iSHELL FITS Keyword Reference

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NASA Infrared Telescope Facility

Institute for Astronomy University of Hawaii

Revision History

2017.04.06 - Added DEKKER keyword.

Revision No. Description of Revision Date 1.0 Initial release 2017-02-16

1. Introduction

iSHELL is a 1.1-5.3 μm cross-dispersed high-resolution echelle spectrograph built by the NASA Infrared Telescope Facility (IRTF) for use at the IRTF observatory on Mauna Kea. iSHELL commisioning began September 2016..

The spectrograph is known colloquially as Cartman. The guider/image is known as Kyle.

Cartman uses a 2048x2048 H2RG detector, and its FITS files normally contains 3 HDUs. The primary or 1st HDU is the image data, or sum of the sample-pedestal frames. The 2nd HDU Image XTENSION contains the sum of the pedestial readout frames The 3rd HDU image XTENSION contains the sum of the sample readout frames.

Kyle uses a 512x512 PAIDAI array, and its FITS files normally contain 1 HDU, the sample-pedestal frame.

As of February 2017, the FITS data from iSHELL will be archived at the Infrared Processing and Analysis Center (IPAC) located in Pasadena, California.

The iSHELL instrument home page is located at: http://irtfweb.ifa.hawaii.edu/~ishell/

The purpose of this document is to provide documentation for the keyword in the iSHELL FITS files. This document covers the data produced as of February 2017.

2. Keyword Reference

The keyword reference table describes the keywords in the FITS file.

Keyword	Description
BITPIX	Standard FITS keyword. iSHELL saves data using either a 16 or 32 bit data format, depending on the range of the pixel values.
SIMPLE	Standard FITS keyword. Alway set to T
NAXIS	Stamdard FITS keyword. Aways 2 for iSHELL.
NAXIS1	Standard FITS keyword, related to data geometry.
NAXIS2	Standard FITS keyword, related to data geometry.
EXTEND	Standard FITS keyword indicating possible extensions within the FITS file.
DATAMIN	Standard FITS keyword.

DATAMAX	Standard FITS keyword.
DATAMEAN	The Data value in the Primary HDU.
DIVISOR	iSHELL data can be a sum of multiple readout (coadd, NDR). The divisor keyword is the nuber of coadd addtions. Data can be divided by DIVISOR to get the average for 1 readout.
ORIGIN	Standard FITS keyword. Normally set to “Institute for Astronomy”
TELESCOP	Standard FITS keyword. Normally set to “NASA IRTF”
INSTRUME	Standard FITS keyword. Normally set to'iSHELL Spectrograph' for Cartman, and 'iSHELL Imager' for Kyle.
INST_ID	A 3 char code to identify the insturmment. Set to 'icm' for Cartman, and 'ike' for Kyle
PROG_ID	IRTF Program ID. Each IRTF observing program is assigned a program ID for identification. The program ID format is YYYYSNNN. ● YYYY – The year. ● S – Semester in the year. Value is 'A' or 'B' ● NNN – A program number, ie: 001, 002, etc
OBS_UTC	UTC date when observer logs into the instrument. The purpose of this keyword is to timestamp the observing session (at log in) in case the session crosses into a new UTC date. This log in day is used when generating directory paths, and filename during saves. Added on 2017-01-24.
OBSERVER	Standard FITS keyword. Observers can enter this value via the iSHELL GUI.
OBJECT	Standard FITS keyword. Observers can enter this value via the iSHELL GUI.
COMMENT	Standard FITS keyword. The 1st comment field in the iSHELL header contains data the observers can enter via the iSHELL GUI.
IRAFNAME	The keyword/value to support the use of IRAF. Usually set to the saved filename.
BEAM	The Telecsope Beam is an IRTF telescop offset position. The values for BEAM can be: A – indicated imaging the observed object. B – indicated imaging the offset, or sky position.
DATE_OBS	The date of observation. Format is YYY-MM-DD in UTC

TIME_OBS	The time of observation. Format is HH:MM:SS.SSSSSS in UTC
MJD_OBS	DATE_OBS+TIME_OBS as a Modified Julian Date.
DATE_PC	The date of observation as timestamped from the PC. Format is YYY-MM-DD in UTC
TIME_PC	The time of observation as timestamped from the PC. The PC time is read when the readout command is issued to the array controller. Format is YYY-MM-DD in UTC
CAMMODE	iSHELL Camera Mode. Values are: ● 0: Basic – Cartman and Kyle both support the basic camera mode, or simple image acquisition. ● 1: Guiding – Kyle has an addition guide mode where image can be used to guide the telescope. ● 2: Movie – Cartman and Kyle movie mode (not currently operational).
ITIME	Amount of time photons were collected for final image product.
CO_ADDS	Number of co-additions for array readout.
CYCLES	Number of Cycles that make of a GO (command to start an observation sequence).
DATATYPE	Indicated the type of object being observed. Values can be: ● target – a science target ● standard – a standard object ● calibration – a calibration frame (dark, lamps, etc)l The observation specifies the DATATYPE value from the iSHELL GUI.
DTYPE_ID	Datatype ID is a counter which auto-increments when a 'datatype' command is issued. It is used to group a set of FITS by datatype as a set of FITS files with a common ID value after a datatype command is issued.
ARCHMODE	iSHELL arcive mode setting. Values can be: ● Off – archive mode is off. Some restriections, like where to save the file, are disabled. ● On – archive mode ON.
ARRAY	The values are the x,y,wid,hgt of the readout area of the array
BEAMPAT	Beam switch pattern. Values are: ● 0 = A. The telescope is assumed to be in the A beam position. ● 1 = B.The telescope was assumed to be in the B beam position. ● 2 = AB. In this mode, the iSHELL software set the beam postion of the telescopee, and take a image a each beam position.
RO_MODE	The IARC controller readout mode. Acceptable values are: ● 0 = Single

	• 1 = Double
NDR	Number of non-destructive readout per coadd
TABLE_SE	Time in seconds to readout the array one time.
ELAPTIME	The realtime duration of observation in seconds.
QTH_LAMP	State of the Quartz lamp. Values: • Off • On
IR_LAMP	State of the IR Lamp (Infrared Source). Values: • Off • On
ARG_LAMP	State of the Argon Lamp. Values: • Off • On
WINCOV	Postion of the Window Cover. Values are: • In – Window cover is in, light is blocked. • Out – Window cover is out, light is passing through the window..
CALMIR	Postion of the Calibration Mirror. Values are: • In – Mirror is in. The mirror directs the light path to the calibration lamp, block the sky view. • Out – The mirror is out, as in 'out of the beam'.
ARLMPSTG	Postion of the Argon Lamp Stage. Values are: • In – Stage is in. ThAr lamp is in the light path. • Out – Stage is out, ThAr lamp is not in the light path.
GASCELL	Postion of the Gas Cell. Values are: • In – Gas cell stage is in. Gas cell is in the light path. • Out – Gas cell stage is out, gas cell is not in the light path.
XDROT	Cross disperser position. Values are: Lp, M1, M2, Blank, J, H, K, L
XDTILT	Cross disperser tilt position. Values are: J1, J2, J3, H1, H2, H3, K1, K2, Kgas, K3, L1, L2, L3, Lp1, Lp2, Lp3, Lp4, M1, M2, Darks, Custom.
XDTILTST	Cross disperser tilt step position.

OSF	OSF wheel position. Values are: Blank, Jo, Ho, Ko, Lo, Mo
ROTATOR	The image rotator's mechanical angle in degrees.
POSANGLE	The sky position angle provide by the rotator. In degrees.
SLIT	Position of the slit wheel. Value are: 4.00, Mirror, 0.375, 0.75, 1.5
DEKKER	Position of the dekker. The dekker sets the length of the slit. Values are: 5, 15, 25
GFLT	Position of the Guider Filter: Values are: K, Jo, PV, 1.58um1%, nbM, 3.46um, Lprime, Kcont..
AFOC	The spectrograph array focus position in steps.
PLATE_SC	The array platescale in arcseconds/pixel.
TC335A	Cartman's array temperature controller data: Control Temp K, Sample Temp K, Set Point in K, Heater power setting, Heater power in percent.
TC335B	Kyle's array temperature controller data: Control Temp K, Sample Temp K, Set Point in K, Heater power setting, Heater power in percent.
TC218	Sampled temperatures from the lakeshore 218 8-channel temperature monitor unit.
CAMERA	The camera setting. Values are: iarc – IRTF ARC is the array controller for iSHELL's H2RG and Aladdin array. sim – simulation data (only used for software testing).
VOFFSET	IARC VOFFSET in counts.
VDD	IARC VDD in millivolts
VDDA	IARC VDDA in millivolts
VBG	IARC VBG in millivolts
VBP	IARC VBP in millivolts
VDSUB	IARC VDBUS in millivolts
VRST	IARC VRST in millivolts\
IA_GAIN	IARC n_gain_flag, 0=LOW 1=HIGH

IA_ROM	IARC ReadOut Mode: 0=SINGLE. 1=DOUBLE. 2=RAMP
IA_INDR	IARC itime_ndrs
IA_NDR	IARC n_ndr_count
IA_COADD	IARC n_coadd_count
IA_PX_TM	IARC n_pixel_time.
TCSSYS	TCS System Parameter. Values are: • off – communcations to TCS is disabled. • sim – commuciation to TCS is simulated. • tcs3 – communication to TCS3 is enabled.
TCS_OK	Indicates if the TCS query was successful. Values are: 0 = TCS communication error. No TCS data avaailable. 1 = TCS communication sucessful. If the TCS_OK communications was successful, the followng TCS_ keywords from the query will be included in the FITS header.
TCS_UTC	TCS time as a MJD. Timestamps the tcs query.
TCS_RA	TCS RA position in FK5 J2000.0
TCS_DEC	TCS DEC position in FK5 J2000.0
TCS_HA	TCS Observed Hour Angle
TCS_AZ	TCS Observed Aziumth, degrees
TCS_EL	TCS Elevation , degrees
TCS_NSRA	TCS non-sidereal rate RA, as/s
TCS_NSDE	TCS non-sidereal rate Dec, as/s
TCS_PA	TCS Parallactic Angle, degrees
TCS_AM	TCS Airmass
TCS_SM	TCS Servo_mode provide the servo motor mode for the TCS HA and Dec axis stop – motor are stopped. Brakes are ON MP – Move Position (Engineerimg Move to Position mode) MV – Move Velocity (Engineering Move to Volecity mode). track – Tracking a RA, DEC sky position (normal observing mode servo mode). slew – Slew

	to new RA, DEC sky position (High speed move to a new observing position).
TCS_OBJ	Object Name as provide to the TCS.
TCS_MAG	Object Magnitude, as provided to the TCS.
TCS_SEC	TCS seconadary mirror support hardware. chopper – The IRTF Chopping secondary. hexapod – The IRTF Hexapod
TCS_FOC	The TCS focus postion.The secondary, and chopper have different focus units.
TCS_AIRT	TCS outside air temp, DegC
TCS_HUM	TCS humidity, 0-100
TCS_WMSP	TCS mean wind speed, mph
TCS_WDIR	TCS wind direction, deg
TCS_TD6	TCS Dome TD6 temperature sensor reading (air temperature in the dome), degC
TCS_BP	TCS Barometric Presssure BP1 sersor value, mbar
DIMM	A seeing measurement from the Maunakea Differential Image Motion Monitor (DIMM) instrument. This Multi-Aperture Scintillation Sensor, determines how much each altitude in the air contributes to the overall atmospheric turbulence **Not present if no data is available.**
MASS	A seeing measurement from the Maunakea MASS instrument. This Differential Image Motion Monitor, determines how much atmospheric turbulence there is overall. **Not present if no data is available.**
TAU225	An optical depth measurement using the TAU 225GHz sensor on Maunakea Not present if no data is available.
LS_VALID	The LS_ data provide informtion on the LAST SLEW performed by the TCS. This LS data is the catalog postion sent to the TCS. The LS_VALID indicated if this data is valid. If value, then the remainding LS_ values are present. 0 = LS data not available 1 = LS data is available.
LS_CS	Last Slew Coordinate System. The LS_CS can be: fk5 – Coordinates in the FK5 refreence frame. fk4 – Coordinates in the FK4 refreence frame. app – Coordinaate are in geocentric apparent.
LS_EQ	Last Slew CS epoch of equinox. The field does not apply to apparent coordinates.

LS_RA	Last Slew Right Ascension
LS_DEC	Last Slew Declination
LS_PMRA	Last Slew proper motion RA, seconds/year
LS_PMDEC	Last Slew proper motion DEC, arcsecondsyear
LS_EP	Last Slew epoch for proper motion correction for FK4, FK5. For APP, the epoch timestamps the coordinates for the apparent posiotion.
LS_NSRA	Last Slew non-sidereal rate RA, arcseconds/seconds
LS_NSDEC	Last Slew non-sidereal rate Dec, arcseconds/seconds
LS_NAME	Last Slew Object Name
LS_SRC	• Last Slew Data Source • starcat – from IRTF Star Catalog appliation. Data from IRTF supported catalog. • userlist – from IRTF Star Catalog applicaton. Data from imported user's list. • t3remote – User inputted data sent to TCS from t3remote's 'Next Slew' data form. • jpl-horizon – Data sent to TCS from IRTF Htool appication. Htool queries ephemeris data from JPL Horizons.
GBOX_DIM	Indicates the x,y,wid,hgt of the Guide subarray on the detector duing the guiding CAMMODE. This keyword is present only in Kyle FITS files taken when CAMODE is 1 (guideing).
GBOX_FRM	Indicates the x,y centoid in pixel position of the object, or the FROM point for guiding. This keyword is present only in Kyle FITS files taken when CAMODE is 1 (guiding).
GBOX_TO	Indicates the x,y in pixel position to guide to, or the TO point for guiding. This keyword is present only in Kyle FITS files taken when CAMODE is 1 (guideing).
END	Standard FITS keyword.

3. Change Log to iSHELL Keywords

DATE CHANGES

2017-0M-DD - Document released up to date.

4. Sample of Cartman FITS keywords (Primary HDU)

```
SIMPLE  =                    T / DATA IS IN FITS FORMAT
BITPIX  =                   32 / 32 BITS TWOS COMPLEMENT INTEGERS
NAXIS   =                    2 / NUMBER OF AXIS
NAXIS1  =                 2048 / PIXELS ON 1st MOST VARYING AXIS
NAXIS2  =                 2048 / PIXELS ON 2nd MOST VARYING AXIS
EXTEND  =                    T / There may be standard extensions
DATAMIN =             -43285.0 / MIN DATA VALUE IN FILE
DATAMAX =             692410.0 / MAX DATA VALUE IN FILE
DATAMEAN=                 0.00 / MEAN DATA VALUE IN FILE
DIVISOR =                   32 / Normalization value
ORIGIN  = 'Institute for Astronomy'
TELESCOP= 'NASA IRTF'
INSTRUME= 'iSHELL Spectrograph'
INST_ID = 'icm'
PROG_ID =           '2017A901' / IRTF Program ID YYYSNNN
OBS_UTC =         '2017-03-16' / UTC Date when observer logged in to inst
OBSERVER= 'your name'
OBJECT  = 'dark'
COMMENT = 'FITS comment'
IRAFNAME= 'icm.2017A901.170316.dark_59.77.00032.a.fits'
BEAM    =                  'A' / Object(A) or sky(B)
COMMENT = Using PC time for DATE, TIME_OBS
COMMENT = iarc timestamp is 1970-01-01 00:00:00.000000
DATE_OBS=         '2017-03-16' / DATE OF OBS IN UTC
TIME_OBS=    '22:03:21.316877' / TIME OF OBS IN UTC
MJD_OBS =     57828.9189967229 / MJD from DATE_OBS+TIME_OBS
DATE_PC =         '2017-03-16' / Date when PC started GO in UTC
TIME_PC =    '22:03:21.316877' / Time when PC started GO in UTC
CAMMODE =                    0 / CameraMode is Basic
ITIME   =              59.3089 / Integration time in seconds
CO_ADDS =                    1 / Integration co-added
CYCLES  =                   10 / Number of cycles
DATATYPE=        'calibration' / Datatype description
DTYPE_ID=                    6 / Data type counter
ARCHMODE=                 'On' / ArchiveMode value
ARRAY   =      '0,0,2048,2048' / x,y,wid,hgt of data sub-arrays
BEAMPAT =                    0 / Beam Pattern
RO_MODE =                    1 / ReadOut Mode is DOUBLE
NDR     =                   32 / Number of Non-Destructive Reads
TABLE_SE=             0.463351 / sec to clock out array
ELAPTIME=            74.599459 / realtime exposure time seconds
QTH_LAMP=                'Off' / Quart 0.8-2.5 10W lamp
IR_LAMP =                'Off' / IR 1.9-5.5 lamp
ARG_LAMP=                'Off' / THAR Thorium-Argon Arc lamp
WINCOV  =                 'In' / menu=1,dpos=0
```

```
CALMIR  =                'Out' / menu=0,dpos=0
ARLMPSTG=                'Out' / menu=0,dpos=0
GASCELL =                'Out' / menu=0,dpos=0
XDROT   =                 'Lp' / menu=0,dpos=0
XDTILT  =                'Lp1' / menu=13,dpos=0
XDTILTST=             -6100000 / XDTILT steps
OSF     =              'BLANK' / menu=0,dpos=0
ROTATOR =               296.50 / Rotator_Mechanical_Angle; dpos=0
POSANGLE=               296.50 / Sky_Position_Angle
SLIT    =             'Mirror' / menu=1,dpos=0
DEKKER  =                 '15' / menu=1,dpos=0
GFLT    =                  'K' / menu=0,dpos=0
AFOC    =              -300000 / dpos=-300000,volts= 0.00
PLATE_SC=                0.125 / PlateScale arcsec/pixel
TC335A  = '37.00,80.00,37.00,Med,64.60%' / Cartman ctempK,stempK,SetPt,Heater
TC335B  = '30.00,74.65,30.00,Med,63.30%' / Kyle ctempK,stempK,SetPt,Heater
TC218   = ' 38.6  73.9  74.9  74.2  16.6 104.3  73.5  75.0'
CAMERA  =               'iarc' / Camera: iarc, sim
VOFFSET =              4476750 / IARC preamp offset in counts
VDD     =                 3300 / IARC VDD in millivolts
VDDA    =                 3100 / IARC VDDA in millivolts
VBG     =                 2380 / IARC VBG in millivolts
VBP     =                 3300 / IARC VBP in millivolts
VDSUB   =                  450 / IARC VDBUS in millivolts
VRST    =                   50 / IARC VRST in millivolts
IA_GAIN =                    1 / IARC n_gain_flag, 0=LOW 1=HIGH
IA_ROM  =                    1 / IARC ReadOut Mode 1 = DOUBLE.
IA_INDR =                   96 / IARC itime_ndrs
IA_NDR  =                   32 / IARC n_ndr_count
IA_COADD=                    1 / IARC n_coadd_count
IA_PX_TM=                    3 / IARC n_pixel_time 3 is 3 us/px.
TCSSYS  =               'tcs3' / TCS System Parameter
TCS_OK  =                    1 / 0=TCS_comm_ERR; 1=TCS_comm_OK
TCS_UTC =     57828.9189965282 / TCS UTC MJD. UTC=2017-03-16 22:03:21.300
TCS_RA  =       ' 23:19:22.96' / TCS Right Ascension, FK5 J2000
TCS_DEC =        ' 19:40:16.4' / TCS Declination FK5 J2000
TCS_HA  =       '-00:00:02.06' / TCS Observed Hour Angle
TCS_AZ  =              172.76 / TCS Observed Azimuth, degrees
TCS_EL  =               89.94 / TCS Observed Elevation, degrees
TCS_NSRA=              0.0000 / TCS non-sidereal rate RA, as/s
TCS_NSDE=              0.0000 / TCS non-sidereal rate Dec, as/s
TCS_PA  =               -7.17 / TCS Parallactic Angle, degrees
TCS_AM  =               1.000 / TCS Airmass
TCS_SM  =              'stop' / TCS Servo_mode
TCS_OBJ =           'no_name' / object name
TCS_MAG =                -2.4 / TCS object magnitude
TCS_SEC =                   1 / TCS secondary:0=chopper;1=hexapod
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```
TCS_FOC =               -0.219 / TCS actual focus
TCS_AIRT=                  5.6 / TCS outside air temp, DegC
TCS_HUM =                 52.4 / TCS humidity, 0-100
TCS_WMSP=                  4.8 / TCS mean wind speed, mph
TCS_WDIR=                311.0 / TCS wind direction, deg
TCS_TD6 =                  8.5 / TCS Dome TD6, degC
TCS_BP  =                620.7 / TCS Barometric Presssure BP1, mbar
TAU225  =                0.123 / TAU 225GHz Measurement
LS_VALID= 1 / 1=Valid Last Slew data; 0=No data
LS_CS = 'fk5' / Last Slew Coordinate System
LS_EQ = 2000.0 / Last Slew CS epoch of equinox
LS_RA = ' 01:14:00.39' / Last Slew Right Ascension
LS_DEC = ' 36:13:53.0' / Last Slew Declination
LS_PMRA = 0.000000 / Last Slew proper motion RA, s/y
LS_PMDEC= 0.000000 / Last Slew proper motion DEC, as/y
LS_EP = 2000.00 / Last Slew epoch for proper motion correction
LS_NSRA = 0.034480 / Last Slew nonsidereal rate RA, as/s
LS_NSDEC= 0.027290 / Last Slew nonsidereal rate Dec, as/s
LS_NAME = '154244 (2002 KL6)' / Last Slew Object Name
LS_SRC = 'jplhorizon' / Last Slew Data Source
END
```

5. Sample of Kyle FITS Keywords

```
SIMPLE  =                    T / DATA IS IN FITS FORMAT
BITPIX  =                   16 / 16 BITS TWOS COMPLEMENT INTEGERS
NAXIS   =                    2 / NUMBER OF AXIS
NAXIS1  =                  512 / PIXELS ON 1st MOST VARYING AXIS
NAXIS2  =                  512 / PIXELS ON 2nd MOST VARYING AXIS
DATAMIN =               -159.0 / MIN DATA VALUE IN FILE
DATAMAX =               3988.0 / MAX DATA VALUE IN FILE
DATAMEAN=              2194.23 / MEAN DATA VALUE IN FILE
DIVISOR =                    1 / Normalization value
ORIGIN  = 'Institute for Astronomy'
TELESCOP= 'NASA IRTF'
INSTRUME= 'iSHELL Imager'
INST_ID = 'ike'
PROG_ID =           '2017A999' / IRTF Program ID YYYSNNN
OBSERVER= 'your name'
OBJECT  = 'object name'
COMMENT = 'FITS comment'
IRAFNAME= 'ike.2017A999.170316.fname.00001.a.fits'
BEAM    =                  'A' / Object(A) or sky(B)
COMMENT = Using PC time for DATE, TIME_OBS
COMMENT = iarc timestamp is 1970-01-01 00:00:00.000000
DATE_OBS=         '2017-03-17' / DATE OF OBS IN UTC
TIME_OBS=    '00:09:28.859224' / TIME OF OBS IN UTC
MJD_OBS =     57829.0065840189 / MJD from DATE_OBS+TIME_OBS
DATE_PC =         '2017-03-17' / Date when PC started GO in UTC
TIME_PC =    '00:09:28.859224' / Time when PC started GO in UTC
CAMMODE =                    0 / CameraMode is Basic
ITIME   =               0.2410 / Integration time in seconds
CO_ADDS =                    1 / Integration co-added
CYCLES  =                    1 / Number of cycles
DATATYPE=             'target' / Datatype description
DTYPE_ID=                    1 / Data type counter
ARCHMODE=                 'On' / ArchiveMode value
ARRAY   =        '0,0,512,512' / x,y,wid,hgt of data sub-arrays
BEAMPAT =                    0 / Beam Pattern
RO_MODE =                    1 / ReadOut Mode is DOUBLE
NDR     =                    1 / Number of Non-Destructive Reads
TABLE_SE=             0.241000 / sec to clock out array
ELAPTIME=             0.482500 / realtime exposure time seconds
QTH_LAMP=                'Off' / Quart 0.8-2.5 10W lamp
IR_LAMP =                'Off' / IR 1.9-5.5 lamp
ARGLAMP =                'Off' / THAR Thorium-Argon Arc lamp
WINCOV  =                 'In' / menu=1,dpos=0
CALMIR  =                'Out' / menu=0,dpos=0
ARLMPSTG=                'Out' / menu=0,dpos=0
```

```
GASCELL =                'Out' / menu=0,dpos=0
XDROT   =                 'Lp' / menu=0,dpos=0
XDTILT  =                'Lp1' / menu=13,dpos=0
XDTILTST=             -6100000 / XDTILT steps
OSF     =              'BLANK' / menu=0,dpos=0
ROTATOR =               206.50 / Rotator_Mechanical_Angle; dpos=0
POSANGLE=               386.50 / Sky_Position_Angle
SLIT    =             'Mirror' / menu=1,dpos=0
DEKKER  =                 '15' / menu=1,dpos=0
GFLT    =                  'K' / menu=0,dpos=0
AFOC    =              -300000 / dpos=-300000,volts= 0.00
PLATE_SC=                 0.10 / PlateScale arcsec/pixel
TC335A  = '37.02,80.00,37.00,Med,63.50%' / Cartman ctempK,stempK,SetPt,Heater
TC335B  = '30.03,74.63,30.00,Med,60.90%' / Guider ctempK,stempK,SetPt,Heater
TC218   = ' 38.4  73.9  74.9  74.2  17.6 104.9  73.5  75.1'
CAMERA  =               'iarc' / Camera: iarc, sim
VOFFSET =                   0 / IARC preamp offset in counts
VDD     =                   0 / IARC VDD in millivolts
VDDA    =                   0 / IARC VDDA in millivolts
VBG     =                   0 / IARC VBG in millivolts
VBP     =                   0 / IARC VBP in millivolts
VDSUB   =                   0 / IARC VDBUS in millivolts
VRST    =                   0 / IARC VRST in millivolts
IA_GAIN =                   1 / IARC n_gain_flag, 0=LOW 1=HIGH
IA_ROM  =                   1 / IARC ReadOut Mode 1 = DOUBLE.
IA_INDR =                   0 / IARC itime_ndrs
IA_NDR  =                   1 / IARC n_ndr_count
IA_COADD=                   1 / IARC n_coadd_count
IA_PX_TM=                   3 / IARC n_pixel_time 3 is 3 us/px.
TCSSYS  =               'tcs3' / TCS System Parameter
TCS_OK  =                   1 / 0=TCS_comm_ERR; 1=TCS_comm_OK
TCS_UTC =     57829.0065839123 / TCS UTC MJD. UTC=2017-03-17 00:09:28.850
TCS_RA  =       ' 01:25:46.68' / TCS Right Ascension, FK5 J2000
TCS_DEC =        ' 19:40:36.2' / TCS Declination FK5 J2000
TCS_HA  =       '-00:00:02.06' / TCS Observed Hour Angle
TCS_AZ  =              172.74 / TCS Observed Azimuth, degrees
TCS_EL  =               89.94 / TCS Observed Elevation, degrees
TCS_NSRA=              0.0000 / TCS non-sidereal rate RA, as/s
TCS_NSDE=              0.0000 / TCS non-sidereal rate Dec, as/s
TCS_PA  =               -7.18 / TCS Parallactic Angle, degrees
TCS_AM  =               1.000 / TCS Airmass
TCS_OBJ =           'no_name' / object name
TCS_MAG =                -2.4 / TCS object magnitude
TCS_SEC =                   1 / TCS secondary:0=chopper;1=hexapod
TCS_FOC =              -0.219 / TCS actual focus
TCS_AIRT=                 5.8 / TCS outside air temp, DegC
TCS_HUM =                71.8 / TCS humidity, 0-100
```

```
TCS_WMSP=                   8.7 / TCS mean wind speed, mph
TCS_WDIR=                 332.0 / TCS wind direction, deg
TCS_TD6 =                  10.2 / TCS Dome TD6, degC
TAU225  =                 0.110 / TAU 225GHz Measurement
LS_VALID= 1 / 1=Valid Last Slew data; 0=No data
LS_CS = 'fk5' / Last Slew Coordinate System
LS_EQ = 2000.0 / Last Slew CS epoch of equinox
LS_RA = ' 01:30:21.83' / Last Slew Right Ascension
LS_DEC = ' 08:46:51.1' / Last Slew Declination
LS_PMRA = 0.000000 / Last Slew proper motion RA, s/y
LS_PMDEC= 0.000000 / Last Slew proper motion DEC, as/y
LS_EP = 2000.00 / Last Slew epoch for proper motion correction
LS_NSRA = 0.000580 / Last Slew nonsidereal rate RA, as/s
LS_NSDEC= 0.000230 / Last Slew nonsidereal rate Dec, as/s
LS_NAME = 'Uranus (799)' / Last Slew Object Name
LS_SRC = 'jplhorizon' / Last Slew Data Source
END
```