Roman DCL Triplet Test FITS Format

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Scope

This specifies the format and metadata keywords for FITS files delivered from the DCL triplet test of Roman Space Telescope flight detectors.

Format

The format for the data is a 4D cube comprised of all the frames of an “integration,” organized columns x rows x frames x integrations. Here we use “integration” in the NIRCAM sense, the set of frames after one reset. (In DCL usage, the number of integrations will always be 1.) The cube is located in the first extension HDU, with EXTNAME “SCI”, and EXTVER 1. The primary HDU is null. Pixel values will be represented as unsigned 16 bit words (which is current DCL practice).

Laboratory housekeeping data recorded during this exposure is in a table extension with EXTNAME “LABMK” and EXTVER 1. The columns of this table are listed in Table 2.

If data from the reference output is included (keyword REFOUT is “T”) it appears in the data cube as an extra output channel – i.e. an extra 128 columns appended to the detector image.

If guide windows are present (keyword GUIDEWIN is “T”), they are in an extension with EXTNAME “GUIDE” and EXTVER 1. All the guide window images are compiled in chronological order into one data cube. If the reference output is included (keyword REFOUT is “T”) then the reference output during the guide window reading is appended to the guide window output. To clarify, if the guide window is 16x16, and the reference output is included, then the windows appear in the data cube as 16x32.

If a reset frame is present (keyword RESETFRM is “T”), it is in an extension with EXTNAME “RESET” and EXTVER 1.

If both guide windows and a reset frame are present, then the guide windows taken during the reset frame are in an extension with EXTNAME “RESET_GUIDE” and EXTVER 1.

A file contains data from one SCA.

Metadata is in the primary header; extensions only have the minimal required header. The keyword dictionary is presented below.

Discussion

This format is intended to strike a balance between current DCL usage and existing STScI data models. Following a suggestion from the Roman data format working group, it uses the NIRCAM datacube format and attempts as far as possible to use metadata keywords in common with NIRCAM usage.

NIRCAM has the practice of storing multiple “integrations” (the set of frames read after one reset) in a file, which it then calls an “exposure.” In the DCL, a file always contains just one integration.

NIRCAM also has provisions for Multiaccum. DCL does not use Multiaccum, but in this document I have retained the related NIRCAM keywords, set to appropriate values.

Caveat for DCL users: DCL FITS files have traditionally used NFRAMES for the number of frames in an integration; but this standard uses the NIRCAM definition that NFRAMES is the number of frames in a multiaccum group. Thus for files following this standard the value of NFRAMES is typically 1.

Metadata keywords

The metadata keywords are listed in Table 1. The column “Source/Comments” begins with an indication of the source of the keyword:

- “NIRCAM” keywords came from the NIRCAM dictionary,
- “Standard” keywords are from the FITS standard version 4.0 (of course some of these were also in the NIRCAM dictionary), and
- “DCL” keywords were added by the DCL

The collection of keywords in each file will be those required by the FITS standard, plus those that are applicable to that particular measurement. If the value for a keyword cannot be determined, the keyword is absent.

Keyword	**Description**	**Source/Comment**
BITPIX		Standard
BSCALE		Standard
BUNIT		Standard
BZERO		Standard
CABLESN	Serial number of the SCA-SCE cable. (String)	DCL
DATAPROB	T if science telemetry indicated any problems with the data. (Boolean)	NIRCAM
DATE	UTC date and time file created, formatted as a ISO-8601 string. (String)	Standard
DATE-BEG	Date-time of the start of the exposure, formatted as a ISO-8601 string. (String)	Standard
DATE-END	Date-time of the end of the exposure, formatted as a ISO-8601 string. (String)	Standard
DELRST	For single pixel reset tests, the change in reset voltage (V). (Float)	DCL
DETECTOR	Name of the SCA used to acquire this data. (String)	NIRCAM/DCL uses S/N as the detector name.

Keyword	Description	Source/Comment
DEWAR	Name of the dewar/setup used to acquire this data. (String)	DCL
DURATION	Total duration of exposure in units of seconds. (Float)	NIRCAM/Synonym for standard keyword TELAPSE.
EFFEXPTM	Effective exposure time in units of seconds. (Float)	NIRCAM/Synonym for standard keyword XPOSURE
EFFINTTM	Effective integration time in units of seconds. calculation: EFFEXPTM/NINTS (Float)	NIRCAM/Note that in the DCL, NINTS is always 1.
EXPEND	UTC exposure end time (Modified Julian Date). (Float)	NIRCAM/Synonym for standard keyword MJD-END
EXPMID	UTC exposure mid time (Modified Julian Date). Halfway between EXPSTART and EXPEND. (Float)	NIRCAM
EXPSTART	UTC exposure start time (Modified Julian Date). (Float)	NIRCAM/Synonym for standard keyword MJD-BEG
EXTEND		Standard
EXTNAME		Standard
EXTVER		Standard
FASTAX4	Indicates the axis and direction of fast readout. First character: “+” ascending readout, “-” descending readout, “A” alternating direction by ROIC channel, starting with ascending, “B” alternating starting with descending. Second character: “1” or “2” indicating the axis. (String)	DCL/This is an adaptation of NIRCAM keyword FASTAXIS for the expanded set of H4RG readout modes.
FILENAME	Name of the file. (String)	NIRCAM
FILETYPE	Type of data found in file: original, uncalibrated, slope-fit, calibrated, etc. (String)	NIRCAM/Files from the DCL will have the value “original.”
FPAPOS	Location of this SCA in the FPA. The set of possible values and their meanings depends on the DEWAR. (String)	DCL
FRSLEEP	Duration that SCA clocking is halted between frame reads (s). (Float)	DCL/In a flight-like timing pattern, this is always 0.
GAINMAX	For files taken to characterize gain, the nominal maximum integrated signal (ADU). (Float)	DCL

Keyword	Description	Source/Comment
GROUPGAP	Number of frames dropped between groups. (Integer)	NIRCAM
GUIDEWIN	Indicates if guide windows are present. (Boolean)	DCL
HISTORY		Standard
LODFILE	Name of the timing pattern microcode file. (String)	DCL
METAVERS	Version of metadata specification. For this document, use “Triplet 210813”. (String)	DCL
MJD-BEG	Modified Julian Date of beginning of exposure. (Float)	Standard
MJD-END	Modified Julian Date of end of exposure. (Float)	Standard
MONOFILT	Monochromator filter number. (String)	DCL
MONOGRAT	Monochromator grating. (String)	DCL
NAXIS		Standard
NAXIS1		Standard
NAXIS2		Standard
NAXIS3		Standard
NEXTEND	Number of file extensions. (Integer)	NIRCAM
NFRAMES	Number of frames per group. (Integer)	NIRCAM/In DCL usage, always 1. Note that this is a change from historical DCL usage of NFRAMES.
NGROUPS	Number of groups in integration. Each integration within an exposure is required to have the same number of groups. The total number of groups in an exposure is determined by NGROUPS * NINTS. (Integer)	NIRCAM/In DCL usage, this will always be the number of frames.
NGWPEDES	If guide windows are present, the number of pedestal frames. (Integer)	DCL
NGWRESET	If guide windows are present, the number of reset frames. (Integer)	DCL
NGWSIGNA	If guide windows are present, the number of signal frames. (Integer)	DCL
NINTS	Number of integrations within the exposure. An exposure consists of one or more integrations, and an integration contains one or more groups. Each integration within an exposure is required to have the same number of groups. (Integer)	NIRCAM/In DCL usage, always 1.

Keyword	Description	Source/Comment
NOUTPUTS	The number of SCA ROIC readout channels that were used for this data. (Integer)	NIRCAM
NSAMPLES	Number of A/D samples per read of pixel. (Integer)	NIRCAM/In DCL data, this will always be 1.
OBSERVER	Who acquired the data. (String)	Standard
ORIGIN	Organization or institution responsible for creating this FITS file. (String)	Standard
OUTBUF	Configuration of the ROIC output buffer. Typical values are “PMOS” or “NMOS”. (String)	DCL
READMODE	Indicates if data read from detector is differential (“Diff”) or single-ended (“SE”). (String)	DCL
REFOUT	Indicates if the reference output is included. (Boolean)	DCL
RESETFRM	Indicates if a reset frame is present. (Boolean)	DCL
RSTTYPE	Type of detector reset timing pattern. Values include “Pixel”, “Line”, and “Global”. (String)	DCL
SCATEMP	Nominal temperature of the SCA (K). (Float)	DCL
SCESN	Serial number of the SCE. (String)	DCL
SCETEMP	Nominal temperature of the SCE (K). (Float)	DCL
SIMPLE		Standard
SLOWAXIS	Indicates the axis and direction of slow readout (values = 1, 2, -1, -2). The digit value is set by whether axis 1 or 2 is the fast/slow readout axis. The sign indicates the direction of the readout with respect to the science frame. (Integer)	NIRCAM
TELAPSE	The amount of time elapsed, in the units of TIMEUNIT, between the start and the end of the observation. (Float)	Standard/The unit will be s.
TESTTYPE	Type of test in which this file was acquired. Values include: BASE, CROSSTALK, DARK, ELECGAIN, FLAT, FULLWELL, GAIN, LINEARITY, NOISE, PERSIST, RELQE, SPRESET, STABILITY, THERMALSTAB. (String)	DCL/More values for this keyword will likely be added in the future.
TFRAME	Time between start of successive frames in units of seconds. (Float)	NIRCAM
TFRAMSCE	Time between start of successive frames, in units of seconds, derived from the SCE header. This keyword is only present if the relevant SCE header is available. (Float)	

Keyword	Description	Source/Comment
TGROUP	Time between start of successive groups in units of seconds. Calculation: (GROUPGAP+NFRAMES)*TFRAME (Float)	NIRCAM
TIMESYS	Principal time system for time-related keywords. Universal Time Coordinated (UTC) will be used. (String)	Standard/Will always be UTC.
TIMEUNIT	A character string that specifies the time unit. (String)	Standard/Will always be ‘s’. Applies to TELAPSE and XPOSURE.
TSCA-BEG	Measured temperature of the SCA at the beginning of the exposure. (Float)	DCL/Location of thermometer depends on setup (DEWAR) but is typically on the plate the SCA mounts on.
TSCA-END	Measured temperature of the SCA at the end of the exposure. (Float)	DCL
TSCE-BEG	Measured temperature of the SCE at the beginning of the exposure. (Float)	DCL
TSCE-END	Measured temperature of the SCE at the end of the exposure. (Float)	DCL
WAVELEN	Central wavelength of illumination (nm). (Float)	DCL
WINX0	Starting pixel coordinate of guide window, in fast read direction. Window spans WINX0 to WINX0+WINXD-1. Only present in data taken with guide windows. (Integer)	DCL
WINXD	Guide window width in pixels, in fast read direction. Only present in data taken with guide windows. (Integer)	DCL
WINY0	Starting pixel coordinate of guide window, in slow read direction. Window spans WINY0 to WINY0+WINYD-1. Only present in data taken with guide windows. (Integer)	DCL
WINYD	Guide window height in pixels, in slow read direction. Only present in data taken with guide windows. (Integer)	DCL
XPOSURE	Effective exposure duration for the data in the units of TIMEUNIT. (Float)	Standard/The unit will be s.
XTENSION		Standard

Table 1: Metadata keywords

Laboratory housekeeping data

The laboratory housekeeping data columns are detailed in the following table.

Name	**Description**
MJD	Modified Julian Date of this data sample.
FPA_A, FPA_B	Temperature sensors located in the thermal zone of the SCAs (K).
SCE_A, SCE_B	Temperature sensors located in the thermal zone of the SCEs (K).
MCT_Diode	Output of the MCT photodiode located in the illumination optics. This the output of a trans-impedance amplifier (V).
Si_Diode	Output of the Si photodiode located in the illumination optics (A).