

OGIP Memo OGIP/96-001

The Format for WMAPs in Spectral Files

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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.

LOG OF SIGNIFICANT CHANGES

Release Date	Sections Changed	Brief Notes
1998 Dec 4 2002 Jan 14 with CIAO. (HDUVERS=2.0.0)	All	Original version. (HDUVERS=1.1.0) Correct use of WCS keywords. Now compatible

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 standard image keywords. Downstream software will likely require both the primary and the secondary (WCSTY#P='PHYSICAL') WCS keywords.

- 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).
- CDELTA1 - the X-axis increment for each WMAP bin in detector units.
- DDELTA1 - the original X-axis increment
- CDELTA2 - the Y-axis increment for each WMAP bin in detector units.
- DDELTA2 - the original Y-axis increment
- CRVAL1 - the coordinate position of the X-axis reference pixel.
- CRVAL2 - the coordinate position of the Y-axis reference pixel.
- CRPIX1 - the X-axis reference pixel.
- DRPIX1 - the original X-axis reference pixel

- CRPIX2 - the Y-axis reference pixel.
- DRPIX2 - the original Y-axis reference pixel
- 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.
- WCSTY1P- PHYSICAL
- WCSTY2P- PHYSICAL
- CTYE1P - Source of X-axis.
- CTYE2P - Source of Y-axis.
- CRPIX1P- X-axis reference pixel.
- CRPIX2P- Y-axis reference pixel.
- CRVAL1P- Coordinate of X-axis reference pixel in original image.
- CRVAL2P- Coordinate of Y-axis reference pixel in original image.
- CDELTA1P- X-axis increment
- CDELTA2P- Y-axis increment
- 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 :

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HDUCLASS= 'OGIP      '           / Format conforms to OGIP/GSFC conventions
HDUCLAS1= 'IMAGE     '           / Extension contains an image
HDUCLAS2= 'WMAP      '           / Extension contains a weighted map
HDUVERS  = '2.0.0    '           / Header version
HDUDOC   = 'OGIP/96-001'         / OGIP memo describing format

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3 Upgrading software from HDUVERS=1 to HDUVERS=2

Software originally designed to read HDUVERS=1 WMAP files requires minor changes to support HDUVERS=2. Any use of the values of the keywords CRVAL1 and CRVAL2 should be replaced by using the values of CRVAL1P and CRVAL2P.

4 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 CDELTA1 and CDELTA2 are set to $0.027 * 8 = 0.216$. The original detector coordinates have a reference pixel of the center of the array (640.5, 640.5) and assign this a physical position of (0mm, 0mm). The CRPIX1/2 keywords give the WMAP pixel positions of the physical position (0mm, 0mm).

The keywords ending in P document the relation between the original detector pixels and the WMAP pixels. Thus CDELTA1/2P is 8 for the rebinning factor while CRVAL1/2P give the original detector coordinate position of the WMAP pixel (1,1) (as specified by CRPIX1/2P).

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WMREBIN =                8 / Weighted Map rebinning
CRPIX1  = 3.687500000000000E+01 / X axis reference pixel
DRPIX1  = 6.405000000000000E+02 / original X axis reference pixel
CRVAL1  = 0.000000000000000E+00 / coord of X ref pixel
CDELTA1 = 2.160000000000000E-01 / X axis increment
DDELTA1 = 2.700000000000000E-02 / original X axis increment
CRPIX2  = 3.937500000000000E+01 / Y axis reference pixel
DRPIX2  = 6.405000000000000E+02 / original Y axis reference pixel
CRVAL2  = 0.000000000000000E+00 / coord of Y ref pixel
CDELTA2 = 2.160000000000000E-01 / Y axis increment
DDELTA2 = 2.700000000000000E-02 / original Y axis increment
WCSTY1P = 'PHYSICAL'
CTYPE1P = 'DETX      ' / Source of X-axis
CRPIX1P = 1.000000000000000E+00 / X axis reference pixel
CRVAL1P = 3.535000000000000E+02 / coord of X ref pixel in original image
CDELTA1P = 8.000000000000000E+00 / X axis increment
WCSTY2P = 'PHYSICAL'
CTYPE2P = 'DETY      ' / Source of Y-axis
CRPIX2P = 1.000000000000000E+00 / Y axis reference pixel
CRVAL2P = 3.335000000000000E+02 / coord of Y ref pixel in original image
CDELTA2P = 8.000000000000000E+00 / Y axis increment
OPTIC1  = 6.627222290000000E+02 / X Optical axis in detector pixels
OPTIC2  = 5.590184936500000E+02 / Y Optical axis in detector pixels
HDUVERS = '2.0.0      ' / Version of format (OGIP memo OGIP-96-001)
HDUCLASS= 'ogip      ' / Format conforms to OGIP/GSFC conventions
HDUCLAS1= 'IMAGE     ' / Extension contains an image
HDUNAME  = 'WMAP      '
HDUCLAS2= 'WMAP      ' / Extension contains a weighted map
HDUDOC  = 'OGIP/96-001' / OGIP memo describing format
BLANK   =                -1 / Null value

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