

Testing the On-The-Fly- Reprocessing System with WFPC2 Data

Shireen Gonzaga, Sylvia Baggett, John Biretta
August 16, 2001

ABSTRACT

Quality assurance checking of the OTFR WFPC2 data has been performed on a representative subset of 89 images. No problems were detected in the data (pixel values) though some procedural issues and header keyword values required further investigation. Critical issues were fixed and retested prior to OTFR's release to the public on May 15, 2001. Problem reports have been submitted for all remaining minor issues. This TIR presents details of the tests, discrepancies found, and their resolution.

Introduction

In the past, both raw and calibrated files were stored in the HST Archive, and were accessible using Starview. Primarily due to projected archive space constraints, a decision was made to store only raw data and implement "on-the-fly calibration" (OTFC), a system that calibrates data when the data are requested from the HST archive. It uses the best-available reference files and calibration software at the time the data are requested. The OTFC system was released to the public in December 1999.

The advantages to using OTFC included the automatic application of improved calibration files and switches, use of most recent calibration software (allowing for rapid access to improved algorithms, new capabilities, and software fixes), and correction of header keywords if needed. In addition, only the uncalibrated data need be stored in the archive.

In an effort to further improve the pipeline, the "on-the-fly reprocessing" (OTFR) system was developed. In OTFR, the processing begins earlier in the data stream, starting with the original telemetry files ("POD" files) received from Goddard Space Flight Center. OTFR performs all pipeline processing steps: data partitioning, data editing, generic conversion, and calibration and delivers both raw and calibrated files to the user. The older OTFC system performed only the last pipeline processing step (calibration) on raw files retrieved from the archive.

The benefits of the new OTFR system encompass the benefits in the OTFC system; in addition, OTFR data needs fewer header fixes (most problems are fixed as part of the pre-calibration pipeline processing) and the system as a whole is expected to require significantly less maintenance effort than OTFC.

The OTFR pipeline processes data from the POD file format, passes it through generic conversion, producing WFPC2 images in "extension" FITS format. (Extension FITS is the standard FITS format used by STIS, NICMOS, and future HST instruments.) However, the public calibration code for WFPC2 (*calwp2*) operates on GEIS format, so the extension FITS files are converted to GEIS before calibration. There are plans to convert STSDAS WFPC2 software to handle extension FITS files, but to date, this hasn't been completed; since the *calwp2* extension FITS path still contains some header keyword problems. We note that the OPUS pipeline currently performs the calibration on extension FITS files, however, users never receive OPUS calibrated data. The OPUS calibrated products are not archived, they are used only for filling certain keyword values (which are correct) in the StarView database. When an OTFR user requests data, the POD file is obtained from the archive, processed in extension FITS format, converted to GEIS (using a file conversion program called *fits2geis*), calibrated by *calwp2*, converted back to waivered FITS format (using the *stsdas* task *stwfits*) and sent to the user.

Data

Testing of the OTFR data for WFPC2 was performed in April and May of 2001; this TIR presents details of the testing procedure and issues found. In summary, all raw (d0, q0, x0, q1) and all calibrated (c0, c1) files were determined to be suitable for release. Prime keywords of the standard header files (shh) were checked as well, though verification of some of the less-used keywords has been deferred to a later date. Header keyword values and comments as well as pixel values were checked for correctness. OTFR data was consistently the same or better than OTFC data. There were, however, problems with some header keywords. Critical issues were resolved before OTFR was released to the public; but non-critical items were filed as problem reports, for resolution at a later time. The full list of open problem reports can be found in Table 2.

Regression Test Set:

We used the same list of images used for OTFC testing in 1999, a large representative sample of typical WFPC2 data as well as some "problem" datasets, then added a few more datasets to test other individual cases of concern.

Table 1. The list of datasets used for OTFR testing.

Dataset	Date Obs	*Target	Filter(s)	Comments
u20I0u02t	7/12/93	KSPOT	none in header	OTFC list, <i>Note 1</i>
u21y0103t	18/12/93	BIAS	F437N/F1042M	OTFC list
u21y010at	18/12/93	INTFLAT	F555W	OTFC list
u21y0205t	19/12/93	VISFLAT	F439W	OTFC list
u21y0503t	24/12/93	VISFLAT	F555W	OTFC list
u21y0707t	1/01/94	KSPOTS	F437N/F1042M	OTFC list
u21y0a01t	5/01/94	BIAS	F673N	OTFC list
u21y0a09p	5/01/94	INTFLAT	F555W	OTFC list
u21y0b01t	5/01/94	VISFLAT	F555W	OTFC list
u21y0b02t	5/01/94	VISFLAT	F555W	OTFC list
u21y0b05t	5/01/94	VISFLAT	F439W	OTFC list
u21y0I02t	24/01/94	DARK	F437N/F1042M	OTFC list
u22p0106t	29/12/93	NGC188	F555W	OTFC list
u22t0102t	23/01/94	NGC5139	F547M	OTFC list
u22t0206t	22/01/94	A+81D266	F130LP/F122M	OTFC list
u22t5101t	27/01/94	NGC5139	F300W	OTFC list
u22t5102t	27/01/94	NGC5139	F547M	OTFC list
u22u6501t	1/05/95	M67	F555W	OTFC list
u2310c05t	24/12/93	A+81D266	F170W	OTFC list
u2310t01p	6/01/94	KSPOTS	F437N/F1042M	OTFC list
u2310t02p	6/01/94	DARK	F437N/F1042M	OTFC list
u2320101t	10/01/94	EARTHCAL	F218W	OTFC list
u2320404t	11/01/94	EARTHCAL	F656N	OTFC list
u2320601t	12/01/94	EARTHCAL	F336W	OTFC list
u23i0107t	23/12/93	DARK	F437N/F1042M	OTFC list

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Dataset	Date Obs	*Target	Filter(s)	Comments
u23t0201t	12/01/94	GALCLUS	F702W	OTFC list
u23x0102t	31/12/93	2141+175	F702W	OTFC list
u2410507p	31/12/93	ETA-CAR	F375N	OTFC list
u2410509p	31/12/93	ETA-CAR	F375N	OTFC list
u2440101t	29/12/93	NGC1976	F656N	OTFC list
u2480f01t	20/12/93	WFC2CEN	F555W	OTFC list
u24z0101t	14/09/94	M101	F502N	OTFC list
u26m1201t	7/02/94	NGC1860	F450W	OTFC list
u28u6n01t	11/01/95	DARK	F1042M/F437N	OTFC list
u29n0b01t	11/07/95	BIAS	F502N	OTFC list
u29n0b03t	11/07/95	INTFLAT	F555W	OTFC list
u29n2p09t	7/02/95	KSPOTS	F555W	OTFC list
u2bx0601t	6/01/95	NGC1952	F170W	OTFC list
u2eb0101t	17/05/94	SL-17	F702W	OTFC list
u2eb0302t	17/05/94	SL-5	F702W	OTFC list
u2eq0201t	19/05/94	JUPITER	F673N	OTFC list
u2eu0402t	29/06/94	NEPTUNE	FQCH4N15	OTFC list
u2fu0401t	25/01/96	TX0828+	F555W/POLQ	OTFC list
u2h50805t	25/02/95	MARS	F336W	OTFC list
u2ih0104t	21/09/94	HD39060	F555W/POLQN33	OTFC list
u2ke0403t	28/11/94	COMET	F675W	OTFC list
u2190305p	3/02/95	MARK463E	F439W/POLQN33	OTFC list
u2ls0202m	3/08/97	NGC6995	F502N	OTFC list
u2mm0f09t	24/02/95	EARTHCAL	F502N/FR533N18	OTFC list
u2o10o0ct	11/02/96	DARK	F1042M/F437N	OTFC list
u2qq8001t	8/01/96	VISFLAT	F336W	OTFC list
u2sa8101t	22/01/96	K1-14	F814W	OTFC list
u2su030bt	16/03/96	MMJ6504	F606W	OTFC list
u2ut1101t	27/08/95	UVFLAT	F160BW	OTFC list
u2w90404r	30/06/98	A1689-4	F814W	OTFC list
u307140at	8/11/95	NGC2300	F814W	OTFC list

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Dataset	Date Obs	*Target	Filter(s)	Comments
u30k0106t	22/11/95	HR-8728	F555W	OTFC list
u30t0101t	10/03/96	V1L4	F300W	OTFC list
u30t0201p	5/01/96	V2L8	F300W	OTFC list
u31t0803t	30/12/95	HDF123..	F814W	OTFC list
u31z0201t	19/02/96	3C303.1	FR680N	OTFC list
u37g030ar	23/03/97	TER8	F555W	OTFC list
u38n0402m	22/07/97	IO	F410M	OTFC list
u3av240ft	9/02/97	DARK	F1042M/F437N	OTFC list
u3av2503r	20/03/97	BIAS	F814W	OTFC list
u3av3009r	5/04/97	KSPOTS	F555W	OTFC list
u3b3010dm	12/06/97	HEN401	F606W/POLQ	OTFC list
u3ek0701m	5/06/97	EARTHCAL	F343N	OTFC list
u3i2030cm	2/05/97	P041-C	F336W	OTFC list
u3i9050jr	29/11/97	G191B2B	F439W/POLQ	OTFC list
u3i90511r	29/11/97	G191B2B	F300W/POLQN33	OTFC list
u3i9a207r	3/10/97	G191B2B	F555W/POLQ	OTFC list
u3ik010bt	17/01/97	BD+75D..	F122M/F130LP	OTFC list
u3jg070bt	21/12/96	WD2126..	F122M/F130LP	OTFC list
u3jj5103r	10/09/97	SATURN	FQCH4P15	OTFC list
u3kg0107r	26/03/97	NGC6752	F439W	OTFC list
u3lu0202r	8/02/98	XZ-TAU	F675W	OTFC list
u3m00209r	10/03/97	MARS	FR868N	OTFC list
u3ma0201r	4/02/98	UZ-TAU	F569W	OTFC list
u3ma020ir	4/02/98	UZ-TAU	F631N	OTFC list
u41g021zr	6/11/97	JUPITER	F336W	OTFC list
u460a202r	10/10/97	PKS074..	FR680N	OTFC list
u46a6407r	13/10/98	SATURN	F814W	<i>Note 2</i>
u46a6408m	13/10/98	SATURN	F1042M	<i>Note 2</i>
u4720101r	14/11/97	UVFLAT	F160BW	OTFC list
u5ed0102r	1999-05-25	HD42581	F1042M	SOGS list
u5i80503r	2000-03-12	LEOII-C	F555W	<i>Note 3</i>

Dataset	Date Obs	*Target	Filter(s)	Comments
u5js0404r	1999-07-30	NGC1976	FR680N	<i>Note 4</i>
u693xx01r	2001-03-07	GRW+70..	F218W	<i>Note 5</i>

*Target - target names abbreviated to indicate if it was internal, fixed target, or planetary (i.e., moving) target.

Note 1: This is one of the first 3 WFPC2 images ever taken. They should not be calibrated; only raw data in waived FITS format should be delivered when a request is made. However, OTFR is delivering the raw files in a format (extension FITS) that should not go out to users. OPR 43702 has been filed to fix this bug. Affected images are: u2010u01t (bias), u2010u02t (kspots) and u2010u03t (intflat).

Note 2: Originally, these images were included in the OTFR set to test a problem where roll angle and orientation keywords were not populated correctly. The problem was later discovered to be related to OPR 37390 (scheduling software), i.e., OTFR can not be expected to correct the keywords automatically. Individual image keywords can be corrected via database updates, these images will be added to that list.

Note 3: This image was included to test a bug that affected spatial scans of more than 2 points per line (OPR 41582, implemented in SOGS12.0). OTFR produces correct values.

Note 4: This dataset was on the Data System Team's (DST's) list; we conservatively included it as well. OTFR correctly sets MTFLAG to F (OTFC incorrectly left it blank, OPR 35112 addressed the issue).

Note 5: This image (corresponding to POD file lz_a201_303_0000272086.pod) was added to the OTFR regression suite because it had missing packets and the pipeline failed to process it properly. A fix was built for the OTFR release and this dataset used to test this fix.

Testing Procedure

The general strategy for testing OTFR was to retrieve OTFC files from the archive and compare them with OTFR files provided by DST (Data Systems Team). The OTFC data consisted of raw data files (d0, q0, x0, q1) from the archive, as they were processed from POD files shortly after the observations were executed, and new calibrated data files (c0, c1) generated upon the retrieval request. The OTFR files, as mentioned in the Introduction, underwent data partitioning, data editing, generic conversion, and calibration; these were processed by DST in their test environment. Near the end of the testing period, a test database and Starview system was made available; the full regression set was retrieved through the test Starview system and results compared to the previous OTFR data used, thereby exercising and verifying new parts of the software (e.g., POD file identification, as POD names are not the same as image names).

Some differences were expected between the OTFC data and the test data (OTFR), primarily in header keyword values, e.g., changes due to updates in generic conversion and data

partitioning software that had occurred since the raw OTFC-era files had been created. Nevertheless, each difference required an explanation, as either intentional, and hopefully an improvement, or as a problem. To provide these explanations, it was necessary to track down many software changes that had occurred over the past 7 years, a job that was occasionally made more difficult by the lack of a proper search mechanism in the OPR system, sparse documentation in some of the OPRs, and in some case, no documentation available at all. Differences in OTFC and OTFR pixel values were not expected (and not found) except in cases where reference files had been updated.

Testing Results

Initially, the test pipeline produced extension FITS files, not the required waived FITS files. This problem was promptly fixed and the test data rerun by DST and redelivered for further testing. In addition, a sporadic problem occurred with the delivery of the FITS files, where *strfits* would refuse to unpack the file and complain about finding EOF (specifically, "EOF while reading gpb table"). The problem appeared in 1-2% of the images, always different files and different images. DST traced the problem to how the files were being moved around on disk; once the method was changed, the EOF problem did not reoccur.

No differences were found between OTFC and OTFR pixel values, except in one case where reference files had been updated. There were, however, numerous differences in keyword values and comments; these were cross-correlated to the OPR (Operational Problem Reporting) system. If there was no problem report and the value was incorrect, new OPRs were filed. In some cases, the OTFC/OTFR differences had no documented problem reports, but it was determined that OTFR produced the correct value. These differences are documented in detail in Appendices A, B, and D. Due to the large number of keyword differences found, we decided to require validation of only the most critical ones prior to OTFR release. Critical keywords were defined as ones known to be used in science analysis, or which might impact future observations.

Many keyword comments or descriptions appeared as differences and required evaluation. Some discrepancies have been traced to the *fits2geis* routine, which converts extension FITS files to GEIS format; these will be fixed once *calwp2* is updated to run on extension FITS only and once the archive can accept WFPC2 data in extension FITS format. Cases where the comment is worse in OTFR than OTFC (e.g., words truncated, disagreement between comment generated by OTFR and comment required by ICD 19 (Interface Control Document)) have been filed in OPR 44202. A complete list with examples can be found in Appendix C.

Some of the most important keyword differences found are highlighted here:

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Keyword(s): PROCTIME
Status: Expected, closed
File Type: science headers
Description: Pipeline processing time (MJD)
Change: New keyword in OTFR headers
PR #: 42740
Reason: Records the processing date of the file. This is necessary to flag the dataset as an OTFR product and to alert users that the STSDAS task *uchcoor* should not be run. (*uchcoor* is currently not necessary as OTFR now provides the best values for the CD-matrix keywords (cpix1, cpix2, crval1, crval2, cd1_1, cd1_2, cd2_1, cd2_2, and orientat.)

Keyword(s): CD1_1, CD1_2, CD2_1, CD2_2, CRPIX1, CRPIX2, CRVAL1, CRVAL2 (and some cases of ORIENTAT)
Status: Closed/unable to find PR for case 2 (see below).
File Type: science headers
Description: In order listed above
CD1_1 - partial of the right ascension w.r.t. x
CD1_2 - partial of the right ascension w.r.t. y
CD2_1 - partial of the declination w.r.t. x
CD2_2 - partial of the declination w.r.t. y
CRPIX1 - x-coordinate of reference pixel
CRPIX2 - y-coordinate of reference pixel
CRVAL1 - right ascension of reference pixel (deg)
CRVAL2 - declination of reference pixel (deg)
Change: Some images have different values for OTFC vs. OTFR
PR #: 41582 (for case 1 below). None available for case 2.
Reason:

1. In one instance, the discrepancy was due to a bug where spatial scans of more than 2 points per line were not populated correctly after the WCS code was converted to C (OPUS 11.0). OTFR keyword values are correct.

2. In other cases, no PR could be found to explain these differences for the images taken in '93, '94, and one in '95. The OTFR values were verified as correct by comparing the target position in the proposal to the RA and DEC provided by running *metric*.

Keyword(s): ORIENTAT
Status: Closed
File Type: science headers
Description: ORIENTAT - orientation of the image (deg)
Change: Some images have different values for OTFC vs. OTFR
PR #: For case 1, no PR but it's documented as an email from D. Swade. No OPR for case 2.
Reason:

1. Orients were not set correctly in internals. This was changed for SOGS build 10 so that ORIENT keywords for internals are set to 1.

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2. In other cases, the images were taken in '93, '94, and one in '95. No PR could be found to explain these differences. Believed be related to CD-Matrix problem documented above.

Keyword(s): ERRCNT
Status: Open
File Type: science headers, overscan image headers
Description: number of segments containing errors
Change: Different values seen in (only) one dataset in regression test list.
PR #: 38534
Reason: Unknown. C. Heller is investigating.

Keyword(s): EXPFLAG
Status: Closed/unable to find PR
File Type: science headers
Description: Exposure interruption indicator
Change: different values, set to "indeterminate" for OTFC, "normal" for OTFR. Affects one dataset in regression test list.
PR #: None
Reason: Unknown. Jitter files confirmed that flag contained the correct value.

Keyword(s): FILTROT
Status: Closed
File Type: science headers
Description: partial filter rotation angle (degrees)
Change: Keyword incorrectly populated for most rotated filters. Affected one dataset in regression test list.
PR #: 43736
Reason: Lack of requirements in original OPR 24506.

Keyword(s): LRFWAVE
Status: Closed
File Type: science headers
Description: linear ramp filter wavelength
Change: Keyword value set to 0 in OTFC. Correct values in OTFR. Ten datasets in regression list affected.
PR #: 31906
Reason: Keyword not populated with linear ramp wavelength values for observations using the linear ramp filter.

Keyword(s): NSHUTA17
Status: Closed
File Type: science headers
Description: Number of AP17 shutter B closes

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Change: For two images, value=1 in OTFC, 0 in OTFR. Both images from 1994 (September and November).
PR #: 27017
Reason: OTFR values verified by M.Swam, based on OPR 27017.

Keyword(s): PHOTTAB
Status: Closed/unable to find PR
File Type: science headers
Description: name of the photometry calibration table
Change: About 50 OTFC files have blank values.
PR #: unable to locate PR
Reason: OPR 25899 was filed in late 1993 to set a blank value for this keyword. This was later changed so that the keyword value is populated with a .c3t file.

Keyword(s): READTIME
Status: Closed
File Type: science headers
Description: Length of time for CCD readout in clock ticks
Change: increase to larger values (22 was too small)
PR #: 25983
Reason: Value (22) was too small, this was recognized in the PR and corrected. Only affects old images (from '93 & 94)

Keyword(s): SHADFILE, SHUTTER
Status: Closed
File Type: science header
Description: SHADFILE - name of the reference file for shutter shad(ing) file
SHUTTER - Shutter in place at beginning of the exposure
Change: OTFC values blank. OTFR values correct. Affected 13 images in regression test list.
PR #: 26050, 25122
Reason: Affected images from '93 and '94. The PR corrects the blank field entries by inserting the correct SHUTTER value. As a result the SHADFILE keyword is now correctly populated.

Keyword(s): STDCFFP
Status: Closed
File Type: science headers, overscan image headers
Description: st dcf fill pattern (hex)
Change: OTFC values=0000, OTFR values=0x5569
PR #: 40469
Reason: Values need to be 6 characters long.

Keyword(s): UBAY3TMP
Status: Closed
File Type: science headers

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Description: bay 3 A1 temperature (deg C)
 Change: Changes in precision of 0.05 or smaller.
 PR #: None
 Reason: According to M. Swam in email dated 00oct17: "This difference seems to be due to an updated set of PDB conversion values. OPUS processing uses the new conversions. OTFC just passes these values as they were in the original data, which would have used older conversions." (Same applies to OTFR data.)

Keyword(s): FILTER1, FILTER2
 Status: Closed
 File Type: overscan header (x0h)
 Description:
 FILTER1 - first filter number (0-48)
 FILTER2 - second filter number (0-48)
 Change: Few files had different values for OTFC vs. OTFR
 PR #: 36998
 Reason: Some OTFC files had corrupted FILTER1 and FILTER1 values.

Of the shh keywords, the following subset exhibited differences between OTFC and OTFR. Those identified with ** were deemed critical, and were verified before the public release of OTFR; the remaining keyword differences will be verified as time allows.

**ANNPARRA	**APEROFFX	**APEROFFY	APER_2	APER_3
ARGPERIG	**CALIBRAT	CIRVELOC	CLKDRFTR	COSINCLI
**DATE	ACCPDATE	**DGESTAR	ECBDX3	ECBDX4D3
ECCENTRY	ECCENTX2	EPCHTIME	ESQDX5D2	FDMEANAN
HSTHORB	MEANANOM	**MTFLAG	**OPUS_VER	**PAR_CORR
**PROC_TYP	**PROPTTL1	**PR_INV_F	**PR_INV_L	**PR_INV_M
RASCASCN	RCARGPER	RCASCNRD	RCASCNRV	**ROOTNAME
RTAMATCH	SDMA3SQ	SDMEANAN	SDMA3SQ	SEMILREC
**SGESTAR	SINEINCL	SPCLINCN	T51_ANGL	T51_RATE
**TARDESCR	TARGDIST	TIMEFFEC	**TRK_TYPE	UAFMPWR
UAFMRIUT	UATPATMP	UATPBTMP	UATPCTMP	UBAY1TMP
UBAY2TMP	UBAY3TMP	UBAY4TMP	UBAY5TMP	UCH1HJTM
UCHBHTMP	UCMODTMP	UFMBHTMP	UHTPIHTR	ULVPSO NF
UMECHPWR	UMNTPTMP	UP1AFMX	UP1AFMY	UPOMTEMP
UPYRMDTM	URADPTMP	URFILTPS	URIUATMP	URIUBTMP
URPLHTR	**SPCLINCN	**UTC01	**UTC02	**UTC0

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UTCO1	UTECPWRS	UW3AFMX	UW3AFMY	UW4AFMX
UW4AFMY	**V2APERCE	**V3APERCE		

Note: ANNPARRAS, APEROFFX, APEROFFY, V2APERCE, and V3APERCE were simply round-off errors.

Some of the more important shh keyword differences are:

Keyword(s): DGESTAR, SGESTAR

Status: Closed

File Type: standard header packet (shh)

Description:

DGESTAR - FGS ID(F1,F2,F3) concat. w/ dom. gd. star id

SGESTAR - FGS ID(F1,F2,F3) concat. w/ subdom. gd. star id

Change:

OTFC/OTFR values for DGESTAR

u2fu0401t_shf.fits: 0138700691F1 / 0138701243F2

u30t0101t_shf.fits: 0088000340F1 / 0088000919F3

u3b3010dm_shf.fits: 0895603516F1 / 0895603428F3

OTFC/OTFR values for SGESTAR

u2fu0401t_shf.fits: 0138701243F2 / 0138700691F1

u30t0101t_shf.fits: 0088000919F3 / 0088000340F1

u3b3010dm_shf.fits: 0895603428F3 / 0895603516F1

PR #: none

Reason: OTFR is producing the correct values, verified by M.Swam and M. Reinhart. For the OTFC data, OPUS may have used the guide star pair naming convention to determine the dominant/subdominant stars; however, that is not guaranteed to provide the correct values (e.g., occasionally, due to FGS restrictions, the order of the guidestars must be reversed during the calendar building process).

Keyword(s): MTFLAG

Status: Closed

File Type: standard header packet (shh)

Description: moving target flag; T if it is a moving target

Change: OTFR correctly leaves it blank

u5ed0102r_shf.fits: F / <blank>

PR #: None

Reason: OTFC file had value F, it should have been blank. Fixed in OTFR.

Keyword(s): OPUS_VER

Status: Closed

File Type: standard header packet (shh)

Description: OPUS software system version number

Change: New keyword added, seen in one new dataset

PR #: 38754

Reason: A useful keyword for determining which version of the SOGS software was used for

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trouble-shooting purposes.

Keyword(s): PROC_TYP
Status: Closed
File Type: standard header packet (shh)
Description: type of pipeline processing
Change: About 16 files had these changes
Example:
OTFC/OTFR values
u26m1201t_shf.fits: REPRO / NORMAL
u2eq0201t_shf.fits: MINOR / NORMAL
PR #: 31460
Reason: Uncritical change

Keyword(s): SPCLINCN
Status: Closed
File Type: standard header packet (shh)
Description: spacecraft clock at UTC0
Change: Differences seen in many files, a sample included below.
OTFC/OTFR values:
u21y0103t_shf.fits: 916637768 / 870299052.0
u21y0503t_shf.fits: 918855368 / 916637768.0
u2fu0401t_shf.fits: 1389783372 / 1347643692.0
u2ls0202m_shf.fits: 1773670591 / 1731173791.0
u2mm0f09t_shf.fits: 1180047372 / 1132288332.0
u5ed0102r_shf.fits: 2146599394.0 / 2102847395.0
PR #: None
Reason: Unknown, but OTFR values have been verified as correct by M. Swam and S. Baggett.

Keyword(s): TRK_TYPE
Status: Closed
File Type: standard header packet (shh)
Description: track 48 or track 51 commanding used
Change: Different values appear in many files.
Example:
OTFC/OTFR
u21y0103t_shf.fits: NO / F
u2eb0302t_shf.fits: T51 / S
PR #: None
Reason: T51 tracking only occurs for moving target. All OTFC T51 values are now "S" in OTFR. All non-planetary targets have value "NO" in OTFC, and "F" in OTFR.

Keyword(s): UTC0
Status: Closed
File Type: standard header packet (shh)

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Description: Coordinated Universal Time (Mod Julian Date)
Change: Different values in all files, Example of OTFC/OTFR values
u21y0103t_shf.fits: 49332.125 / 49265.0840278
u21y010at_shf.fits: 49332.125 / 49265.0840278
PR #: None
Reason: Unknown, but OTFR values have been verified as correct by M. Swam and S. Baggett.
(UTC0 values can change when SPSS vehicle coefficient time database is updated.)

Keyword(s): UTCO1, UTCO2
Status: Closed, OPR filed
File Type: standard header packet (shh)
Description: UTCO1 - bytes 5-8 of UTC0
UTC02 - bytes 1-4 of UTC0

Change: Different values seen in most files, Example:
OTFC/OTFR values
u22u6501t_shf.fits: -422074880 / 3872892416
u2310c05t_shf.fits: -1346666496 / 2948300800
PR #: 43899
Reason: Keywords no longer populated and values are meaningless. OPR filed to set values to NULL.

Summary

In summary, testing of OTFR found no pixel value differences. There were many header keyword value differences; for the more critical keywords, these were either fixed, OPR'd, or determined to be improvements. For some of the less critical keywords, we have merely documented the differences here, and if time permits, they will be investigated at a later date. Table 2 below provides a summary of the issues, along with their status. In addition, there were many keyword comment differences, listed for completeness in the Appendix C.

Table 2: Summary of WFPC2 OTFR testing issues

Issue	Comment
Extension FITS instead of waived FITS	fixed
EOF problem	fixed
crval/cdmatrix (1993-1994)	OTFR is ok
crval/cdmatrix (year 2000)	OTFR is ok
UTC0/SPLINCN	values ok and consistent with each other

Issue	Comment
UTC0/UTC01/UTC02 inconsistencies	OPR filed (43899); UTC0s are correct
Raw file statistics incorrect	OPR filed (43899)
MTFLAG sometimes blank	OTFC problem, corrected in OTFR
DGE/SGESTAR mismatches	OPR to be filed to fix DB, (OTFR values are correct)
TIMEFFEC & EPCHTIME	ok
ERRCNT in 1 image non-zero	open (under investigation)
FILTR0T no longer populated	OPR filed (43736)
POD file repairs needed in OTFR era	OPR filed (43781; 6 images affected)
First 3 WFPC2 images produce ext.fits	OPR filed (43702)
Hundreds of keyword comment diffs	OPR filed (44202)
NSHUTA17 diffs in 2 images	ok, OTFR correct
EXPFLAG diff in 1 image	ok, OTFR correct

Acknowledgements

Thanks to Lisa Sherbert, Daryl Swade, Mike Swam and Steve Slowinsky for providing test OTFR data for evaluation, and for helping to clear up discrepancies found between the OTFC and OTFR data. Also our thanks to J.C. Hsu, Ed Hopkins, Merle Reinhart, Chris Heller, Grace Mitchell, Howard Lanning and Laretta Nagel for their assistance in various parts of the testing process.

References

TIR WFPC2 00-05: Testing the On-The-Fly-Calibration System with WFPC2 Data.
Mike Wiggs and Sylvia Baggett

The STScI Software Problem Reporting System
<http://www.sesd.stsci.edu/prsystem/>

Appendix A

Appendix A: New Keyword *Values* in Calibrated Science Header Files (c0h files).

This section contains a list of keywords from the calibrated science header files that are new in OTFR, have been dropped from OTFR, or have new keyword values in OTFR. In most cases, only some images in the OTFR regression image list were affected because these changes occurred as a part of past SOGS builds.

I. Keywords used in some versions of SOGS (OTFC), but removed from OTFR data. They are present in science data headers, x0h, and shh header files.

DADSCLAS DADSDATE DADSFIL

II. New keywords in OTFR data:

PROCTIME (Pipeline processing time (MJD))

Reason: Added to all science headers. Documented in OPR 42740/populate processing time keyword for OTFR SIs. (See main text for details.)

TELESCOP (telescope used to acquire data)

Reason: Added to all science headers, overscan image headers (x0f) and standard header packet (shf file)

III. Keywords dropped in some OTFC headers and later reinstated in newer OTFC data. They all correctly appear in OTFR data. All were added to Science Data Headers and standard header packet (shh file) and are documented in OPR 34438/97jun06.

ECL_LAT (ecliptic latitude of the target (deg) (J2000))

ECL_LONG (ecliptic longitude of the target (deg) (J2000))

GAL_LAT (galactic latitude of the target (deg) (J2000))

GAL_LONG (galactic longitude of the target (deg) (J2000))

IV. List of keywords that contain new values in OTFR (values displayed as OTFC/OTFR in the example section below):

EQUINOX (equinox of celestial coord. system)

Reason: Format change

Example:

u21y0707t_c0f.fits: J2000 / 2000.0

EXPNAME (9 character exposure identifier)

Reason: Upper to lower case

Example:

u21y010at_c0f.fits: U21Y010AT / u21y010at

ROOTNAME (rootname of the observation set)

Reason: Upper to lower case

Example:

u21y010at_c0f.fits: U21Y010AT / u21y010at

CD1_1 (partial of the right ascension w.r.t. x)

CD1_2 (partial of the right ascension w.r.t. y)

CD2_1 (partial of the declination w.r.t. x)

CD2_2 (partial of the declination w.r.t. y)

CRPIX1 (x-coordinate of reference pixel)

CRPIX2 (y-coordinate of reference pixel)

CRVAL1 (right ascension of reference pixel (deg))

CRVAL2 (declination of reference pixel (deg))

ORIENTAT (orientation of the image (deg))

Reason: All these keywords are related to each other. See main text for details.

ERRCNT (number of segments containing errors)

Reason: Unknown. Occurs in one dataset in regression test list. See main text for details

Example:

u30t0101t_c0f.fits: 0 / 3

EXPFLAG (Exposure interruption indicator)

Reason: Unknown. Occurs in one dataset in regression test list. Baggett checked jitter files and found OTFR value to be correct. See main text for details

Example:

u30k0106t_c0f.fits: INDETERMINATE / NORMAL

FILTROT (partial filter rotation angle (degrees))

Reason: Lack of requirements in original OPR 24506. See main text for details.

Example:

u2mm0f09t_c0f.fits: -18.0 / 0.0

LRFWAVE (linear ramp filter wavelength)

Reason: Keyword not populated with linear ramp wavelength values for observations using the linear ramp filter. See main text for details.

Example:

u460a202r_c0f.fits: 0.0 / 7237.0

NSHUTA17 (Number of AP17 shutter B closes)

Reason: Unknown, but OTFR values verified correct. See main text for details.

Example:

u2ih0104t_c0f.fits: 1 / 0

PHOTTAB (name of the photometry calibration table)

Reason: No phottab values for 50 images in regression test list. Initially this was done deliberately, then changed at later date. See main text for details.

Example:

u22p0106t_c0f.fits: <blank> / u22p0106t.c3t

READTIME (Length of time for CCD readout in clock ticks)

Reason: Unknown. Problem was noticed and corrected in OPR 25983. See main text for details.

Example:

u21y0707t_c0f.fits: 22 / 464

SHADFILE (name of the reference file for shutter sha)

SHUTTER (Shutter in place at beginning of the exposure)

Reason: Different values seen in these two keywords are related. Some early images had no shutter value. It was restored in OTFR and therefore, a shutter shading file could be provided. See main text for details.

Example:

SHADFILE

u21y0707t_c0f.fits: N/A / uref\$e371355iu.r5h

SHUTTER

u21y0707t_c0f.fits: <blank> / B

STDCFFP (st dcf fill pattern (hex))

Reason: Value had to be 6 characters long, OPR 40469. About 75 images in regression list affected.

Example:

u21y010at_c0f.fits: 0000 / 0x5569

TARGNAME (proposer's target name)

Reason: OTFR value has entire target name, not truncated anymore.

Example:

u23t0201t_c0f.fits: GAL-CLUS-093942+47 / GAL-CLUS-093942+4713-FLD1

UBAY3TMP (bay 3 A1 temperature (deg C))

Reason: changes in precision of 0.05 or smaller, due to new set of PDB conversion values. See main text for details.

Example:

u21y010at_c0f.fits: 17.4750289917 / 17.4749

DATE (date this file was written (yyyy-mm-dd))

Reason: format change to accomodate Y2K

Example:

u21y010at_c0f.fits: 17/06/98 / 2001-06-25

Appendix B

Appendix B: New Keyword *Values* in Overscan Image Header (x0h) File

This section contains a list of keywords from the overscan image header files (x0h) that are new in OTFR, have been dropped from OTFR, or have new keyword values in OTFR. In most cases, only some images in the OTFR regression image list were affected because these changes occurred as a part of past SOGS builds.

I. Keywords used in some versions of SOGS (OTFC), but removed from OTFR data. They are present in science data headers, x0h, and shh header files.

DADSCLAS DADSDATE DADSFILE

II. New keywords in OTFR x0h files (See Appendix A for descriptions):

TELESCOP ECL_LAT ECL_LONG
EQUINOX GAL_LAT GAL_LONG

III. List of keywords that contain new (different) values in OTFR (values displayed as OTFC/OTFR in the example section below):

ERRCNT (number of segments containing errors)

Reason: Unknown. Occurs in one dataset in regression test list. See main text for details

Example:

u30t0101t_x0f.fits: 0 / 3

FILTER1 (first filter number (0-48))

Reason: Some files had corrupted FILTER1 and FILTER1 values. See main text for details. 3 files in regression test set affected.

Example:

u2ih0104t_x0f.fits: 0 / 25

u2l90305p_x0f.fits: 0 / 18

u2mm0f09t_x0f.fits: 0 / 23

FILTER2 (second filter number (0-48))

Reason: Some files had corrupted FILTER1 and FILTER1 values. See main text for details. One file in regression test set affected.

Example:

u2eu0402t_x0f.fits: 43 / 0

STDCFFP (st dcf fill pattern (hex))

Reason: Value had to be 6 characters long, OPR 40469. About 80 images in regression list affected.

Example:

u21y0103t_x0f.fits: 0000 / 0x5569

TARGNAME (proposer's target name)

Reason: OTFR value has entire target name, not truncated anymore.

Example:

u23t0201t_x0f.fits: GAL-CLUS-093942+47 / GAL-CLUS-093942+4713-FLD1

ROOTNAME (rootname of the observation set)

Reason: Upper to lower case

Example:

u21y0103t_x0f.fits: U21Y0103T / u21y0103t

DATE (date this file was written (yyyy-mm-dd))

Reason: Format change to accomodate Y2K. About 80 files affected.

Example:

u21y0103t_x0f.fits: 17/06/98 / 2001-06-25

EXPNAME (9 character exposure identifier)

Reason: Upper to lower case, all images affected.

Example:

u21y0103t_x0f.fits: U21Y0103T / u21y0103t

Appendix C

Appendix C: Different Keyword *Description or Comments* for Calibrated Science Image headers (c0h), Overscan Image Headers (x0h), and Standard Header Packet file (shh).

Examples of keyword comments that changed between OTFR and OTFC for science headers (c0h files), overscan image headers (x0h files), and standard header packet files (shh files). Not all comments appear in each file because some OTFC files were created after different SOGS builds. In most cases, updates either have to be done to the header comments in OTFR or in ICD-19. A problem report (OPR 44202) has been filed.

Note: due to lack of time, not all the keywords comments were checked against ICD-19.

Comment differences for science headers (c0h files)

BLEVCORR

Example:

otfc/u21y0707t_c0f.fits: Do bias level correction: PERFORM, OMIT, COMPLE

otfr/u21y0707t_c0f.fits: Do bias level correction

BLEVFILE

Example:

otfc/u21y010at_c0f.fits: Engineering file with extended register data

otfr/u21y010at_c0f.fits: Engineering file with extended register da

CDBSFILE

Example:

otfc/u21y0707t_c0f.fits: GENERIC/BIAS/DARK/FLAT/MASK/NO

otfr/u21y0707t_c0f.fits: GENERIC/BIAS/DARK/PREF/FLAT/MASK/ATOD/NO

DATE

Example:

otfc/u21y010at_c0f.fits: date this file originated (dd/mm/yy)

otfr/u21y010at_c0f.fits: date this file was written (yyyy-mm-dd)

DATE-OBS

Example:

otfc/u21y010at_c0f.fits: UT date of start of observation (dd/mm/yy)

otfr/u21y010at_c0f.fits: UT date of start of observation (yyyy-mm-dd)

DOPHOTOM

Example:

otfc/u21y0707t_c0f.fits: Fill photometry keywords: PERFORM, OMIT, COMPLE

otfr/u21y0707t_c0f.fits: Fill photometry keywords

DOSATMAP

Example:

otfc/u21y0707t_c0f.fits: Output saturated pixel map: PERFORM, OMIT, COMP

otfr/u21y0707t_c0f.fits: Output saturated pixel map

EPLONGPM

Example:

otfc/u21y0707t_c0f.fits: epoch of longitude of prime meridian

otfr/u21y0707t_c0f.fits: epoch of longitude of prime meridian (sec)

EQRADTRG

Example:

otfc/u21y0707t_c0f.fits: equatorial radius of target

otfr/u21y0707t_c0f.fits: equatorial radius of target (km)

EQUINOX

Example:

otfc/u21y010at_c0f.fits: equinox of the celestial coordinate system

otfr/u21y010at_c0f.fits: equinox of celestial coord. system

FILETYPE

Example:

otfc/u21y010at_c0f.fits: shp, ext, edq, sdq, sci

otfr/u21y010at_c0f.fits: type of data found in data file

FLATCORR

Example:

otfc/u21y0707t_c0f.fits: Do flat field correction: PERFORM, OMIT, COMPLE

otfr/u21y0707t_c0f.fits: Do flat field correction

INSTRUME

Example:

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otfc/u21y010at_c0f.fits: instrument in use

otfr/u21y010at_c0f.fits: identifier for instrument used to acquire data

LONGPMER

Example:

otfc/u21y0707t_c0f.fits: longitude of prime meridian

otfr/u21y0707t_c0f.fits: longitude of prime meridian (deg)

MOONANGL

Example:

otfc/u21y010at_c0f.fits: angle between moon and V1 axis (deg)

otfr/u21y010at_c0f.fits: angle between moon and V1 axis

MTFLAG

Example:

otfc/u21y0707t_c0f.fits: moving target flag

otfr/u21y0707t_c0f.fits: moving target flag; T if it is a moving target

NPDECTRG

Example:

otfc/u21y0707t_c0f.fits: north pole declination of target

otfr/u21y0707t_c0f.fits: north pole declination of target (deg)

NPRATR

Example:

otfc/u21y0707t_c0f.fits: north pole right ascension of target

otfr/u21y0707t_c0f.fits: north pole right ascension of target (deg)

PA_V3

Example:

otfc/u21y010at_c0f.fits: position angle of v3 of HST (deg)

otfr/u21y010at_c0f.fits: position angle of V3-axis of HST (deg)

PODPSFF

Example:

otfc/u21y0707t_c0f.fits: 0=(no podps fill), 1=(podps fill present)

otfr/u21y0707t_c0f.fits: 0=(no podps fill); 1=(podps fill present)

PSTPTIME

Example:

otfc/u21y0707t_c0f.fits: Predicted obs. stop time (yyyy:ddd:hh:mm:ss)

otfr/u21y0707t_c0f.fits: predicted obs. stop time (yyyy.ddd:hh:mm:ss)

PSTRTIME

Example:

otfc/u21y0707t_c0f.fits: Predicted obs. start time (yyyy:ddd:hh:mm:ss)

otfr/u21y0707t_c0f.fits: predicted obs. start time (yyyy.ddd:hh:mm:ss)

SHADCORR

Example:

otfc/u21y0707t_c0f.fits: Do shaded shutter correction: PERFORM, OMIT, CO

otfr/u21y0707t_c0f.fits: Do shaded shutter correction

SHADFILE

Example:

otfc/u21y010at_c0f.fits: name of the reference file for shutter shading

otfr/u21y010at_c0f.fits: name of the reference file for shutter sha

SHUTTER

Example:

otfc/u21y0707t_c0f.fits: Shutter in place during IFLAT (AorB)

otfr/u21y0707t_c0f.fits: Shutter in place at beginning of the exposure

STDCFFF

Example:

otfc/u21y0707t_c0f.fits: 0=(no st dcf fill), 1=(st dcf fill present)

otfr/u21y0707t_c0f.fits: 0=(no st dcf fill); 1=(st dcf fill present)

SUNANGLE

Example:

otfc/u21y010at_c0f.fits: angle between sun and V1 axis (deg)

otfr/u21y010at_c0f.fits: angle between sun and V1 axis

SUN_ALT

Example:

otfc/u21y010at_c0f.fits: altitude of the sun above Earth's limb (deg)

otfr/u21y010at_c0f.fits: altitude of the sun above Earth's limb

SURFALTD

Example:

otfc/u21y0707t_c0f.fits: surface feature altitude
otfr/u21y0707t_c0f.fits: surface feature altitude (km)

SURFLATD

Example:

otfc/u21y0707t_c0f.fits: surface feature latitude
otfr/u21y0707t_c0f.fits: surface feature latitude (deg)

SURFLONG

Example:

otfc/u21y0707t_c0f.fits: surface feature longitude
otfr/u21y0707t_c0f.fits: surface feature longitude (deg)

UEXPODUR

Example:

otfc/u21y0707t_c0f.fits: Commanded duration of exposure (seconds)
otfr/u21y0707t_c0f.fits: commanded duration of exposure (sec)

COMPTAB

Example:

otfc/u21y010at_c0f.fits: None
otfr/u21y010at_c0f.fits: the HST components table

GRAPHTAB

Example:

otfc/u21y010at_c0f.fits: None
otfr/u21y010at_c0f.fits: the HST graph table

IMAGETYP

Example:

otfc/u5ed0102r_c0f.fits: type of exposure identifier
otfr/u5ed0102r_c0f.fits: DARK/BIAS/IFLAT/UFLAT/VFLAT/KSPOT/EXT/ECAL

Comment differences for overscan image headers (x0h files)

CTYPE1

Example:

otfc/u5ed0102r_x0f.fits: the coordinate type for the first axis
otfr/u5ed0102r_x0f.fits: unitless, line, pixel, channel, sample, time

(1 file in regression test list)

DATE

Example:

otfc/u21y0103t_x0f.fits: date this file originated (dd/mm/yy)

otfr/u21y0103t_x0f.fits: date this file was written (yyyy-mm-dd)

(78 files in regression test list)

FILETYPE

Example:

otfc/u21y0103t_x0f.fits: shp, ext, edq, sdq, sci

otfr/u21y0103t_x0f.fits: type of data found in data file

(77 files in regression test list)

INSTRUME

Example:

otfc/u21y0103t_x0f.fits: instrument in use

otfr/u21y0103t_x0f.fits: identifier for instrument used to acquire data

(78 files in regression test list)

LINEBEG

Example:

otfc/u21y0707t_x0f.fits: line number (1st line: wrt source format)

otfr/u21y0707t_x0f.fits: first line number wrt source format

(28 files in regression test list)

SAMPBEG

Example:

otfc/u21y0707t_x0f.fits: sample number (1st sample: wrt source format)

otfr/u21y0707t_x0f.fits: first sample number wrt source format

(29 files in regression test list)

STDCFFF

Example:

otfc/u5ed0102r_x0f.fits: ST DDF fill present (T/F)

otfr/u5ed0102r_x0f.fits: 0=(no st dcf fill); 1=(st dcf fill present)

(2 files in regression test list)

STDCFFP

Example:

otfc/u5ed0102r_x0f.fits: ST DDF fill pattern (hex)
otfr/u5ed0102r_x0f.fits: st dcf fill pattern (hex)
(1 file in regression test list)

TARGNAME

Example:

otfc/u46a6408m_x0f.fits: None
otfr/u46a6408m_x0f.fits: proposer's target name

Reason: unknown.

(1 file in regression test list, image from 1998.)

Comment differences for standard header packet (shh files)

DATE

Example:

otfc/u21y0103t_shf.fits: date this file originated (dd/mm/yy)
otfr/u21y0103t_shf.fits: date this file was written (yyyy-mm-dd)

FILETYPE

Example:

otfc/u21y0103t_shf.fits: shp, ext, edq, sdq, sci
otfr/u21y0103t_shf.fits: type of data found in data file

INSTRUME

Example:

otfc/u21y0103t_shf.fits: instrument in use
otfr/u21y0103t_shf.fits: identifier for instrument used to acquire data

PAR_CORR

Example:

otfc/u21y0103t_shf.fits: parallax correction used (T or F)
otfr/u21y0103t_shf.fits: parallax correction used (T/Y or F/N)

PA_V3

Example:

otfc/u21y0103t_shf.fits: position angle of v3 of HST (deg)
otfr/u21y0103t_shf.fits: position angle of V3-axis of HST (deg)

PR_INV_M

Example:

otfc/u21y0103t_shf.fits: middle initial of principal investigator

otfr/u21y0103t_shf.fits: middle name / initial of principal investigat

SCAN_TYP

Example:

otfc/u21y0707t_shf.fits: C:bostrophidon; D:'C' with dwell; N:not applicab

otfr/u21y0707t_shf.fits: C:bostrophidon; D:C with dwell; N:N/A

(about 39 files from the regression test list affected)

UUVINSEL

Example:

otfc/u21y0103t_shf.fits: Cal lamp select (UV/INCAN)

otfr/u21y0103t_shf.fits: Cal lamp select (UV/VIS/INCAN)

(about 78 files from the regression test list affected)

V2APERCE

Example:

otfc/u21y0103t_shf.fits: V2 offset of target from aper. center (arcsec)

otfr/u21y0103t_shf.fits: V2 offset of target from aper fiducial (arcsec)

(about 79 files from the regression test list affected)

V3APERCE

Example:

otfc/u21y0103t_shf.fits: V3 offset of target from aper. center (arcsec)

otfr/u21y0103t_shf.fits: V3 offset of target from aper fiducial (arcsec)

(about 79 files from the regression test list affected)

Appendix D

Appendix D: New Keyword *Values* in Calibrated Science Header Files (shh)

These keywords appear in all OTFR files but not in most OTFC files.

AFFILIAT	APVER1V2	APVER1V3	APVER2V2	APVER2V3	APVER3V2
APVER3V3	APVER4V2	APVER4V3	AS2CSX00	AS2CSX10	AS2CSX11
AS2CSY00	AS2CSY10	AS2CSY11	CS2ASX00	CS2ASX10	CS2ASX11
CS2ASY00	CS2ASY10	CS2ASY11	EQUINOX	HOSAPOR	HOSD1
HOSD2	HOSIASX	HOSIASY	HOSIMPAR	HOSISHA	HOSIVDM
HOSPOLY	HOSTH1	HOSTH2	HOSV2CNT	HOSV3CNT	
OPUS_VER	TELESCOP				

These keywords are no longer in OTFR files

DADSCLAS DADSDATE DADSFIL

Keywords that have different values in OTFR (values displayed as OTFC/OTFR in the example section below):

ANNPARRA (par. shift in position, non-solar sys target)

Reason: Round-off difference

Example:

u2eu0402t_shf.fits: 0.2056465 / 0.205646

APEROFFX (x comp of object offset in aperture (arcsec))

Reason: Round-off difference (typical values 0.00 for non-shifted images)

Example:

u2eb0302t_shf.fits: -4.218847e-15 / -0.0

u38n0402m_shf.fits: 3.146208e-16 / 0.0

APEROFFY (y comp of object offset in aperture (arcsec))

Reason: Round-off difference

Example:

u38n0402m_shf.fits: -3.13415e-16 / -0.0

u3jg070bt_shf.fits: -3.13415e-16 / -0.0

APER_2 (instrument aperture)

Reason:

Unknown. OTFC values for a few files were blank. They were filled in OTFR. In all cases, these involved rotated filters.

Affects files from `94 to `97

Example:

u2eu0402t_shf.fits: <blank> / FQCH4N15

u3jj5103r_shf.fits: <blank> / FQCH4P15

APER_3 (instrument aperture)

Reason:

Unknown. OTFC values for a few files were blank. They were filled in OTFR. In all cases, these involved rotated filters. Affects files from `94 to `97

Example:

u2ih0104t_shf.fits: <blank> / POLQN33

u2l90305p_shf.fits: <blank> / POLQN33

u2mm0f09t_shf.fits: <blank> / FR533N18

u3i90511r_shf.fits: <blank> / POLQN33

ARGPERIG (argument of perigee (revolutions))

Reason: Unknown

Example:

u22t5101t_shf.fits: 0.161070276434 / 0.192914198496

u22t5102t_shf.fits: 0.161070276434 / 0.192914198496

u2bx0601t_shf.fits: 0.157716303508 / 0.189292126771

CALIBRAT (calibrate data flag)

Reason: Different flags used. 79 files affected.

Example:

u21y0103t_shf.fits: Y / T

CIRVELOC (circular orbit linear velocity (meters/second))

Reason: Unknown

Example:

u22t5101t_shf.fits: 7564.18848671 / 7564.30305971

u22t5102t_shf.fits: 7564.18848671 / 7564.30305971

u2bx0601t_shf.fits: 7564.85150479 / 7564.90583853

CLKDRFTR (spacecraft clock drift rate)

Reason: Unknown. About 50 files affected.

Example:

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u21y0103t_shf.fits: 5.90301493874e-19 / 4.89766372023e-19
u31t0803t_shf.fits: 9.55890315967e-20 / -7.25866633048e-20
u3lu0202r_shf.fits: 3.17750761186e-19 / 5.41067344006e-19
u5ed0102r_shf.fits: 3.76557190795e-19 / 2.8740584593e-19

COSINCLI (cosine of inclination)

Reason: Round-off difference

Example:

u22t5101t_shf.fits: 0.879433979179 / 0.879402740159
u22t5102t_shf.fits: 0.879433979179 / 0.879402740159
u2bx0601t_shf.fits: 0.879238741597 / 0.879189504472

DATE (date this file was written (yyyy-mm-dd))

Reason: Different format, different file creation dates. OK. 81 files affected.

Example:

u21y0103t_shf.fits: 17/06/98 / 2001-06-25

DGESTAR (FGS ID(F1,F2,F3) concat. w/ dom. gd. star id)

Reason: Known trans bug that has been fixed in OTFR. OK.

Example:

u2fu0401t_shf.fits: 0138700691F1 / 0138701243F2
u30t0101t_shf.fits: 0088000340F1 / 0088000919F3
u3b3010dm_shf.fits: 0895603516F1 / 0895603428F3

ECBDX3 (eccentricity cubed times 3)

Reason: Unknown

Example:

u22t5101t_shf.fits: 3.76014271095e-09 / 4.42965004228e-09
u22t5102t_shf.fits: 3.76014271095e-09 / 4.42965004228e-09
u2bx0601t_shf.fits: 3.63563097816e-09 / 4.33776580665e-09

ECBDX4D3 (eccentricity cubed times 4/3)

Reason: Unknown

Example:

u22t5101t_shf.fits: 1.6711745382e-09 / 1.96873335212e-09
u22t5102t_shf.fits: 1.6711745382e-09 / 1.96873335212e-09
u2bx0601t_shf.fits: 1.61583599029e-09 / 1.92789591407e-09

ECCENTRY (eccentricity)

Reason: Unknown.

Example:

u22t5101t_shf.fits: 0.00107818766221 / 0.00113871765474

u22t5102t_shf.fits: 0.00107818766221 / 0.00113871765474

u2bx0601t_shf.fits: 0.00106615295145 / 0.0011307891049

ECCENTX2 (eccentricity times 2)

Reason: Unknown

Example:

u22t5101t_shf.fits: 0.00215637532442 / 0.00227743530949

u22t5102t_shf.fits: 0.00215637532442 / 0.00227743530949

u2bx0601t_shf.fits: 0.0021323059029 / 0.00226157820981

EPCHTIME (epoch time of parameters (secs since 1/1/85))

Reason: Unknown

Example:

u22t5101t_shf.fits: 286070400.0 / 286243200.0

u22t5102t_shf.fits: 286070400.0 / 286243200.0

u2bx0601t_shf.fits: 315792000.0 / 315964800.0

ESQDX5D2 (eccentricity squared times 5/2)

Reason: Unknown

Example:

u22t5101t_shf.fits: 2.90622158735e-06 / 3.24169474307e-06

u22t5102t_shf.fits: 2.90622158735e-06 / 3.24169474307e-06

u2bx0601t_shf.fits: 2.84170528972e-06 / 3.19670999942e-06

EXPNAME (9 character exposure identifier)

Reason: Upper --> lower case. 80 files affected.

Example:

u21y0103t_shf.fits: U21Y0103T / u21y0103t

FDMEANAN (1st derivative coef for mean anomaly (revs/sec))

Reason: Round-off difference

Example:

u22t5101t_shf.fits: 0.00017265760004 / 0.000172660492513

u22t5102t_shf.fits: 0.00017265760004 / 0.000172660492513

u2bx0601t_shf.fits: 0.000172698423301 / 0.000172699726641

HSTHOR (half the duration of the ST orbit (seconds))

Reason: Unknown

Example:

u22t5101t_shf.fits: 2895.90495804 / 2895.85644477
u22t5102t_shf.fits: 2895.90495804 / 2895.85644477
u2bx0601t_shf.fits: 2895.22041049 / 2895.19856067

MEANANOM (mean anomaly (radians))

Reason: Unknown

Example:

u22t5101t_shf.fits: 5.83178038745 / 4.79553389967
u22t5102t_shf.fits: 5.83178038745 / 4.79553389967
u2bx0601t_shf.fits: 4.36823089522 / 3.3751669219

MTFLAG (moving target flag; T if it is a moving target)

Reason: One file has blank value. Fixed in OTFR.

Example:

u5ed0102r_shf.fits: F / <blank>

OPUS_VER (OPUS software system version number)

Reason: Different OPUS versions used. One file affected.

Example:

u693xx01r_shf.fits: OPUS 13.0C / OPUS 13.1C

PAR_CORR (parallax correction used (T/Y or F/N))

Reason: Different flag used. 79 files affected.

Example:

u21y0103t_shf.fits: F / N

PROC_TYP (type of pipeline processing)

Reason: Unknown. 16 files affected.

Example:

u21y010at_shf.fits: REPRO / NORMAL
u2eq0201t_shf.fits: MINOR / NORMAL

PROPTTL1

Reason: OTFR has full text. 5 other files affected.

Example:

u2fu0401t_shf.fits: THE NATURE OF PRIM / THE NATURE OF PRIMEVAL
GALAXIES

PR_INV_F (first name of principal investigator)

Reason: Upper --> lower case. 57 files affected.

Example:

u21y0707t_shf.fits: JOHN / John

PR_INV_L (last name of principal investigator)

Reason: Upper --> lower case. 53 files affected.

Example:

u21y0707t_shf.fits: TRAUGER / Trauger

PR_INV_M (middle name / initial of principal investigat)

Reason: <Blank> --> lower case. 36 files affected.

Example:

u22p0106t_shf.fits: <blank> / J.

RASCASCN (right ascension of ascending node (revolutions))

Reason: Unknown

Example:

u22t5101t_shf.fits: 0.210254244344 / 0.174546487211

u22t5102t_shf.fits: 0.210254244344 / 0.174546487211

u2bx0601t_shf.fits: 0.0719911016383 / 0.0362888358627

RCARGPER (rate change of argument of perigee (revs/sec))

Reason: Unknown

Example:

u22t5101t_shf.fits: 1.8300958727e-07 / 1.80641626391e-07

u22t5102t_shf.fits: 1.8300958727e-07 / 1.80641626391e-07

u2bx0601t_shf.fits: 1.80610275131e-07 / 1.79422963799e-07

RCASCNRD (rt chge right ascension ascend node (rads/sec))

Reason: Unknown

Example:

u22t5101t_shf.fits: -1.29835689647e-06 / -1.29826129386e-06

u22t5102t_shf.fits: -1.29835689647e-06 / -1.29826129386e-06

u2bx0601t_shf.fits: -1.29805634275e-06 / -1.29776520821e-06

RCASCNRV (rt chge right ascension ascend node (revs/sec))

Reason: Probably machine-related differences.

Example:

u22t5101t_shf.fits: -2.06639917971e-07 / -2.06624702343e-07

u22t5102t_shf.fits: -2.06639917971e-07 / -2.06624702343e-07

u2bx0601t_shf.fits: -2.06592083361e-07 / -2.0654574786e-07

ROOTNAME (rootname of the observation set)

Reason: Upper to lower case, change occurs 160 times

Example:

u21y0103t_shf.fits: U21Y0103T / u21y0103t

RTAMATCH (above f&i match RTA (TRUE,FALSE,NO RTA F&I AVL)

Reason: OTFR has full text, 39 files affected.

Example:

u21y0707t_shf.fits: NO RTA FI AVAILABL / NO RTA FI AVAILABLE

SDMA3SQ (3 * (SDMEANAN**2) radians/second**2)

Reason: Unknown

Example:

u22t5101t_shf.fits: 3.5306314964e-06 / 3.53074979226e-06

u22t5102t_shf.fits: 3.5306314964e-06 / 3.53074979226e-06

u2bx0601t_shf.fits: 3.53230126278e-06 / 3.53235457895e-06

SDMEANAN (2nd deriv coef for mean anomaly (revs/sec/sec))

Reason: Unknown

Example:

u22t5101t_shf.fits: 2.27088397328e-15 / 4.00606413655e-15

u22t5102t_shf.fits: 2.27088397328e-15 / 4.00606413655e-15

u2bx0601t_shf.fits: 1.39338016026e-15 / 1.45434926275e-15

SEMILREC (semi-latus rectum (meters))

Reason: Unknown

Example:

u22t5101t_shf.fits: 6972473.66712 otfr/u22t5101t_shf.fits: 6972437.69221

u22t5102t_shf.fits: 6972473.66712 otfr/u22t5102t_shf.fits: 6972437.69221

u2bx0601t_shf.fits: 6971468.71413 otfr/u2bx0601t_shf.fits: 6971414.47952

SGESTAR (FGS ID(F1,F2,F3) concat. w/ subdom. gd. star id)

Reason: Primary and Secondary stars swapped. OTFR is correct. OK

Example:

u2fu0401t_shf.fits: 0138701243F2 / 0138700691F1

u30t0101t_shf.fits: 0088000919F3 / 0088000340F1

u3b3010dm_shf.fits: 0895603428F3 / 0895603516F1

SINEINCL (sine of inclination)

Reason: Unknown

Example:

u22t5101t_shf.fits: 0.476020877972 / 0.47607858658
u22t5102t_shf.fits: 0.476020877972 / 0.47607858658
u2bx0601t_shf.fits: 0.476381396861 / 0.476472260709

SPCLINCN (spacecraft clock at UTC0)

Reason: Unknown, but OTFR values have been verified as correct by M. Swam and S. Baggett. Most files affected

Example:

u21y0103t_shf.fits: 916637768 / 870299052.0
u22t5102t_shf.fits: 918855368 / 916637768.0
u2440101t_shf.fits: 918855368 / 916637768.0
u2bx0601t_shf.fits: 1132288332 / 1092276972.0

T51_ANGL (position angle of motion of aperture (deg))

Reason: Unknown. About 8 files affected.

Example:

u2eb0302t_shf.fits: 154.191421509 / 0.0
u38n0402m_shf.fits: 200.167694092 / 0.0
u3m00209r_shf.fits: 157.767562866 / 0.0
u46a6408m_shf.fits: 200.788345337 / 0.0

T51_RATE (rate of motion commanded (arcsecs/sec))

Reason: Unknown. About 8 files affected.

Example:

u2eb0302t_shf.fits: 0.00427347561345 / 0.0
u38n0402m_shf.fits: 0.0104374019429 / 0.0
u3m00209r_shf.fits: 0.0153778316453 / 0.0
u46a6408m_shf.fits: 0.00323300040327 / 0.0

TARDESC2

Reason: New target description keywords

Example:

u31t0803t_shf.fits: OGALAXY / PROTOGALAXY;
u3ma0201r_shf.fits: BIPOLAR OUTFLOW,WIND,JET / ULA,BIPOLAR
OUTFLOW,WIND,JET

TARDESCR

Reason: New target description keywords. 11 other files affected.

Example:

u2eb0302t_shf.fits: SOLAR SYSTEM;COMET SHOEMAKER-LEVY 1993E-5
COMET SHOEMAKER-LEVY 1993E-5

TARGDIST (distance to target from Earth's center (km))

Reason: Unknown. About 8 files affected.

Example:

u2eb0302t_shf.fits: 661486592.29 / 0.0
u38n0402m_shf.fits: 612794756.177 / 0.0
u3m00209r_shf.fits: 100353506.333 / 0.0
u46a6408m_shf.fits: 1243071475.01 / 0.0

TIMEFFEC (time parameters took effect (secs since 1/1/85))

Reason: Unknown

Example:

u22t5101t_shf.fits: 286075507.0 / 286243280.0
u22t5102t_shf.fits: 286075507.0 / 286243280.0
u2bx0601t_shf.fits: 315796031.0 / 315989228.0

TRK_TYPE (track 48 or track 51 commanding used)

Reason: Different flag used. 79 files affected.

Example:

u21y0103t_shf.fits: NO / F

UAFMPWR (AFM Electronics Power (ON,OFF))

Reason: Upper to lower case

Example:

u21y0103t_shf.fits: ON / On

UAFMRIUT (AFM RIU temperature (deg C))

Reason: Unknown, about 79 files affected.

Example:

u21y0103t_shf.fits: 16.4269104004 / 16.4275
u23t0201t_shf.fits: 153 / 16.4275
u2mm0f09t_shf.fits: 154 / 16.0913
u41g021zr_shf.fits: 16.7593841553 / 16.7599

UATPATMP (opt bench attach pt A temperature (deg C))

Reason: Most cases are round-off differences, others unexplained. About 77 files affected.

Example:

u21y0103t_shf.fits: 12.2337265015 / 12.2337 (roundoff)
u21y0707t_shf.fits: 12.2878265381 / 12.2337 (unknown)
u21y0102t_shf.fits: 12.615776062 / 12.5633 (unknown)
u22u6501t_shf.fits: 11.9622650147 / 11.9066 (unknown)

UATPBTMP (opt bench attach pt B temperature (deg C))

Reason: Most cases are round-off differences, others unexplained About 79 files affected.

Example:

u21y0103t_shf.fits: 11.2591705322 / 11.2593
u21y0707t_shf.fits: 11.3183670044 / 11.2593
u21y0102t_shf.fits: 11.9622650147 / 11.9066
u22u6501t_shf.fits: 11.3183670044 / 11.2593

UATPCTMP (opt bench attach pt C temperature (deg C))

Reason: Most cases are round-off differences, others unexplained About 58 files affected.

Example:

u21y0707t_shf.fits: 11.9622650147 / 11.9066
u23x0102t_shf.fits: 12.2878265381 / 12.2337
u30k0106t_shf.fits: 12.615776062 / 12.5633
u4720101r_shf.fits: 12.2337265015 / 12.2337

UBAY1TMP (bay 1 A1 temperature (deg C))

Reason: Some are round-off or machine-dependent differences. Others unknown. 61 files affected

Example:

u21y010at_shf.fits: 12.8955154419 / 12.8955
u21y0707t_shf.fits: 12.2878265381 / 12.2337
u3ik010bt_shf.fits: 11.3183670044 / 11.2593
u3jg070bt_shf.fits: 11.9622650147 / 11.9066

UBAY2TMP (bay 2 A1 temperature (deg C))

Reason: Some are round-off or machine-dependent differences. Others are unknown. 68 files affected.

Example:

u21y0707t_shf.fits: 12.9464950562 / 12.8955

u2310t01p_shf.fits: 13.6156539917 / 13.5677
u29n0b03t_shf.fits: 13.2796859741 / 13.2302
u4720101r_shf.fits: 12.8955154419 / 12.8955

UBAY3TMP (bay 3 A1 temperature (deg C))

Reason: Some are round-off or machine-dependent differences. Others are unknown. 69 files affected.

Example:

u21y0103t_shf.fits: 14.5969314575 / 14.5969
u21y0707t_shf.fits: 14.6405181885 / 14.5969
u2ih0104t_shf.fits: 17.8813171387 / 17.8491
u3kg0107r_shf.fits: 14.9457702637 / 14.9458

UBAY4TMP

Reason: (bay 4 A1 temperature (deg C))

Example: Some are round-off or machine-dependent differences. Others are unknown. 73 files affected.

u21y0707t_shf.fits: 14.2960281372 / 14.251
u2su030bt_shf.fits: 20.5858306885 / 20.5609
u3jg070bt_shf.fits: 16.7722167969 / 16.7364
u460a202r_shf.fits: 14.2509460449 / 14.251

UBAY5TMP (bay 5 A1 temperature (deg C))

Reason: Some are machine-dependent differences. Others are unknown. 74 files affected.

Example:

u21y0a01t_shf.fits: 11.3183670044 / 11.2593
u29n0b01t_shf.fits: 8.51719665527 / 8.44138
u3av240ft_shf.fits: 7.22430419922 / 7.22427
u4720101r_shf.fits: 2.38539886475 / 2.38549

UCH1HJTM (camera head hot junction 1 temperature (deg C))

Reason: Unknown. 78 files affected

Example:

u21y0103t_shf.fits: -37.6710357666 / -37.6706
u22u6501t_shf.fits: -28.7550048828 / -29.1864
u3av2503r_shf.fits: -34.1103057861 / -34.1098
u4720101r_shf.fits: -37.6710357666 / -37.6706

UCHBHTMP (Opt bench CH BH temp (deg C))

Reason: Round-off differences. 45 files affected.

Example:

u21y0103t_shf.fits: 12.2774868011 / 12.2775

u21y0102t_shf.fits: 12.6333341598 / 12.6333

u28u6n01t_shf.fits: 12.4109296799 / 12.4109

u4720101r_shf.fits: 12.5443725586 / 12.5444

UCMODTMP (Cal module temp (deg C))

Reason: Unknown. 78 files affected

Example:

u21y0103t_shf.fits: 9.98974609375 / 9.98981

u22t0102t_shf.fits: 10.3686599731 / 10.3043

u2190305p_shf.fits: 10.3686599731 / 10.3043

u3i9a207r_shf.fits: 10.3042297363 / 10.3043

UFMBHTMP (Opt bench FM BH temp (deg C))

Reason: Round-off differences. 57 files affected.

Example:

u21y0103t_shf.fits: 12.3219671249 / 12.322

u21y0102t_shf.fits: 12.8112573624 / 12.8113

u2310t02p_shf.fits: 12.6778154373 / 12.6778

u3ma0201r_shf.fits: 12.4776506424 / 12.4777

UHTPIHTR (heat pipe heater on (ON, OFF))

Reason: Upper to lower case. 79 file affected.

Example:

u3m00209r_shf.fits: OFF/Off

ULVPSONF (LVPS power off (ON, OFF))

Reason: Upper to lower case. 79 file affected.

Example:

u4720101r_shf.fits: ON/On

UMECHPWR (mechanism power off (ON, OFF))

Reason: Upper to lower case. 79 file affected.

Example:

u46a6408m_shf.fits: ON/On

UMNTPTMP (SOFA/shutter mounting plate temperature (deg C))

Reason: Some are round-off differences. Others unknown. 50 files affected.

Example:

u21y0103t_shf.fits: 11.5817871094 / 11.5818
u2320404t_shf.fits: 12.2337265015 / 12.2337
u2eu0402t_shf.fits: 11.9622650147 / 11.9066
u2ih0104t_shf.fits: 11.6392440796 / 11.5818

UP1AFMX (PC 1 AFM X-position (arcsec))

Reason: Machine-dependent differences. 75 files affected

Example:

u21y0205t_shf.fits: -27.4485492706 / -27.4486092887
u22u6501t_shf.fits: -8.0473651886 / -8.04749202326
u2w90404r_shf.fits: -8.04654693603 / -8.04656446875
u4720101r_shf.fits: -8.00758838654 / -8.0076066023

UP1AFMY (PC 1 AFM Y-position (arcsec))

Reason: Machine-dependent differences. 57 files affected.

Example:

u21y0205t_shf.fits: -7.03309011459 / -7.03310524717
u2eq0201t_shf.fits: -14.4055261612 / -14.4054506156
u3ek0701m_shf.fits: -14.4631595612 / -14.4631421269
u4720101r_shf.fits: -14.4054918289 / -14.4054506156

UPOMTEMP (Pickoff mirror temp (deg C))

Reason: Round-off differences. 57 files affected.

Example:

u21y0103t_shf.fits: 14.1745214462 / 14.1745
u29n2p09t_shf.fits: 14.4381246567 / 14.4381
u2qq8001t_shf.fits: 14.5435657501 / 14.5436
u46a6408m_shf.fits: 14.7017278671 / 14.7017

UPYRMDTM (optical bench pyramid bulkhead temperature (C))

Reason: Some are round-off differences. Others unknown. 69 files affected.

Example:

u21y0503t_shf.fits: 12.2337265015 / 12.2337
u21y0707t_shf.fits: 12.2878265381 / 12.2337
u28u6n01t_shf.fits: 11.9622650147 / 11.9066

URFILTPS (SOFA partial step (counts))

Reason: Unknown. All involve rotated filters.

Example:

u2eu0402t_shf.fits: 58 / 0
u2ih0104t_shf.fits: 13568 / 0
u2l90305p_shf.fits: 13568 / 0
u2mm0f09t_shf.fits: 16128 / 0
u3i90511r_shf.fits: 13578 / 0
u3jj5103r_shf.fits: 59 / 0

URIUATMP (RIU A temperature (deg C))

Reason: Unknown. 79 files affected.

Example:

u21y0103t_shf.fits: 17.0891723633 / 17.0885
u22t5101t_shf.fits: 17.3155517578 / 17.4135
u2eb0302t_shf.fits: 16.9844818115 / 17.0885
u3m00209r_shf.fits: 16.7593841553 / 16.7599

URIUBTMP (RIU B temperature (deg C))

Reason: Unknown, some are probably machine-dependent differences. 79 files affected.

Example:

u21y0103t_shf.fits: 16.4269104004 / 16.4275
u22t5101t_shf.fits: 16.6509552002 / 16.7599
u2ih0104t_shf.fits: 16.3113555908 / 16.4275
u41g021zr_shf.fits: 17.0891723633 / 17.0885

URPLHTR (replacement heater on (ON, OFF))

Reason: Upper to lower case. 79 files affected.

Example:

u21y0103t_shf.fits: OFF / Off

UTC0 (Coordinated Universal Time (Mod Julian Date))

Reason: OTFR values have been verified to be correct by M. Swam and S. Baggett.

Example:

u21y0103t_shf.fits: 49332.125 / 49265.0840278
u29n0b03t_shf.fits: 49845.7881944 / 49786.6583333
u3av2503r_shf.fits: 50459.2861111 / 50434.4069213
u460a202r_shf.fits: 50670.5416667 / 50572.0451273

UTCO1 (bytes 5-8 of UTC0)

Reason: keyword is no longer populated, OPR filed to NULL it. 58 files affected.

Example:

u21y0503t_shf.fits: -1346666496 / 2948300800
u24z0101t_shf.fits: -1790775808 / 2504191488
u2190305p_shf.fits: -630192128 / 3664775168
u2qq8001t_shf.fits: -984321664 / 3310645632

UTECPWRS (TEC power off (ON, OFF))

Reason: Upper to lower case. 79 files affected.

Example:

u21y0103t_shf.fits: OFF / Off

UW3AFMX (WFC 3 AFM X-position (arcsec))

Reason: Round-off or machine-dependent differences. 77 files affected.

Example:

u21y0103t_shf.fits: 27.866476059 / 27.8664327294
u21y0b02t_shf.fits: 6.02752685547 / 6.02757180981
u30t0201p_shf.fits: -0.283895760775 / -0.283837631748
u4720101r_shf.fits: -0.284377455711 / -0.284442084559

UW3AFMY (WFC 3 AFM Y-position (arcsec))

Reason: Machine-dependent differences. 66 files affected.

Example:

u21y0103t_shf.fits: -32.6830406189 / -32.6829929565
u22u6501t_shf.fits: -47.197303772 / -47.1970488472
u2410509p_shf.fits: -39.6421279907 / -39.642075276
u30k0106t_shf.fits: -46.9211196899 / -46.9209545865

UW4AFMX (WFC 4 AFM X-position (arcsec))

Reason: Machine-dependent differences. 50 files affected.

Example:

u21y0205t_shf.fits: -1.27049207687 / -1.27049430907
u22u6501t_shf.fits: 5.94181156158 / 5.94179870347
u2310t02p_shf.fits: 10.2151899338 / 10.2152219076
u3i9a207r_shf.fits: 5.92988157272 / 5.92987052282

UW4AFMY (WFC 4 AFM Y-position (arcsec))

Reason: Either round-off or machine-dependent differences. 77 files affected.

Example:

u21y0103t_shf.fits: -3.15928530693 / -3.15928158294
u22t0206t_shf.fits: 8.03238677978 / 8.03232414129
u2qq8001t_shf.fits: 0.370999276638 / 0.371019943916

u3i90511r_shf.fits: 0.369868218899 / 0.369893485023

V2APERCE (V2 offset of target from aper fiducial (arcsec))

Reason: Round-off differences

Example:

u2bx0601t_shf.fits: -0.006812347 / -0.006812

u30k0106t_shf.fits: -0.2292866 / -0.229287

u38n0402m_shf.fits: 4.440892e-16 / 0.0

u3jg070bt_shf.fits: 4.440892e-16 / 0.0

V3APERCE (V3 offset of target from aper fiducial (arcsec))

Reason: Round-off differences

Example:

u22p0106t_shf.fits: -0.01626346 / -0.016263

u2su030bt_shf.fits: 0.006516152 / 0.006516