OGIP Memo OGIP/93-013

Standard Strings for Mission, Instrument, Filter, Detector & Grating Names for OGIP FITS files

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Version: 2012 Oct 10

SUMMARY

We give a list of standard character strings used within the OGIP for the specification of the Mission, Instrument, Filter, Detector & Grating in use.

LOG OF SIGNIFICANT CHANGES

Release Date	**Sections Changed**	**Brief Notes**
1993 Jan 13		First (internal) Draft
1994 Oct 14	All	Major revision to all strings
1994 Nov 19	All	Made compatible with `LaTeX2HTML` software
1995 Jan 17	HEAO-1/A-4	Added instrument sub-strings for HEAO-1/A-4
1995 Jan 26	OSO-8	Added instrument sub-strings for OSO-8/GCXSE
1995 Feb 17	SAC-B	Added mission/instrument names
1995 Feb 27	Ariel-V	Added acronyms for Expts A & F
1995 Mar 03	1.5, *Einstein* & EXOSAT	Added Grating Definitions
1995 Mar 06	SAS-2	Revised instrument names
2006 Feb 17 (MFC)		Added Chandra, XMM-Newton, Swift, Suzaku, GLAST, HETE-2; merged Table 1 (instrument name) & Table 2 (detector name); removed SAC-B; added html links to mission web pages; convert `tables` to `longtables`
2011 Mar 30 (MFC)	Table 2	include Fermi as an alias for GLAST
2012 Oct 10 (MFC)	Table 2	include NuSTAR

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1 INTRODUCTION

In order to facilitate interpretation of archived FITS datasets by software and users, the Office of Guest Investigator Programs (OGIP) at NASA/GSFC and the High Energy Astrophysics Science Archive Research Center (HEASARC) FITS Working Group (OFWG) have adopted a standard set of FITS header keywords and keyword values to be used to uniquely specify the Mission, Instrument and Detector to which the dataset refers, and to specify any Filter and/or Grating in use. This memo lists those currently in use.

1.1 FITS Keywords

The following FITS keywords are used to provide information regarding the provenance of the dataset:

Table 1: FITS Identification Keywords

FITS Keyword	Meaning	Reference
`TELESCOP`	observatory or mission; for space science, usually refers to the spacecraft on which various instruments are mounted	NOST Standard
`INSTRUME`	refers to a particular instrument system contained on `TELESCOP`	NOST Standard
`DETNAM`	identifies the detector subsystem (for example, the CCD chip in an array)	this document
`FILTER`	identifies the filter in front of the particular instrument or detector	this document
`GRATING`	identifies the particular grating which may be interposed in the optical path	this document

In the table above, the NASA Office of Science and Technology (NOST) Standard is the "Definition of the Flexible Image Transport System (FITS)", March 29, 1999 (NOST 100-2.0).

1.2 Design Criteria

During the development of these standard strings we decided **against** deriving a standard-recipe (set of rules) for specifying all the necessary information for all missions, instruments *etc.* This decision was primarily based on the great variety of instrumentation handled by the OGIP. Instead we considered it preferable to define the **minimum** number of unique strings which served the purpose of identificaton, and wherever possible adopting the strings in common use by instrument teams & scientists.

Values already in widespread use for the mandatory FITS keywords `TELESCOP` and `INSTRUME` also influenced our decision in some cases.

In almost all cases, the Mission and Filter strings are fairly obvious (& uncontroversial), thus are straightforward to define. It is likely that these strings will most often be used as the values of the `TELESCOP` & `FILTER` keywords in FITS files.

The character strings adopted for the specification of the instrument/detector/grating (and, where necessary, sub-detector) are naturally highly instrument-specific. These strings will most often be used as the values of the `INSTRUME` & `DETNAM` or `INSTRUME` & `GRATING` keywords in FITS files.

It should be noted that many of the strings specified in the following sections are provided solely to enable calibration datasets to be fully specified.

1.3 Case-Sensitivity

All the strings listed in the following sections should be considered **case-sensitive**. However, reliance on case to distinguish different values of `TELESCOP`, `INSTRUME`, `DETNAM`, `FILTER` or `GRATING` is deprecated.

1.4 Specification of multiple instruments & detectors

Under certain circumstances it may be desirable to combine data from different instruments and/or different parts (sub-detectors) of a given instrument together in a single FITS dataset (eg. combining *ASCA* GIS2 and GIS3 datasets, combining the Argon layers of detector modules DET-A and DET-B for the *EXOSAT* ME). It is crucial that the `INSTRUME` and/or `DETNAM` keywords reflect such combinations, to inform the user and reduction or analysis software.

There are two ways in which such combinations are specified via the `INSTRUME` and/or`DETNAM` keywords:

1. Certain common combinations are given their own unique values
   For example:
   - For the *EXOSAT* ME
     `INSTRUME= 'ME       '`
     `DETNAM  = 'QUAD`j XX`'`
     is used to denote that quadrant j of the 8 ME modules have been combined (with j=1 representing `DET-A` + `DET-B`, j=2 representing `DET-C` + `DET-D` *etc*).
2. The `INSTRUME` and/or `DETNAM` keyword strings for less common combinations are constructed using the standard strings listed in this document separated by a comma (`,`).
   For example:

- For a combination of the two *ASCA* GIS experiments
  `INSTRUME= 'GIS2,GIS3'`

1.5 Filters/Gratings in the Optical Path

Some instrument/detector combinations can operate in conjunction with a filter or grating inserted into the optical path. Often the usage of such a grating is optional, and observations can also be carried out using the detector without the grating in place. In the past, the instrument/grating combination has often been referred to as a 'separate' instrument. For example, data taken when the moveable transmission grating was in the optical path of one of the two low energy telescopes on EXOSAT was commonly referred to as being obtained from the `'EXOSAT TGS1'` or `'EXOSAT TGS2'` instrument. However, this procedure is strongly discouraged since if different gratings could be associated with the same or different focal plane instruments, different acronyms would need to be defined for each instrument/grating combination.

Instead, the OGIP recommends that the focal plane instrument be specified by the `INSTRUME` keyword, and that the filter or grating be specified by the the `FILTER` or `GRATING` keywords, respectively.

For example:

```
TELESCOP= 'EXOSAT    '
INSTRUME= 'CMA1      '
GRATING = 'TGS1      '
```

or

```
TELESCOP= 'CHANDRA '           / Telescope
INSTRUME= 'ACIS    '           / Instrument
GRATING = 'HETG    '           / Grating
```

1.6 Contacts

Please send any comments or suggestions to the General HEASARC Feedback mailing list from the HEASARC Feedback page, `http://heasarc.gsfc.nasa.gov/cgi-bin/Feedback`

2 REFERENCE TABLES

2.1 Standard Values for Satellite Missions & Instruments

Table 2: Standard Strings for TELESCOP, INSTRUME & DETNAM

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
Ariel-V	ARIEL-V	SSI	DETiXX	SSI= Sky Survey Instrument; i=number of detector module; XX either AA or XE for Argon or Xenon layer respectively; if XX not given then both layers
		ASM		ASM = All Sky Monitor (Expt G)
		RMC		Rotation Modulation Collimator (Expt A)
		ST		Scintillation Telescope (Expt F)

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
Advanced Satellite for Cosmology and Astrophysics (Formerly ASTRO-D)	ASCA	XRT-i	Qj	X-ray Telescope module (i =1,2,3,4); Qj refers to the jth quadrant ($j = 0, 1, 2, 3$) of XRT-i
		GISi		Gas Imaging Spectrometer (i =2,3)
		SISi	CCDj	Solid State Imaging Spectrometer (i =0,1); CCDj refers to the CCD chip number ($j = 0, 1, 2, 3$)
Broad-Band X-ray Telescope	BBXRT	XRT-a		X-ray Telescope module (a =A,B)
		Ai[a]		Detector-A pixel (i =0,1,..5)
		Bi[a]		Detector-B pixel (i =0,1,..5)

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
Chandra X-ray Observatory	CHANDRA, AXAF	ACIS[a]	ACIS-*a*	Advanced CCD Imaging Spectrometer; *a* is a string giving the array of CCD chips that are turned on (for example; ACIS-1; ACIS -01236; etc.; or *a*=I or S for the imaging or spectroscopic array
		HRC[a]	HRC-*b*	High Resolution Camera; *b* is either "I" (for the imaging array), "S", for the spectroscopic array, or "S-*i*" (where *i* is either 1,2,3)
		EPHIN	NONE	Electron Proton Helium Instrument
		PCAD	ACA-P	Pointing Control and Aspect Determination System; Aspect Camera Assembly
			RWA	Reaction Wheel Assembly (?)
			GYRO	
			IRU	Inertial Reference Unit
		SIM		
		TEL	HRMA	Telescope; High Resolution Mirror Assembly
			GRATING	

See the ASC FITS File Designer's Guide by MacDowell & Rots for additional information

[a]Focal plane Instrument

[b]Optical path might include a grating; see Table 2.3

[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
Compton Gamma-Ray Observatory	CGRO, GRO, COMPTON	BATSE	LAD-i	Burst and Transient Source Experiment; Large Area Detector; $i = 0, 1, 2, \ldots 7$
			LADB	Burst-selected LAD detectors
			SD-i	Spectroscopy Detector; $i = 0, 1, 2, \ldots 7$
			SDB	Burst-selected SDs
		COMPTEL	D1 -i	Imaging Compton Telescope; Liquid scintillator Detector; $i = 1, 2, \ldots 7$
			D2 -j	Imaging Compton Telescope; NaI Detector; $j = 1, 2, \ldots 14$
		EGRET		Energetic Gamma-ray Experiment Telescope
		OSSE	OSSE-i	Oriented Scintillation Spectrometer Experiment; independently-pointable scintillator i, $i = 1, 2, 3, 4$

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
COS-B	COS-B	COS-B	COS-B	COS-B spark chamber
Extreme Ultraviolet Explorer	EUVE	DSS[c]		Deep Survey/Spectrometer
		MWS[c]		
		LWS[c]		
		SCANNER-A[c]		
		SCANNER-B[c]		
		SCANNER-C[c]		

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
European X-ray Observatory Satellite	EXOSAT	LEIT-i[b]		Low-Energy Imaging Telescope (i =1,2)
		CMA-i[a]		Channel Multiplier Array (i =1,2)
		PSD-i[a]		Position Sensitive Detector (i =1,2)
		GSPC		Gas-Scintillation Proportional Counter
		ME	DET-x XX	Medium Energy Proportional Counter array; x =A,B,C,....H; XX = AR or XE for Argon or Xenon layer respectively; XX not present: both layers)
			QUADi XX	ME quadrant; i = 1, DET-A + DET-B *etc*; rules for XX as above)
			HALFi XX	ME half; i = 1, QUAD1 + QUAD2 *etc*; rules for XX as above
			CORN XX	ME corner detectors *ie* DET-A, DET-D, DET-E & DET-G); (rules for XX as above)
			ALL XX	All eight ME detectors (DET-A + DET-B ... DET-G); (rules for XX as above)

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
Fermi Gamma-Ray Space Telescope	GLAST, FERMI	GBM	NAI_YY	Gamma-Ray Burst Monitor; NAI= sodium iodide detector; YY=00 to 11
			BGO_ZZ	BGO= Bismuth Germanate; ZZ=00 to 01
			ALL	
		LAT		Large Area Telescope
		ACD		Anti-coincidence detector
GINGA (Japanese for "Galaxy"; formerly ASTRO-C)	GINGA	LAC	*XX*	Large Area proportional counter; *XX* = TOP or MID for Argon or Xenon layer respectively; *XX* not present: both layers
		ASM		All-Sky Monitor
		GBD		Gamma-ray Burst Detector

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
High Energy Astrophysical Observatory #1	HEAO-1 HEAO-A	A-1		Large Area Sky Survey Expt
		A-2	LED-i x	Cosmic X-ray Expt; Low Energy Detector; $i = 1, 2 x = s, l$
			MED x	Medium Energy Detector; $x = s, l$
			HED-i x	High Energy Detector; $i = 1, 2, 3 x = s, l$
		A-3		Scanning Modulation Collimator
		A-4	LED-i	The A-4 High Energy Experiment; Low Energy Detector;$i = 3, 6$
			MED-i	Medium Energy Detector; $i = 1, 2, 4, 5$
			HED-7	High Energy Detector

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
High Energy Astrophysical Observatory-2	EINSTEIN, HEAO-2, HEAO-B	HRMA[b]		High Resolution Mirror Assembly
		FPCS[a]	PET	Focal Plane Crystal Spectrometer; PET for pentaerythritol diffractor
			ADP	ammonium dihydrogen phosphate diffractor
			TAP	thalium acid phthalate diffractor
			RAP	rubidium acid phthalate diffractor
			PbL	lead laurate diffractor PbSt for lead sterate diffractor
		HRI-i[a]		High Resolution Imager (i =1,2,3)
		IPC-i[a]		Imaging Proportional Counter (i =1,2)
		SSS-i[a]		Solid-State Spectrometer (i =1,2)
		MPC		Monitor Proportional Counter
High Energy Transient Experiment #2	HETE-2, HETE	SXC		Soft X-ray Camera
		WXM		Wide-Field X-ray Monitor
		FREGATE		French Gamma Telescope

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
International Gamma-Ray Astrophysics Laboratory	INTEGRAL	SPI		Spectrometer on INTEGRAL
		IBIS	ISGRI	Imager on Board the Integral Satellite; ISGRI is a CdTe array
			PICSIT	PICSIT is a CsI array
		JMXN		Joint European X-Ray Monitor; $N = 1, 2$
		OMC		Optical Monitoring Camera
International Ultraviolet Explorer	IUE	FES-i[a]		(Optical) Fine Error Sensor ($i = 1, 2$)
		LWP[a]		Long Wavelength Prime Camera
		LWR[a]		Long Wavelength Redundant Camera
		SWP[a]		Short Wavelength Prime Camera
		SWR[a]		Short Wavelength Redundant Camera
Nuclear Spectroscopic Telescope Array	NUSTAR	FPM		Focal Plane Monitor
		FPMx,x=A,B		
			DETi	

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
Orbiting Solar Observatory #8	OSO-8, OSO-I	UVS		High-resolution UV spectromter
		MUVS		Multichannel UV & visible spectrometer
		CGCS		Columbia Grating Crystal spectrometer
		CXP-*i*		Columbia X-ray Polarimeter (*i*=1,2)
		XHE		X-ray Heliometer
		WSXE		Wisconsin Soft X-ray Experiment
		GCXSE	DET-*X*	Goddard Cosmic X-ray Spectrometer Experiment; Detector module (*X*=A, B or C)
		HECXE		High-energy celestial X-ray Experiment
		EUV		Extreme UV experiment
Röntgen Satellite	ROSAT	XRT		X-ray Telescope
		HRI[a]		High Resolution Imager
		PSPC*x*[a]		Position Sensitive Proportional Counter (*x*=B,C flown)
		WFC[c]		Wide Field Camera

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
Rossi X-ray Timing Explorer	XTE, RXTE	ASM		All-sky monitor
		HEXTE	PWai	The High Energy X-ray Timing Experiment; Phoswich Detector Identifier (a =A,B; i =0,1,2,3)
		PCA	PCUi	Proportional Counter Array; Proportional Counter Unit ($i = 0, 1, 2, 3, 4$)
Small Astronomy Satellite #2	SAS-2, SAS-B	SC		Spark Chamber
		PC		Proportional Counter
Small Astronomy Satellite #3	SAS-3, SAS-C	XRT-i		X-ray Telescope i of LED experiment ($i = 1, 2$)
		LED-i[a]		Low Energy Detector i ($i = 1, 2$)
		RMC		Rotating Modulation Collimator experiment
		SCD-i XX		Slat Collimator Detector i, layer XX,($i = 1, 2$, XX =`AR`,`XE`)

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
Suzaku	SUZAKU, Astro-E2	HXD	WELL-GSO	Hard X-ray Detector
			WELL-PIN	
			WAM-ANTI	
		XISN		X-ray Imaging Spectrometer; N=0,1,2, or 3
		XRS[c]	PIXNN	X-ray Spectrometer; NN=00,01,02,...31
		XRT, XRT-a		X-ray Telescope; a is either "I" or "S" for imaging or spectroscopy detectors, respectively.
Swift	SWIFT	BAT		Burst Alert Telescope
		UVOTA[b,c]		Ultraviolet & Optical Telescope
		SC		General Spacecraft information
		XRT		X-ray Telescope
Vela 5B	VELA 5B	XC		Vela=watchman in Spanish; All-sky monitor

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

Table 2: (continued)

Observatory Name	TELESCOP	INSTRUME	DETNAM	Comments
XMM-Newton	XMM	EMOS$n^{a,b,c}$		European Photon Imaging Camera (EPIC): Metal-Oxide-Silicon CCD; $n = 1, 2$
		EPN^{a,b,c}		EPIC: PN
		OM^{a,b,c}		Optical Monitor
		RGS^{c}	RGA	Reflection Grating Spectrometer; Reflection Grating Assembly
			RFC^{b}	RGS Focal Camera

[a]Focal plane Instrument
[b]Optical path might include a grating; see Table 2.3
[c]Optical path might include a filter; see Table 3

2.2 Standard Values for Instrument Filters

Table 3: OGIP Standard Strings for Instrument Filters

TELESCOP	INSTRUME	DETNAM	**Filter**	**Comments**
Any	Any	Any	(blank)	No filter in use; similar if `FILTER` keyword missing from file
Any	Any	NONE, OPEN		Filter in open position
Chandra	ACIS	ACIS-n	UVIS_ACISI UVIS_ACISS	n=0,1,2...9
		HRC-I	UVIS_HRCI	
EINSTEIN	*(f.plane inst)*		AL	(BBFS) Aluminium
			BE	(BBFS) Beryllium
EXOSAT	LEIT		CLOSED	Totally opaque filter (FW Pos 1)
			PPL	Polypropylene (FW Pos 2)
			4Lx	Thick (400 nm) Lexan (FW Pos 3)
			Fe Cal	Fe^{55} source (FW Pos 5)
			Al/P	Aluminium-parylene (FW Pos 6)
			3Lx	Thin (300 nm) Lexan (FW Pos 7)
			Bor	Boron (FW Pos 8)
			UV	Magnesium Fluoride (FW Pos 9)
ROSAT	PSPC		BORON	Boron filter
	WFC		S1x	C/Lexan/Bor Survey filter (x=a,b)
			S2x	Be/Lexan Survey filter (x=a,b)
			P1	Al/Lexan Pointed phase filter
			P2	Sn/Al Pointed phase filter
SAS-3	LED		BORON	Boron
			CHROMIUM	Chromium
			GOLD	Gold (Foils)
			RED_AP	Reduced Aperture filter wheel position

Table 3: (continued)

TELESCOP	INSTRUME	DETNAM	**Filter**	**Comments**
XMM	EMOSn		Thin	$n = 1, 2$
			Medium	
			Thick	
	EPN		Thin	
			Medium	
			Thick	
	RGS		Thin	
			Medium	
			Thick	
	OM		U	
			B	
			V	
			UVW2	
			UVM2	
			UVW1	

2.3 Standard Values for Gratings

Table 4: Summary of Standard Strings for Gratings used within the OGIP

TELESCOP	INSTRUME	GRATING	Notes
ANY	ANY	NONE	No grating used
Chandra	Any focal plane instrument	HETG	High Energy Transmission Grating
		LETG	Low Energy Transmission Grating
EINSTEIN	Any focal plane instrument	OGS/Gj	Objective Grating Spectrometer (j =5,10) (used with HRI-i in the focal plane)
EXOSAT	LEIT	TGSi	Transmission Grating Spectrometer (i =1,2) (used with CMAi in f.plane)

ACKNOWLEDGMENTS

We thank the numerous people both inside and outside the OGIP who have contributed suggestions & comments to this document. In particular we thank Jonathan McDowell (CfA) for sharing his great knowledge of previous missions. Jonathan's Space Report is an excellent resource on past and current space missions.

USEFUL LINKS TO OTHER FITS STANDARDS

- Other OFWG FITS Format Documentation:
  `http://heasarc.gsfc.nasa.gov/docs/heasarc/ofwg/ofwg_recomm.html`
- The CALDB Documentation Library:
  `http://heasarc.gsfc.nasa.gov/docs/heasarc/caldb/caldb_doc.html`
  (contains descriptions of other FITS data file conventions and standards)
- The HEASARC FITS Resource Page:
  `http://heasarc.gsfc.nasa.gov/docs/heasarc/fits.html`