL1  =   4.40000000000000000000E+01 / coord of X ref pixel
CRVAL2  =   4.20000000000000000000E+01 / coord of Y ref pixel
OPTIC1  =   6.62720000000000000000E+02 / X Optical axis
OPTIC2  =   5.59020000000000000000E+02 / Y Optical axis
CDELT1  =   2.16000000000000000000E-01 / X axis increment
CDELT2  =   2.16000000000000000000E-01 / Y axis increment
```

```
CTYPE1  =  'DETX    '                / X axis name
CTYPE2  =  'DETY    '                / Y axis name
CUNIT1  =  'pixel   '                / X axis unit
CUNIT2  =  'pixel   '                / Y axis unit
BLANK   =                         -1 / Null value
```