SPRINT-A Data Format Definition Document

Version 1.0

JAXA/ISAS

The Spectroscopic Planet Observatory for Recognition of Interaction of Atmosphere (SPRINT-A) Project

Revision history

Version	Date	Details
Version 0.0	March 2, 2012	Created a rough draft based on documents pertaining to the Planet-C and SELENE data archives (SPRINT-A Kimura)
Version 1.0	January 27, 2014	Updated to the latest version (SPRINT-A Kimura)

Contents

1. Scope

This definition document defines the formats for all data products in the SPRINT-A/EXCEED (SPRINT-A) scientific data archive, which has been established at the JAXA/ISAS Center for Science-Satellite Operation and Data Archive (C-SODA). The matters stipulated in this document apply to the following items.

(1) The SPRINT-A Scientific Data Archive External Design Document, Detailed Design Document, and scientific data archive

(2) The SPRINT-A Scientific Data Pipeline Processing System External Design Document, Detailed Design Document, and pipeline processing system

(3) Other documents that deal with SPRINT-A scientific data products

2. Abbreviations

Abbreviation	English name	Notes
EUV	Extreme UltraViolet spectrometer	
FOV	Field Of View guiding camera	
PHA	Pulse Height Amplitude data	
EUV	Extreme UltraViolet spectrometer	

1. Terms and definitions

- DARTS: Data Archive and Transmission System

DARTS is a system for distributing, searching, and browsing scientific satellite data.

The DARTS data archive provides resources on a wide range of space sciences, including astronomy, solar physics, and solar-terrestrial physics. Most of the data in the system comes from Japanese scientific satellites. DARTS is operated by the Japan Aerospace Exploration Agency/Institute of Space and Astronautical Science Center for Science-Satellite Operation and Data Archive (C-SODA).

- SIRIUS

SIRIUS is a scientific satellite telemetry database that contains archives of telemetry data, orbital element data, and other data gathered by scientific satellites. SIRIUS stamps telemetry data from data distribution/storage devices with the packet creation time and provides the sorted files as merged data.

- Reformatter

The Reformatter system provides a stable server environment, complete with technical support from full-time engineers, to perform pipeline process for creating data for release via DARTS.

- EDISON: Engineering Database for ISAS Spacecraft Operation Needs

EDISON is a database for satellite operation engineering.

EDISON provides the relevant users with engineering data for operating scientific satellites (telemetry data and data from base equipment, etc.) in an accessible format.

- DANS: Data Analysis Network System

DANS provides support for hardware and software shared by different research groups at the Institute of

Space and Astronautical Science.
A higher-order processing system for scientific satellite data.
In this document, “DANS” is a general term referring to the SIRIUS, EDISON, Reformatter, DARTS, and analysis server subsystems managed and operated by the C-SODA Science Data Archive Group for the purpose of processing satellite data.

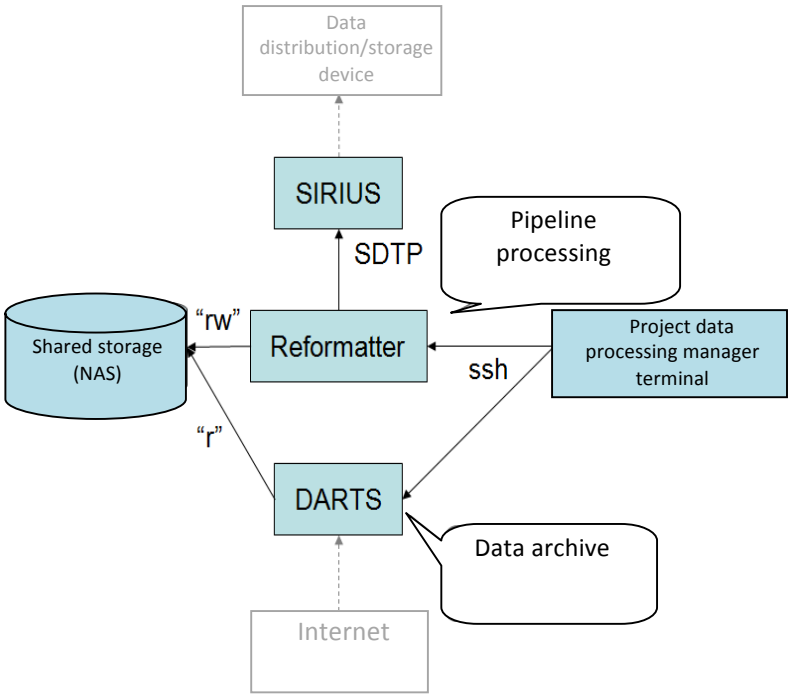


Figure 1: An overview of DANS1

- SPICE Toolkit
The SPICE Toolkit is a set of tools provided by the NASA Navigation and Ancillary Information Facility (NAIF; http://naif.jpl.nasa.gov/naif/) for use in calculating satellite/explorer orbit and ephemeris.

2. Related documents

(1) SPRINT-A Data Archive Requirements Specification
The SPRINT-A Data Archive Requirements Specification, which defines the requirements specifications for the SPRINT-A data archive, is the high-level document that governs this Definition Document.

(2) SPRINT-A Data Archive External Design Document
The SPRINT-A Data Archive External Design Document, which defines the external design of the SPRINT-A data archive, provides detailed stipulations on the pipeline processing and archiving of data products defined in this Definition Document.

(3) Yoshikawa et al., “THE EXCEED MISSION”, ADVANCES IN GEOSCIENCES (A 6-VOLUME SET) VOLUME 25: PLANETARY SCIENCE (PS) pp29-42, 2011
Refer to the literature for an overview of the SPRINT-A/EXCEED Mission.

(4) For more information on the publication and use of scientific data, see http://c-soda.isas.jaxa.jp/bibliography/KagakuData.pdf.

(5) JAXA website policy: http://www.jaxa.jp/policy_j.html

(6) Scientific Satellite Data Archive Guidelines (SED-TEC24572)
Available from C-SODA.

(7) Planetary Data System Archive Preparation Guide (PDS APG)
See http://pds.jpl.nasa.gov/documents/apg/apg_Aug_29h.pdf.

(8) Scientific Satellite Higher-Order Data Processing Guide (SED-TEC21632)
Available from C-SODA.

3. Mounted sensors for data processing/archiving

3.1 EUV (Extreme UltraViolet spectrometer)

The EUV (Extreme UltraViolet spectrometer) detects the wavelength and direction of arrival of photons in the extreme ultraviolet range. The wavelength and direction of arrival of the detected photons provide a basis for generating 2-dimensional (wavelength-space) spectral images.

3.2 FOV (Field Of View guiding camera)

The FOV (Field of View guiding camera) detects images entering the spectrometer slit as 2D images. An FOV produces 2D CCD image data that can be used to determine the center of gravity of a target body disk.

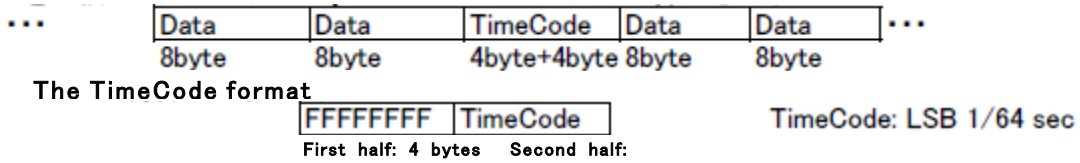
4. Product list

See SPRINT-A_product_list_160127.pdf (attached).

5. Data formats

EUV-Raw packet data

The EUV generates 8 bytes of data (2 bytes x 4 ch) per event. The MDP collects the EUV data by the second and transmits the data to the SMU in accordance with the allocated number of packets. A 4-byte TimeCode is inserted into the data when the MDP sends the TimeCode to the EUV-E. The per-packet data field size is 1009 bytes (8 bytes x 126 events + 1 byte; no ADU subdivision). The allocated number of EUV packets: (The allocated number of 9-FOV packets) The MDP reads the allocated data packets from the EUV-E in 1008-byte (126-event) increments, attaches a 1-byte mission data header, and transmits the results as telemetry data.



The MDP reads allocated data packets from the EUV-E in 1008-byte (126-event) increments, attaches a 1-byte mission data header, and transmits the results as telemetry data.

EUV-L0

EUV-L0 data is time-series data, provided in the FITS format, on the voltage values corresponding to the locations on the MCP detector where photons are detected and the corresponding detection times. The only primary data is the data header, which comprises basic information such as the presence of any extensions and the party responsible for the observations.

EUV-L0 data has 3 extensions. The “Image” extension, an image extension, stores the distribution of all the photons on the detector surface as QL data. The “HK_EUV_FULL” extension, a binary table extension, stores the EUV-HK data for the periods around the times when the photons were observed.

The “Event” extension has a header and a data portion. The header portion indicates the observation times, slits used, and other details. The data portion is a binary table with 131-byte rows. The number of rows in the table matches the number of arriving photons (n photons), and each row contains the information for an individual photon. The table indicates the time that each photon was observed (TI) and the corresponding voltage value, which indicates the photon’s location in the detector coordinate system. Each file covers 1 day of time-series photon data for 1 observation target. The maximum observation time is 12 hours per day, and the maximum photon arrival rate is 1000 Hz. Thus, the estimated maximum daily data volume for this extension is approximately 5.7 GB. Below is an overview of the data. See euv_l0_header.txt (attached) for details.

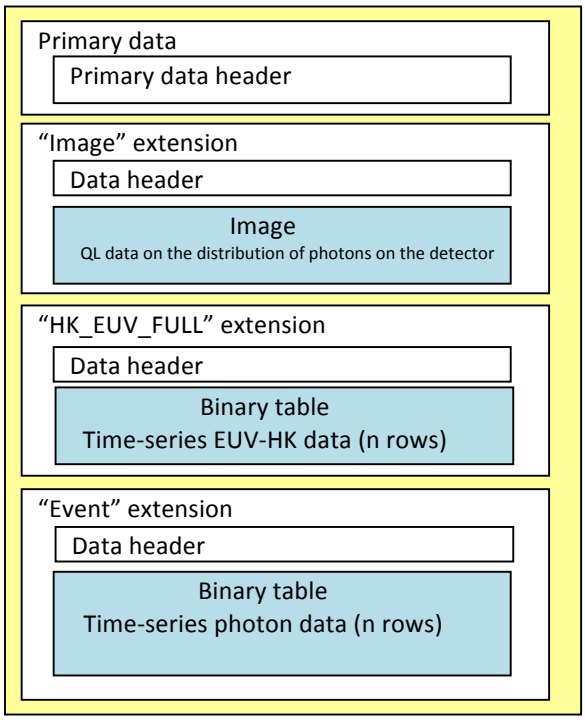


Figure 2: An overview of EUV-L0 data2

EUV-L1

EUV-L1 data is time-series data, provided in the FITS format, that represents the detection locations of photons on the detector as spatial positions in terms of wavelength and the detector coordinate system and tags the locations with detection time information. The only primary data is the data header, which comprises several basic items such as the presence of any extensions.

EUV-L1 data has 2 extensions. The "Total" extension, an image extension, stores the distribution of all the photons on the detector surface as QL data. The "Event" extension contains time-series photon data for a continuous 1-day period. The header portion contains observation times, wavelengths, slits used, and other details. The data portion is a binary table with 131-byte rows. The number of rows in the table matches the number of arriving photons (n photons). Each file covers 1 day of time-series photon data for 1 observation target. Each row contains the information for an individual photon. The table indicates the actual time that each photon was observed (TI), wavelengths, the direction in which the photon arrived, and related HK. The maximum observation time is 12 hours per day, and the maximum photon arrival rate is 1000 Hz. Thus, the estimated maximum daily data volume for this extension is approximately 4.9 GB. Below is an overview of the data. See euv_l1_header.txt (attached) for details.

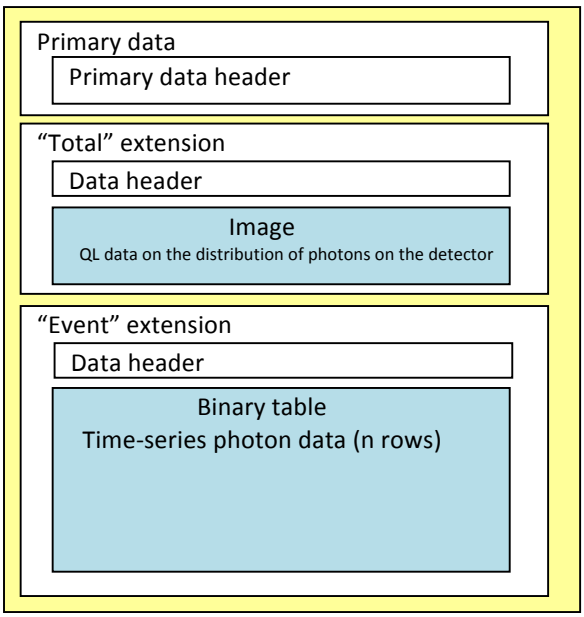


Figure 3: An overview of EUV-L1 data3

EUV-L2

EUV-L2 data is 2D (wavelength-space) spectral data obtained during a fixed (1-minute) exposure time. The data, provided in the FITS format, is QL data that accesses observation result status details as initial analysis results. The only primary data is the data header, which comprises several basic items such as the presence of any extensions. Each "YYYY-MM-DDThh:mm:ss" extension corresponds to a single spectral image obtained during the period from the time given in the extension name and the end of the fixed exposure time. The image size is 32 bit x 1024 pixels x 1024 pixels. The number of "YYYY-MM-DDThh:mm:ss" extensions in the EUV-L2 data corresponds to the times at which L0/L1 time-series photon data was acquired. Each data file comprises the set of image data for 1 day of observations, and each item of image data in each extension is 4.2 MB in size. The value of each pixel represents the number of photons gathered over the fixed exposure time. 1 day (12 hours) of observations produces approximately 3 GB of data. Absolute intensity distribution (Reyleigh/Angstrom) is calculated by multiplying the coefficient in the EUV-CAL-L1L2 data by the count value for each pixel. See euv_l2_header.txt (attached) for details.

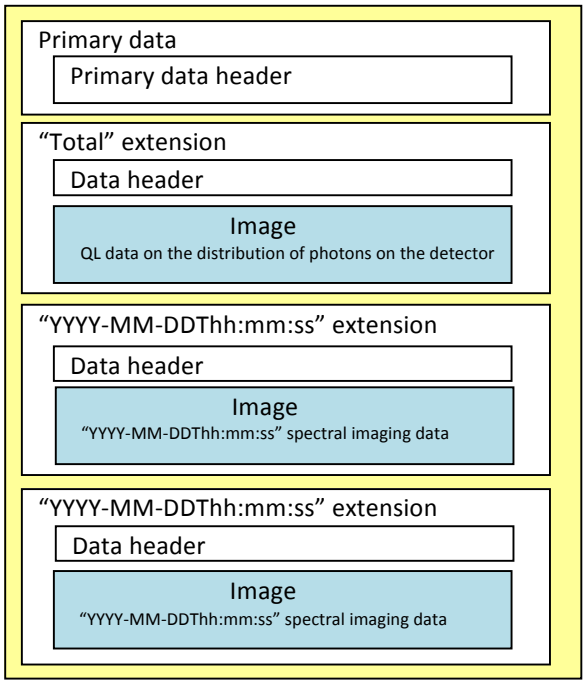


Figure 4: An overview of EUV-L2 data4

EUV-CAL-L0L1

EUV-CAL-L0L1 data stores the coefficients for converting EUV-L0 time-series data on 4ch voltage values into the corresponding locations in the space-wavelength coordinate system (angstrom, arcsec). The data is a text file containing 4 voltage conversion coefficients: a_w, b_w, a_s, and b_s.

- The formulas for converting voltage values (A, B, C, and D) into spatial/wavelength locations are as follows.

$$\lambda(arc\sec) = a_s \cdot \frac{B+C}{A+B+C+D} + b_s$$

$$x(Angstrom) = a_w \cdot \frac{A+B}{A+B+C+D} + b_w$$

EUV-CAL-L1L2

- EUV-CAL data, provided in the FITS format, contains calibration data for wavelength and absolute strength values. The only primary data is the data header, which comprises several basic items such as the presence of any extensions. The 3 items of extension data contain calibration data for 3 pieces of image data. The “X-coord” and “Y-coord” extensions are image extensions that show the photon wavelength and direction-of-arrival distributions, respectively, on the detector surface. The “Cal” extension, another image extension, indicates the distribution of coefficients for converting photon count distribution values into absolute intensity values (Rayleigh/Angstrom) on the detector surface. Each item of image data is 4.2 MB in size. The coefficients in the data are 32-bit floating points (unit: Rayleigh/Angstrom/counts). The image size is 32 bit x 1024 pixels x 1024 pixels. See euv_cal_header.txt for details.

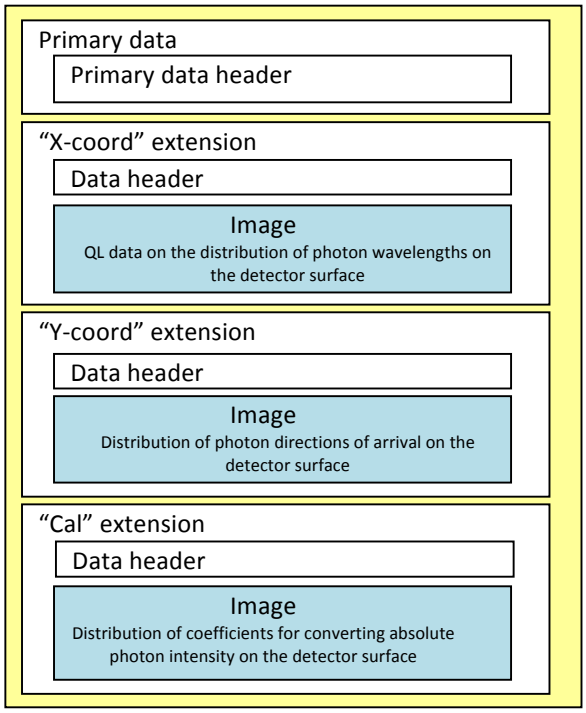


Figure 5: An overview of EUV-CAL-L1L2 data5

FOV-Raw packet data

The FOV generates 256 x 256 x 2-byte (131,072-byte) image data every 3 seconds. This data is subdivided into portions of roughly 1-kByte in size (via ADU subdivision) and then transmitted to the SMU in accordance with the allocated number of packets per second (as defined via a CMD to the MDP application). The number of images that can be transmitted varies according to the FOV’s allocated number of packets. The maximum number of images is 1 image per every 5 images captured (1 image every 15 seconds). A CMD can be issued to the MDP to change the image transmitted to the ground (ex.: raw images, processed images, or binarized images). Once the center of gravity location information, HK, and FOV image data have been added after the TLM Msg Hdr (5 bytes) and Attribute ID (2 bytes), the data is subdivided (ADU subdivision) and transmitted as telemetry data. The maximum per-packet telemetry message size is 1009 bytes (when using ADU subdivision), which means that FOV data is subdivided into 130 packets. Under this subdivision scheme, the per-packet data size is 1009 bytes for packets 1-129 and 986 bytes for packet 130.

The allocated number of FOV packets per second (0-9) is defined via commands to the MDP. For the final several packets of image data, however, the number of packets being sent per second is sometimes smaller than the allocated number of packets. In such cases, the remaining packets are used for the transmission of EUV data. If the allocated number of FOV packets is 4, for example, the rate is 4 packets per second for the first 32 seconds (seconds 1-32) but only 2 packets per second for the final second (second 33).

FOV packet count/images	130			
Allocated number of packets per second	9	4	1	0
Time required for image transfer (sec)	14.4	32.5	130	0
Time required for transfer/5 seconds	2.9	6.5	26	
	MAX			(MIN)

FOV-L0, L1

FOV data is 2D image data on a planet's disk captured by a CCD camera over a fixed (130-second) exposure time. The data is provided in the FITS format.

- FOV-L0 data: Data files organized by day
- FOV-L1 data: Data files organized by target/by day; the data contains satellite orbit data.

The only primary data is the data header, which comprises several basic items such as the presence of any extensions. Each extension includes a data header and 1 item of image data obtained over the fixed exposure time. See the 0 keyword definitions for details on the data header. Each item of image data is 32-bit integers (counts) x 256 pixels x 256 pixels. The number of images n is 1 image/130 sec x 12 h/day, or 330 images/day.

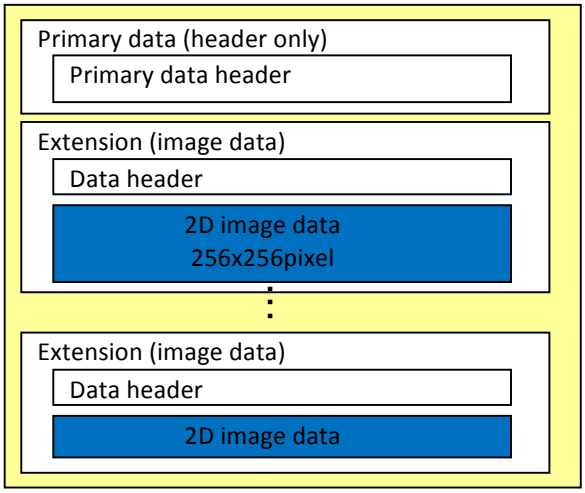


Figure 6: An overview of FOV-L0/L1 data6

SPICE Kernel

SPICE kernels are groups of ancillary data containing information on satellite orbit, attitude, detector FOV, and other conditions. SPICE data is stored in binary files and text files in the special NASA/NAIF SPICE Toolkit format. On average, kernels account for around 3 GB of data a year.

FITS header keywords

Observation overview keywords

- DATE = '2011-07-28T02:21:53' / Date of file creation (UTC)
- ORIGIN = 'ISAS/JAXA' / Data origin
- TELESCOP= 'SPRINT-A' / Telescope name
- SPCECRFT= 'SPRINT-A' / Spacecraft name
- INSTRUME= 'EUV Spectrometer' / Instrument name
- OBJECT = 'jupiter ' / Object (planet)

Observation time keywords

- DATE-OBS= '2013-11-01T00:00:00.000' / Start time of data acquisition (Start time of image data acquisition)
- DATE-END= '2013-11-01T00:00:60.000' / End time of data acquisition (End time of image data acquisition)

- TI-OBS = '0xFFFFFFFF' / SPA s/c ti clock of data acquis start (Start TI of image data acquisition)
- TI-END = '0xFFFFFFFF' / SPA s/c ti clock of data acquis end (End TI of image data acquisition)

EUV observation keywords

- OBS-MOD = 'polar ' / Obs mode of EUV (e.g., polar, torus,...) (EUV power source observation mode)
- TARGET = 'jnpole ' / Target of observation (e.g., venus, jspole) (Region at the slit center)
- SLTMOD = 'dumbbell' / Slit mode (thin=0|medium=1|dumbbell=2) (Slit type)
- EXPOSURE= 60.0 / [sec] Exposure time (Exposure time required to bin the time-series photon data into a 2D spectroscopic image)
- EU_FILT = 'blank ' / Filter of EUV (caf2|indium|blank) (EUV filter)
- EU_WMAX = 1450.0 / [A] Maximum wavelength (Maximum spectrum wavelength)
- EU_WMIN = 600.0 / [A] Minimum wavelength (Minimum spectrum wavelength)
- EU_SMAX = 200.0 / [arcsec] Maximum spatial range (Maximum spatial coordinates)
- EU_SMIN = -200.0 / [arcsec] Minimum spatial range (Minimum spatial coordinates)
- EU_HVST = -4500 / [V] EUV PS HV monitor (Voltage of the EUV HV power source)
- EU_MCPT = -100 / [degC] EUV MCP temperature (MCP temperature)
- EU_TPST = F / test pulse state (Pulse height mode status)
- SLC_RA = 7.4740555 / [hr] RA of slit center (J2000) (Right ascension of the slit center)
- SLC_DEC = 21.865000 / [hr] DEC of slit center (J2000) (Declination of the slit center)
- SLX1_RA = 7.4740555 / [hr] RA of bottom-left corner (J2000) (Right ascension of the bottom-left corner of the slit)
- SLY1_DEC= 21.865000 / [deg] DEC of bottom-left corner (J200) (Declination of the bottom-left corner of the slit)
- SLX2_RA = 7.4740555 / [hr] RA of bottom-right corner (J2000) (Right ascension of the bottom-right corner of the slit)
- SLY2_DEC= 21.865000 / [deg] DEC of bottom-right corner (J200) (Declination of the bottom-right corner of the slit)
- SLX3_RA = 7.4740555 / [hr] RA of top-left corner (J2000) (Right ascension of the top-left corner of the slit)
- SLY3_DEC= 21.865000 / [deg] DEC of top-left corner(J2000) (Declination of the top-left corner of the slit)
- SLX4_RA = 7.4740555 / [hr] RA of top-right corner (J2000) (Right ascension of the top-right corner of the slit)
- SLY4_DEC= 21.865000 / [deg] DEC of top-right corner (J2000) (Declination of the top-right corner of the slit)
- FO_BRMSX= 0.1234567 / [pixel] RMS of planet's barycent x in expos (RMS of the X coordinate of the planet's disk over the exposure time)
- SLCX = 0.1234567 / [km] x of slit center (S/C coord) (X-coordinate of the slit center in the satellite coordinate system)
- SLCY = 0.1234567 / [km] y of slit center (S/C coord) (Y-coordinate of the slit center in the satellite coordinate system)
- SLCZ = 0.1234567 / [km] z of slit center (S/C coord) (Z-coordinate of the slit center in the satellite coordinate system)
- SLX1 = 0.1234567 / [km] x of bottom-left corner (S/C coord) (X-coordinate of the bottom-left corner of the slit in the satellite coordinate system)
- SLY1 = 0.1234567 / [km] y of bottom-left corner (S/C coord) (Y-coordinate of the bottom-left corner of the slit in the satellite coordinate system)
- SLZ1 = 0.1234567 / [km] z of bottom-left corner (S/C coord) (Z-coordinate of the bottom-left corner of the slit in the satellite coordinate system)
- SLX2 = 0.1234567 / [km] x of bottom-right corner (S/C coord) (X-coordinate of the bottom-right corner of the slit in the satellite coordinate system)
- SLY2 = 0.1234567 / [km] y of bottom-right corner (S/C coord) (Y-coordinate of the bottom-right corner of the slit in the satellite coordinate system)
- SLZ2 = 0.1234567 / [km] z of bottom-right corner (S/C coord) (Z-coordinate of the bottom-right corner of the slit in the satellite coordinate system)
- SLX3 = 0.1234567 / [km] x of top-left corner (S/C coord) (X-coordinate of the top-left corner of the slit in the satellite coordinate system)
- SLY3 = 0.1234567 / [km] y of top-left corner (S/C coord) (Y-coordinate of the top-left corner of the

slit in the satellite coordinate system)

- SLZ3 = 0.1234567 / [km] z of top-left corner (S/C coord) (Z-coordinate of the top-left corner of the slit in the satellite coordinate system)
- SLX4 = 0.1234567 / [km] x of top-right corner (S/C coord) (X-coordinate of the top-right corner of the slit in the satellite coordinate system)
- SLY4 = 0.1234567 / [km] y of top-right corner (S/C coord) (Y-coordinate of the top-right corner of the slit in the satellite coordinate system)
- SLZ4 = 0.1234567 / [km] z of top-right corner (S/C coord) (Z-coordinate of the top-right corner of the slit in the satellite coordinate system)
- CAL_AW = 0.1234567 / propotion coeff used for wavelength calib (Value of coefficient a used in wavelength calibration for the L1 data)
- CAL_BW = 0.1234567 / intercept used for wavelength calib (Value of coefficient b used in wavelength calibration for the L1 data)
- CAL_AS = 0.1234567 / propotion coeff used for spatial calib (Value of coefficient a used in spatial calibration for the L1 data)
- CAL_BS = 0.1234567 / intercept used for spatial calib (Value of coefficient b used in spatial calibration for the L1 data)

FOV observation keywords

- EXPOSURE= 5.0 / [sec] Exposure time (Exposure time)
- FO_SMAX1= 120.0 / [arcsec] Maximum spatial range in x (Maximum X-coordinate value)
- FO_SMIN1= -120.0 / [arcsec] Minimum spatial range in x (Minimum X-coordinate value)
- FO_SMAX2= 120.0 / [arcsec] Maximum spatial range in y (Maximum Y-coordinate value)
- FO_SMIN2= -120.0 / [arcsec] Minimum spatial range in y (Minimum Y-coordinate value)
- FO_B1X = 128 / [pixel] Planet's barycenter1 x in exp time (X coordinate of the center of gravity of the planet's disk at the top of the slit)
- FO_B1Y = 128 / [pixel] Planet's barycenter1 y in exp time (Y coordinate of the center of gravity of the planet's disk at the top of the slit)
- FO_B1X = 128 / [pixel] Planet's barycenter1 x in exp time (X coordinate of the center of gravity of the planet's disk at the bottom of the slit)
- FO_B1Y = 128 / [pixel] Planet's barycenter1 y in exp time (Y coordinate of the center of gravity of the planet's disk at the bottom of the slit)
- FO_SLST = 0xff / slit status (Status of the slit)
- FO_BRMSY= 0.1234567 / [pixel] RMS of planet's barycent y in expos (RMS of the Y coordinate of the planet's disk over the exposure time)
- FO_BAVEX= 0.1234567 / [pixel] ave of planet's barycent x in expos (Average X coordinate of the planet's disk over the exposure time)
- FO_BAVEY= 0.1234567 / [pixel] ave of planet's barycent y in expos (Average Y coordinate of the planet's disk over the exposure time)

Satellite attitude/orbit keywords

- SLON_ESU= 1.2345678 / [deg] Sub-solar longitude of earth (Sub-solar longitude of Earth at DATE-OBS)
- SLAT_ESU= 1.2345678 / [deg] Sub-solar lattude of earth (Sub-solar latitude of Earth at DATE-OBS)
- RADI_ESU= 1.23456789d+8 / [km] Radial distance of sun from earth (Earth-sun distance at DATE-OBS)
- SLON_PSU= 1.2345678 / [deg] Sub-solar longitude of planet (Sub-solar longitude of planet at DATE-OBS)
- SLAT_PSU= 1.2345678 / [deg] Sub-solar lattude of planet (Sub-solar latitude of planet at DATE-OBS)
- RADI_PSU= 1.23456789d+8 / [km] Radial distance of sun from planet (Planet-sun distance at DATE-OBS)
- SLON_ESC= 1.2345678 / [deg] Sub-s/c longitude of earth (Sub-satellite longitude of Earth at DATE-OBS)
- SLAT_ESC= 1.2345678 / [deg] Sub-s/c lattude of earth (Sub-satellite latitude of Earth at DATE-OBS)
- RADI_ESC= 1.23456789d+8 / [km] Radial distance of s/c from earth (Earth-satellite distance at DATE-OBS)
- LT_ESC = 1.2345678 / [hr] Local time of s/c seen from earth (Satellite LT seen from Earth at DATE-OBS)
- SLON_PSC= 1.2345678 / [deg] Sub-s/c longitude of planet (Sub-satellite longitude of planet at DATE-OBS)
- SLAT_PSC= 1.2345678 / [deg] Sub-s/c lattude of planet (Sub-satellite latitude of planet at DATE-OBS)
- RADI_PSC= 1.23456789d+8 / [km] Radial distance of s/c from planet (Planet-satellite distance at DATE-OBS)

- LT_PSC = 1.2345678 / [hr] Local time of s/c seen from planet (Satellite LT seen from planet at DATE-OBS)
- APPDIA = 40.0 / [arcsec] Apparent diameter of planet (Apparent diameter of planet at DATE-OBS)
- SUNLIT = F / (T|F) True if S/C in sunlit (Sunlight status [lit/unlit] at DATE-OBS)
- X_SC_SUN= 1.23456789d+8 / [km] x position of sun from S/C (J2000) (X-coordinate of the S/C->sun vector at DATE-OBS in the J2000 coordinate system)
- Y_SC_SUN= 1.23456789d+8 / [km] y position of sun from S/C (J2000) (Y-coordinate of the S/C->sun vector at DATE-OBS in the J2000 coordinate system)
- Z_SC_SUN= 1.23456789d+8 / [km] z position of sun from S/C (J2000) (Z-coordinate of the S/C->sun vector at DATE-OBS in the J2000 coordinate system)
- X_SC_PLA= 1.23456789d+8 / [km] x position of planet from S/C (J2000) (X-coordinate of the S/C->planet vector at DATE-OBS in the J2000 coordinate system)
- Y_SC_PLA= 1.23456789d+8 / [km] y position of planet from S/C (J2000) (Y-coordinate of the S/C->planet vector at DATE-OBS in the J2000 coordinate system)
- Z_SC_PLA= 1.23456789d+8 / [km] z position of planet from S/C (J2000) (Z-coordinate of the S/C->planet vector at DATE-OBS in the J2000 coordinate system)
- X_SC_EAR= 1.23456789d+8 / [km] x position of earth from S/C (J2000) (X-coordinate of the S/C->Earth vector at DATE-OBS in the J2000 coordinate system)
- Y_SC_EAR= 1.23456789d+8 / [km] y position of earth from S/C (J2000) (Y-coordinate of the S/C->Earth vector at DATE-OBS in the J2000 coordinate system)
- Z_SC_EAR= 1.23456789d+8 / [km] z position of earth from S/C (J2000) (Z-coordinate of the S/C->Earth vector at DATE-OBS in the J2000 coordinate system)
- X_SC_SUE= 1.23456789d+8 / [km] x position of sun from S/C (J2000) (X-coordinate of the S/C->sun vector at DATE-OBS in the J2000 coordinate system)
- Y_SC_SUE= 1.23456789d+8 / [km] y position of sun from S/C (J2000) (Y-coordinate of the S/C->sun vector at DATE-OBS in the J2000 coordinate system)
- Z_SC_SUE= 1.23456789d+8 / [km] z position of sun from S/C (J2000) (Z-coordinate of the S/C->sun vector at DATE-OBS in the J2000 coordinate system)
- X_SC_PLE= 1.23456789d+8 / [km] x position of planet from S/C (J2000) (X-coordinate of the S/C->planet vector at DATE-OBS in the J2000 coordinate system)
- Y_SC_PLE= 1.23456789d+8 / [km] y position of planet from S/C (J2000) (Y-coordinate of the S/C->planet vector at DATE-OBS in the J2000 coordinate system)
- Z_SC_PLE= 1.23456789d+8 / [km] z position of planet from S/C (J2000) (Z-coordinate of the S/C->planet vector at DATE-OBS in the J2000 coordinate system)
- X_SC_EAE= 1.23456789d+8 / [km] x position of earth from S/C (J2000) (X-coordinate of the S/C->Earth vector at DATE-OBS in the J2000 coordinate system)
- Y_SC_EAE= 1.23456789d+8 / [km] y position of earth from S/C (J2000) (Y-coordinate of the S/C->Earth vector at DATE-OBS in the J2000 coordinate system)
- Z_SC_EAE= 1.23456789d+8 / [km] z position of earth from S/C (J2000) (Z-coordinate of the S/C->Earth vector at DATE-OBS in the J2000 coordinate system)