LATMOS / IPSL / CNRS

[Mars Express]-[SPICAM]

To Planetary Science Archive Interface Control Document

SA_MEX_ARCH_003

Issue 001

15 January 2012

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Change Log

Date	Sections Changed	Reasons for Change
26/09/2004	3.1.1.3 to 3.1.1.7	Need updating and rewording after the new release concept document received on 15th September
26/09/2004	3.1.4.1 Geometry filenaming convention	remove one letter to the geometry filename
26/09/2004	3.1.4.2 deleted	According to the new release concept document received on 15th September
27/09/2004	3.2.2	Updated – include description of the spacecraft clock format
28/09/2004	3.4.3.6	This section was empty
15/10/04	2.3.2	Section reworded, separate paragraphs for UV and IR
15/10/04	2.4	Sections 2.4.1, 2.4.2, 2.4.3 and 2.4.5 were empty
15/10/04	3.1.3	Data directory naming change
15/10/04	3.4.3.7 to 3.4.3.10	Reworded
27/10/04	2.4.1 to 2.4.3	Completed
27/10/04	3.4.3.10	Reworded
27/10/04	Section 5 deleted	No software
05/01/05	1.7 2.1 2.3.2.3 4.1 and sub-sections 2.4.1,3.1.1.2, 3.4.3.8	Remove Npev and pev abbreviations (no more used) Add sentence to specify that the IR channel has 2 detectors. Add more details about processing of level 0B IR data Delete sections 4.1.2 to 4.1.5 which were empty Update new section 4.1.2 which is now data product design of 0BIR data product Update this section concerning IR calibration.

21/01/05	2.3.2.2.a, 2.3.2.3b, 2.4.4, 3.4.3.10 2.4.1, 3.1.1.2, 3.4.3.8	Sections updated according to modifications made on the MEXSPI_0AUV and MEXSPI_0BIR archive volumes (documentation filename modified, and a CALIB directory added in the MEXSPI_0AUV archive volume)
17/02/05	2.4.3	Remove reference to SBN software as a solution to read the data
24/02/05	4.1.1	Update section according to updated data label file
12/04/05	4.1 2.1 3.1.1.2, 3.4.3.9 3.1.1.4 2.4.6 2.4.3	Modification of the data representation in the UV and IR label files Add more information about the UV and IR operating modes Update sections according to the new directory LABEL in the UV data set. Update release concept examples Corrections and update of the web links Restore reference to SBN software as a solution to read the data – add examples
18/11/05	1.5 3.4.4.3 Appendix 5	Add reference to the geometry and position information technical note Add information about the GEO_MARS.TAB geometry index file Update the directory listing
27/07/07	3.1 3.4.3.6 4.1.2 4.1.3	Update VOLUME_ID and VOLUME_SET_ID of the data level 0 UV and IR SPICAM archive volume Use 2 digits for sequence number in the file name Use 2 digits in the MTP name directory Add "_QL" extension in the browse and label file Update of the UV/IR geometry product content Update of the IR data product desing and content Add TARGET_TYPE keyword Add DATA_QUALITY_ID keyword Add DATA_QUALITY_DESC keyword
27/07/2009	3.4.3.7	Software Directory section developed

04/08/10	1.7 1.8 2.4.3	Add LATMOS acronyms Update contact Names and Addresses Update UV data software
15/01/12	2.3.1, 2.3.2.1, 2.4.3 3.1.1.1, 3.1.1.3.a 3.1.1 3.1.4 3.4.3.6.c figure7 3.4.3.6.c figure8	Add LATMOS acronyms Change data directory naming convention Change Data, Geometry and Browse filenames convention change geometry file header example change geometry label file example

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1 Introduction

1.1 Purpose and Scope

The purpose of this EAICD (Experimenter to (Science) Archive Interface Control Document) is two fold. First it provides users of the SPICAM instrument with detailed description of the product and a description of how it was generated, including data sources and destinations. Secondly, it is the official interface between the SPICAM instrument team and the archiving authority.

1.2 Archiving Authorities

The Planetary Data System Standard is used as archiving standard by

- NASA for U.S. planetary missions, implemented by PDS
- ESA for European planetary missions, implemented by the Research and Scientific Support Department (RSSD) of ESA

ESA implements an online science archive, the ESA's Planetary Science Archive (PSA),

- to support and ease data ingestion
- to offer additional services to the scientific user community and science operations teams as e.g.
  - search queries that allow searches across instruments, missions and scientific disciplines
  - several data delivery options as
    - direct download of data products, linked files and data sets
    - ftp download of data products, linked files and data sets

The PSA aims for online ingestion of logical archive volumes and will offer the creation of physical archive volumes on request.

1.3 Contents

This document describes the data flow of the SPICAM instrument on MARS EXPRESS from the s/c until the insertion into the PSA for ESA. It includes information on how data were processed, formatted, labeled and uniquely identified. The document discusses general naming schemes for data volumes, data sets, data and label files. Standards used to generate the product are explained. Software that may be used to access the product is explained further on.

The design of the data set structure and the data product is given. Examples of these are given in the appendix.

1.4 Intended Readership

Any potential user of the SPICAM data, and the staff of the archiving authority (Planetary Science Archive, ESA, RSSD, design team).

1.5 Applicable Documents

[1] Planetary Data System Preparation Workbook, February 17, 1995, Version 3.1, JPL, D-7669,Part1
[2] Planetary Data System Standards Reference, August 1, 2003, Version 3.6, JPL, D-7669, Part 2
[3] MARS EXPRESS Archive Generation, Validation and Transfer Plan, [ESA-MEX-TN-4009, Issue 1.0, June 2001]
[4] Planetary Science Archive. Experiment Data Release Concept. Technical proposal SOP-RSSD-TN-015
[5] Instruments to Planetary Science Archive End-to-End Test. ME-EST-PL-13128, Issue 2.1, 27 April 2004.
[6] Planetary Science Data Archive Technical Note. Geometry and Position Information. SOP-RSSD-TN-010

1.6 Relationships to Other Interfaces

Changes in the standard SPICAM data products would require changes to this document.

1.7 Acronyms and Abbreviations

DC	Dark Current
DDS	Data Disposition System
DPU	Dedicated Processor Unit
EAICD	Experimenter to (Science) Archive Interface Control Document
IASB	Institut d'Aéronomie Spatiale de Belgique
IKI	Institute Kosmitcheski Isledovanie
IR	Infra Red
LATMOS	Laboratoire Atmosphères, Milieux, Observations Spaciales
MPS	Mission Planning System
N/A	Not Applicable
PDS	Planetary Data System
PSA	Planetary Science Archive
SA	Service d'Aéronomie, CNRS
SPICAM	Spectroscopy for the Investigation of Characteristics of the Atmosphere of Mars
SIR	Spicam Sensor IR
SU	Sensor Unit
SUV	Spicam Sensor UV
TC	Telecommand
TM	Telemetry
UV	Ultra Violet

1.8 Contact Names and Addresses

Data preparation and final products delivery into the PSA are provided by the SPICAM staff at Service d'Aéronomie (SA), France (now LATMOS, GUYANCOURT, France).

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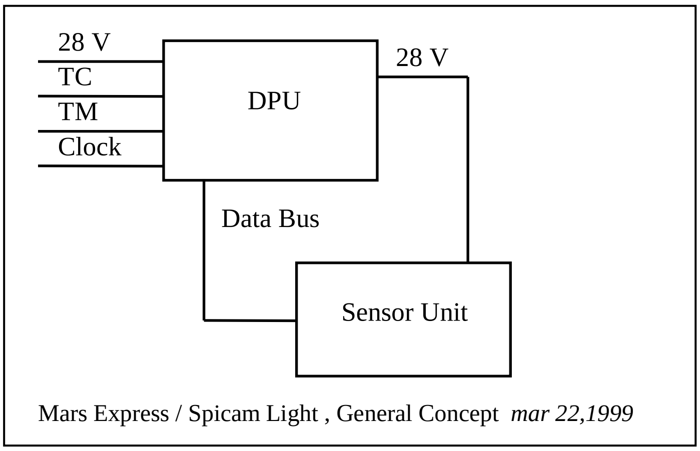
2 Overview of Instrument Design, Data Handling Process and Data Product

2.1 Instrument Design

SPICAM Light is collaboration between Service d'Aéronomie, Verrières le Buisson, France, IASB, Brussels, Belgium, and IKI, Moscow, Russia.

The SPICAM Light instrument is made of 2 boxes as depicted below. The first box called DPU (Data processing Unit) acts as the main electronic interface with the Spacecraft. The other is the sensor box or unit. This sensor unit (SU) has one channel in the ultraviolet wavelength range 118-320 nm (named SUV), and another one (named SIR) in the near infrared wavelength range 1.1-1.7 µm.



Mars Express / Spicam Light , General Concept *mar 22,1999*

See the INST.CAT catalog file in the CATALOG directory of each dataset for more details about all the technical details concerning the Spicam instrument. The mechanical and electrical characteristics are listed. The optical interfaces with spacecraft and the fields of view are explicited. The following table gives a summary of the main characteristics of the instrument.

Summary of SPICAM Light main characteristics

Spectral bands	118 - 320 nm (UV) 1.1 - 1.7 µm (IR)
Spectral sampling	UV: 0.55 nm/pix IR: 0.8 nm/pix at 1.5 µm
Mass	DPU 0.71 kg SU 4.14 kg Total 4.85 kg
Power	DPU+SU 17 W to 26 W
Volume	DPU: 1.65 x 1.14 x 0.65 dm^3 SU: 4 x 2.4 x 1.15 dm^3
Data rate	9 and 34 kbit/s (averaged over several seconds)
Data Volume	100 - 300 Mbits / day
Observations	One Board Time TC, One Spicam TC Duration: 5 to 40 mn
Pointing (orientation)	Inertial Star, Sun, Limb Nadir

2.1.1 UV detector unit

The UV detector is made of 3 parts: a CCD (Thomson 7863) camera, an intensifier (Hamamatsu) coupled to the CCD by fiber optics, and a programmable high voltage for the intensifier. The CCD is made of 288 photon sensitive rows and each row is made of 408 pixels. The rows direction is the spectral dimension.

When observing an extended source (dayside nadir viewing, or limb measurements, dayside star occultation), a slit is mechanically put into place at the focus of the parabolic mirror, which isolates a corresponding field of view. The shape of the slit, perpendicular to the dispersion plane, is composed of two parts: a wide slit (about 500 µm wide) and a narrow slit (50 µm wide). The image of the narrow slit covers CCD lines from 0 to 200, and is used for maximum spectral resolution (1 pixel covers 0.54 nm), while the wide slit is achieving a higher photometric sensitivity, at the expense of a reduced spectral resolution (factor of 10).

For each measurement, the UV detector records a window of 5 bands of the CCD (telemetry rate constraint). The bands can be elementary pixels (each band is made of one physical CCD row) or binned pixels (each band is made of binned rows (2,4,8,16 or 32 rows)). Moreover the binning can be different for each band (progressive binning). The position of the first row read is programmable.

Considering this, various operating modes can be used (Figure 1). A first mode, named alignment mode, allows a complete image of the CCD. At each measurement the position of the 5 bands read is changed.

Two other modes consist in reading the same five bands of the CCD during an observation. In the binning mode, each band is a sum of an identical number of rows, while in the third mode the binning is progressive.

For each of these three modes, the slit can be ON (modes named ALIGN_S, BINNING_S and BINNINGP_S) or OFF (modes named ALIGN, BINNING and BINNINGP).

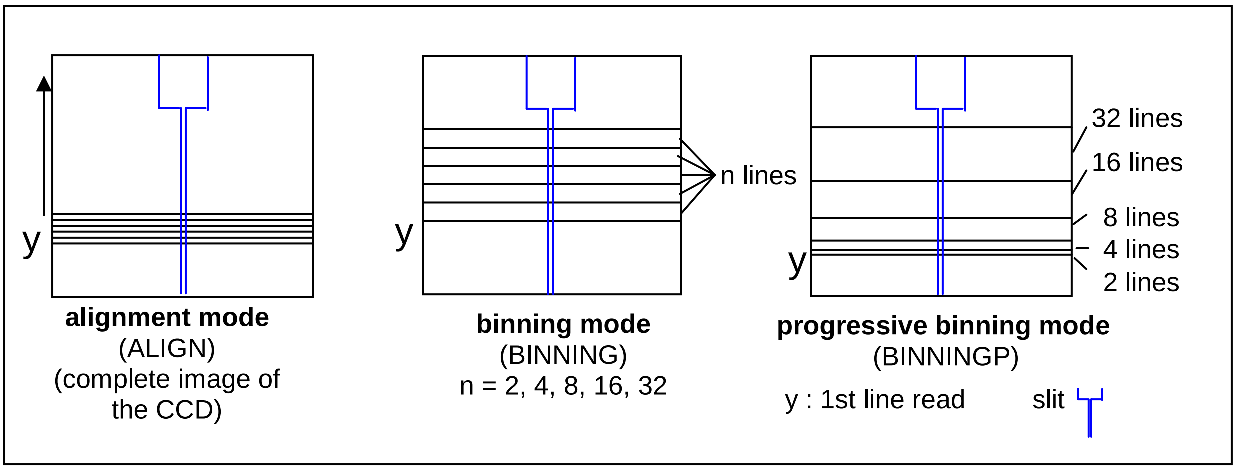


Figure 1. UV detector operating modes

2.1.2 IR channel unit

The SPICAM infrared channel is based around a scanning acousto-optical tuneable filter (AOTF), which is able to scan frequencies from 84 to 148 MHz.

Spectra acquisition can be done on one, two or three frequency windows defined via the telecommand by a start frequency, a number of points and a frequency step. Along with spectrum measurement in three frequency windows a set of spectrum dots can be obtained during measurement cycle. Each dot represents a few adjacent spectrum points and can be viewed as a small window with predefined starting frequency, points number and frequency step.

The infrared channel has two detectors with different polarization, which can be activated at the same time and for the same wavelength range.

2.2 Scientific Objectives

The suite of measurements of SPICAM Light in the various available observation modes is addressing key questions of the atmosphere of Mars, including its present state, the global climate today, and the atmospheric climatic evolution of the planet.

Chemistry: Simultaneous measurements of O_3 and H_2O will allow validating and/or modifying chemistry models, from which will be derived an assessment of the oxidation environment (effect of solar UV, O_3, H_2O_2, O, on minerals and oxidation molecules).

Structure/Dynamics/Meteorology: Vertical profiles of density / temperature (20-160 km) will provide unique information about the global structure and dynamics of the atmosphere, in particular in the altitude region crucial for aerocapture and aerobraking, and a better understanding of meteorological systems.

Clouds/dust/aerosols: Occultation measurements will allow the detection, measurement and characterization of the physical nature of aerosols, dust particles, and their vertical distribution.

Ionosphere/escape rate: Vertical profiling of daylight aeronomic emissions (H, C, O, CO, CO_2^+) will allow to adjust a comprehensive model of the ionosphere, from which an estimate of escape processes may be derived (evolution of the atmosphere), and to study the interaction with the solar wind.

In order to fulfill the previous scientific objectives, there are four configurations summarized below:

Sensor	Mode	Expected results
UV+IR	Stellar occultation	Temperature, density vertical profiles
UV+IR	Solar occultation	Temperature, density vertical profiles
UV+IR	Nadir	Total column abundances
UV+IR	Limb emissions	Vertical profiling of aeronomic emissions

The following table summarizes for the key atmospheric constituents measurable by SPICAM, the observation mode (occultation, nadir, and limb) according to the scientific objective, and the accuracy achieved after processing, in the altitude range given.

Species	Measurements			Accuracy	Altitude range
	Scientific objective	**Mode (occultation, nadir, limb)**	**Spectral range**		
O_3	Concentration vertical profile	Stellar / Solar occultation	220 –300 nm	2 – 10 %	10 – 50 km
O_3	Total abundance	Nadir	220 –300 nm	5 % (>0.15 µ–atm)	N.A.
CO_2	Atmospheric density and temperature vertical profile	Solar / Stellar occultation	180 nm	2 – 10 % 5 K	20 – 160 km
Aerosols	Vertical profile of characteristics	Solar / stellar occultation	UV	10^{-3}(=photo-metric)	5 – 60 km

O_2	Concentration vertical profile	Stellar occultation	200 nm	20 %	35 – 90 km (never done before)
H, C, O, CO_2^+,CO	Vertical profiling of aeronomic emissions	Limb emission	118– 320 nm	20 %	80 – 400 km
H_2O_2	Total abundance	Nadir	210 nm	20 %	Never done before
SO_2	Total abundance	Nadir	220 nm		Tentative
CO_2	Surface pressure	Nadir	200 nm 1.43 µm	0.2 mbar 0.05 mbar	N.A.
H_2O	Total abundance	Nadir	1.38 µm	0.2. pr. µm (detectable)	5 x 5 km ground
Aerosols	Mapping of properties	Spectro polarimetry in nadir	1.2 to 1.7 µm	10^{-3} (=photometric)	Exploratory
Soil	surface studies	Spectro polarimetry in nadir	1.2 to 1.7 µm	10^{-3} (=photometric)	5 x 5 km ground

Table 1.Derived science data products

2.3 Data Handling Process : SPICAM data processing, retrieval algorithms, and definitions of data levels

2.3.1 *SPICAM data processing, retrieval algorithms.*

The SPICAM data collected between each switch ON and switch OFF of SPICAM will be transferred to ESOC and stored at ESOC on the Data Dissemination System (DDS) in Darmstadt (Germany). It will be then transferred via ftp from the DDS to LATMOS.
All new data files and the processed data up to level 2 will be collected at LATMOS.

Retrieval algorithms and softwares which will be used throughout the processing steps from level to level are under development and should be written in IDL.

2.3.2 *Definitions of data levels*

2.3.2.1 Level 0 data

This is the SPICAM data collected by ESOC and stored on the DDS. One ESOC file contains both UV and IR data. One observation, containing all the data collected between Switch ON and switch OFF of SPICAM, which is operated in a single mode during this time, may be spread over several ESOC generated files. LATMOS does NOT intend to archive this Level 0 data, since it is the role of ESOC to do it.
Starting from level 0 data, ESA packets are disassembled and reformatted to build level 0A data files. Level 0A assembles one single file per SPICAM observation and per sensor (UV or IR). In the following, the different SPICAM data levels will be described by sensor, the data processing being different for UV and IR data, and also different for the mode of observation (star, sun, nadir, limb).

2.3.2.2 UV data

The following table summarizes the different UV data products which should be available in the SPICAM archive in the present time.

Mode \ Level	0A*	1A	1B	2
Star	**X**	**NULL**	**NULL**	**NULL**
Sun	**X**	**NULL**	**NULL**	**NULL**
Nadir	**X**	**NULL**	**NULL**	**NULL**
Limb	**X**	**NULL**	**NULL**	**NULL**

* : data files + associated browse and geometry files
X : available
NULL : under processing. Product not yet available.

The different SPICAM UV data products available are described in the following sections. The other data products will be described as soon as they will be available.

2.3.2.2.a Level 0A UV data

The processing from level 0 to level 0A includes the following features:

- the data are not modified : starting from level 0 data, ESA packets are disassembled and reformatted to build level 0A data files.
- a header is added to each record to comply to our requirement. A description of the header is given in the SPICAM_UVDATAFILE_DESC.TXT file in the DOCUMENT directory.
- a UTC time (DDS time) is added in the header. The time of observation is defined in the SPICAM_UVCALIB_DESC.TXT file in the DOCUMENT directory.

A level 0A UV data file contains then all records of a UV SPICAM observation, each record consisting of the SPICAM header followed by the data table, in binary format. Data are in ADU units (Analog to Digital Units). A description of the UV data files is given in the SPICAM_UVDATAFILE_DESC.TXT file in the DOCUMENT directory or in section 4.1.1 of this document. In summary, each UV data table consists of 5 bands selected on the CCD. Each band can be one physical row of the CCD or several physical rows by on chip binning processing (selectable by telecommand). Several operating mode were used for the observations on the Mars Express spacecraft. The different SPICAM UV operating modes are described in the SPICAM_UVMODE_DESC.TXT file in the DOCUMENT directory.

The SPICAM level 0A corresponds with the PDS CODMAC level 2 (edited data or Experimental Data Record (EDR)).

Associated to the level 0A UV data files, the SPICAM team will provide quicklook images (browse files) and geometry files. A description of the geometry files is given in the SPICAM_GEOMETRY_DESC.TXT file in the DOCUMENT directory, as well as in section 3.4.3.6.b of this document.

2.3.2.2.b Level 1A UV data

The SPICAM level 1A should correspond with the PDS CODMAC level 2.
Under processing.

2.3.2.2.c Level 1B UV data

The SPICAM level 1B should correspond with the PDS CODMAC level 3 (calibrated data).
Under processing.

2.3.2.2.d Level 2 UV data

Level 2 data will consist in derived science data products (see Table 1).
The SPICAM level 2 will correspond with the PDS CODMAC level 5 (derived data).

Under processing.

2.3.2.3 IR data

The following table summarizes the different IR data products which should be available in the SPICAM archive in the present time.

Level / Mode	0A	0B*	1A	1B	2
Star	-	**X**	**NULL**	**NULL**	**NULL**
Sun	-	**X**	**NULL**	**NULL**	**NULL**
Nadir	-	**X**	**NULL**	**NULL**	**NULL**
Limb	-	**X**	**NULL**	**NULL**	**NULL**

- : not archived
X : available
NULL : under processing. Product not yet available.
* : data files + associated browse and geometry files

The different SPICAM IR data products available are described in the following sections. The other data products will be described as soon as they will be available.

2.3.2.3.a Level 0A IR data

The processing of IR data from level 0 to level 0A is similar to the processing of UV data:
- the data are not modified : starting from level 0 data, ESA packets are disassembled and reformatted to build level 0A data files.
- a header is added to each record.
- a UTC time (DDS time) is added in the header.

An infrared measurement requires several communication sessions to collect and transmit measurement data (a spectrum) from the two IR detectors. Therefore, in level 0A IR data file, a record corresponds to one communication session (one part of a spectrum) from the two detectors. Moreover, spectrum measurement can be done on three frequency windows, characterized by 3 parameters: FREQUENCY, POINTS and STEP. Along with spectrum measurement in three frequency windows a set of spectrum dots can be obtained during measurement cycle. Each dot represents a few adjacent spectrum points and can be viewed as a small window with predefined starting frequency, points number and frequency step. Height various sets of spectrum dots are predefined, with the possibility of 'no dots' measurement configuration.
To facilitate the use of infrared raw data, the SPICAM team will provide level 0B IR data files in which spectra will be reconstructed for each detector. Level 0A IR data files will not be archived with the PSA, but only at Service d'Aéronomie.

2.3.2.3.b Level 0B IR data

A level 0B IR data file will contain all reconstructed spectra of an IR SPICAM observation collected by the two detectors of the infrared channel. All other relevant information (parameters of the command, frequency array, system monitor's values…) will be also included in the file.
A description of the IR data files will be given in the the SPICAM_IRDATAFILE_DESC.TXT file in the DOCUMENT directory or in section 4.1.2 of this document.

The SPICAM IR level 0B corresponds with the PDS CODMAC level 2 (edited data or Experimental Data Record (EDR)).

Associated to the level 0B IR data files, the SPICAM team will provide quicklook images (browse files) and geometry files. A description of the geometry files is given in the SPICAM_GEOMETRY_DESC.TXT file in the DOCUMENT directory, as well as in section 3.4.3.6.b of this document.

2.3.2.3.c Level 1A IR data

The SPICAM level 1A should correspond with the PDS CODMAC level 2.
Under processing.

2.3.2.3.d Level 1B UV data

The SPICAM level 1B should correspond with the PDS CODMAC level 3 (calibrated data).
Under processing.

2.3.2.3.e Level 2 UV data

Level 2 data will consist in derived science data products (see Table 1).
The SPICAM level 2 will correspond with the PDS CODMAC level 5 (derived data).

Under processing.

2.4 Overview of Data Products

2.4.1 Instrument Calibrations

All information about calibration is related to flight model. Information needed to calibrate the UV and IR data are given in the SPICAM_UVCALIB_DESC.TXT and SPICAM_IRCALIB_DESC.TXT files respectively, in the DOCUMENT directory. These documents explain how the in-flight calibration is done for the various mode of observation for the UV and IR sensor.

For example, for UV data it gives information on :

- the exact timing of the data,
- temperatures,
- how to evaluate the dark current for the various mode,
- the wavelength assignment for the various mode,
- photometry.

Calibration files mentioned in SPICAM_UVCALIB_DESC.TXT or SPICAM_IRCALIB_DESC.TXT files are available in the CALIB directory of the corresponding MEXSPI_0AUV, MEXSPI_0BIR archive volume.

2.4.2 In-Flight Data Products

During the active mission UV and IR data from the CRUISE and MARS NOMINAL phases will be collected. A data set will be defined for each sensor (UV or IR) and for each data product level (level 0A, 1A, 1B and 2). Therefore, the SPICAM volume set will consist of 8 data volumes containing a single data set.
At the moment, the UV 0A dataset contains the accumulation of data products, associated browse and geometry files, and documentation, needed to understand and use the observations.

2.4.3 Software

The ESA packets (level 0) are processed at LATMOS by the SPICAM team for technological verification and SPICAM level 0A data files and associated geometry files are produced:

- ESA packets are disassembled by sensor (UV, IR) and by observations (ON/OFF)
- Geometric parameters are generated with a SPICAM software using SPICE routines and SPICE kernels.

At the present time, we do not intend to archive software. All information needed to read the data file will be given in the SPICAM_UVDATAFILE_DESC.TXT or SPICAM_IRDATAFILE_DESC.TXT file in the DOCUMENT directory.

The SPICAM UV Level 0A and SPICAM IR Level 0B data can be read using the new version SBN (Small Bodies Node) software written in IDL as available for download in April 2005 from http://pdssbn.astro.umd.edu/nodehtml/software.shtml. These packages are intended primarily for end-users of PDS data. An examples directory is included with the distribution. It can be downloaded separately or as part of the complete package.

Below are examples on how to use and plot the UV and IR data with IDL after being read by the SBN software.

UV data

PRO readPDS_SPICAM_UV

```
;select a data label file *.LBL
   fn = dialog_pickfile(PATH=datapath)
   data = readpds(fn)

   ;The header_array contains detector parameters values and time of observation
   ;example to access the header_array of the first and the last record
   first_header_array = data.record_array[0].one_spicam_uv_record.header_array
   nb_records = N_ELEMENTS(data.record_array)
   last_header_array = data.record_array[nb_records-1].one_spicam_uv_record.header_array

       code_op = first_header_array[40] ;operating code (100:full CCD - 101/102:5 bands)
       binning = first_header_array[46] ;binning (number of ccd lines analogically
summed, 0 = progressive binning)
       nlig = first_header_array[45]
       ncol = first_header_array[44]

   print,'TIME_EXPOSURE',first_header_array[41] ; exposure time
   print,'CODE_OP',code_op
   print,'Y0',first_header_array[43] ;first line of CCD read
   print,'BIN',binning
   print,'FIRST TIME',first_header_array[60:66] ; UTC time of first measurement
   print,'LAST TIME',last_header_array[60:66]   ; UTC time of last measurement

   ;The data_array contains 5 CCD "bands" of 408 pixels
```

```
   ;example to access the data_array of the first record
   first_data_array = data.record_array[0].one_spicam_uv_record.data_array
   ;In the BINNING or PROGRESSIVE BINNING mode, a temporal image can be obtained
   ;for each of the five bands.
   tempoimage_band1 = data.record_array.one_spicam_uv_record.data_array[*,0]
   tempoimage_band2 = data.record_array.one_spicam_uv_record.data_array[*,1]
   tempoimage_band3 = data.record_array.one_spicam_uv_record.data_array[*,2]
   tempoimage_band4 = data.record_array.one_spicam_uv_record.data_array[*,3]
   tempoimage_band5 = data.record_array.one_spicam_uv_record.data_array[*,4]

window,1

!p.multi =[0,5,1]

contour,tempoimage_band1,/fill,nlevels=30,xrange=[0,407],xstyle=1,title='band1',color=0,x
title='pixel'

contour,tempoimage_band2,/fill,nlevels=30,xrange=[0,407],xstyle=1,title='band2',color=0,x
title='pixel'

contour,tempoimage_band3,/fill,nlevels=30,xrange=[0,407],xstyle=1,title='band3',color=0,x
title='pixel'

contour,tempoimage_band4,/fill,nlevels=30,xrange=[0,407],xstyle=1,title='band4',color=0,x
title='pixel'

contour,tempoimage_band5,/fill,nlevels=30,xrange=[0,407],xstyle=1,title='band5',color=0,x
title='pixel'


END
```

IR data

```
PRO readSBN_IR

  ;select a data label file *.LBL
  fn = dialog_pickfile()
  ; the SBN routines create a structure x containing all the data objects
  x= readpds(fn)

  ;first record (contains first spectrum recorded by the 2 detectors)
  record0 = x.record_array[0].one_spicam_ir_record
   print,"TIME", record0.year,record0.month,record0.day

  ;plot the first spectrum recorded by the 2 detectors as a function of frequency
   window,0
   plot, x.frequency_array,record0.data_array[*,0]
   oplot, x.frequency_array,record0.data_array[*,1]

   ;temporal image: a temporal image is obtained for each detector
   window,1
   image0 = x.record_array.one_spicam_ir_record.data_array[*,0]

   tvscale,image0 ;www.dfanning.com/programs/tvscale.pro
   window,2
   image1 = x.record_array.one_spicam_ir_record.data_array[*,1]
   tvscale,image1

END
```

2.4.4 Documentation

This document (EAICD) will be provided in the DOCUMENT directory in PDF format. An ASCII version of the EAICD with PNG files for drawings or tables referenced in it will be also available.

The SPICAM Flight User Manual (FUM) and other technical document which could be helpful to use data will be provided in the DOCUMENT directory in PDF or ASCII format only.

The following SPICAM documents will be present in the DOCUMENT directory of the MEXSPI_0AUV archive volume :

- SPICAM_UVDATAFILE_DESC.TXT:This document describes the contents of the UV data files which are delivered in the MEXSPI_0AUV archive volume.
- SPICAM_GEOMETRY_DESC.TXT: This document describes the contents of the geometry files which are delivered in the the MEXSPI_0AUV archive volume.
- SPICAM_UVCALIB_DESC.TXT: This document describes the calibration of the SPICAM UV data which are delivered in the MEXSPI_0AUV archive volume.
- SPICAM_UVMODE_DESC.TXT: This document describes the different operating mode of the SPICAM UV spectrometer.
- SPICAM_UVT31DOC.PDF : This document describes the calibration factors of the SPICAM UV spectrometer channel.

The following SPICAM documents will be present in the DOCUMENT directory of the MEXSPI_0BIR archive volume :

- SPICAM_IRDATAFILE_DESC.TXT:This document describes the contents of the IR data files which are delivered in the MEXSPI_0BIR archive volume.
- SPICAM_IRCALIB_DESC.TXT: This document describes the calibration of the SPICAM IR data which are delivered in the MEXSPI_0BIR archive volume.

2.4.5 Derived and other Data Products

We do not intend to provide any other derived data or data products that result from co-operation with other instrument teams.

2.4.6 Ancillary Data Usage

SPICE files produced by PST/ESTEC in collaboration with NAIF/JPL from the Mars Express orbit files generated by ESOC will be used in our data processing chain, in particular to generate geometry files. SPICE files are available from the following file servers:

At ESTEC FTP Server : ftp://solarsystem.estec.esa.nl/pub/projects/mex/data/spice/

At NAIF FTP Server: ftp://naif.jpl.nasa.gov/pub/naif/MEX

Available SPICE files are:
1. SPK spacecraft/planet/satellites/asteroids ephemeris data kernel files
2. EK event kernel – no EK available for MARS EXPRESS
3. CK C-matrix instrument attitude kernel files

4. LSK leap second kernel files
5. FK frame kernel files
6. IK instrument kernel files
7. PCK planetary constant kernel files
8. SCLK spacecraft clock kernel files

Orbit numbering files, which are derived data product from the MEX kernel data set, are also available at ESTEC or NAIF FTP Servers (in the ORBNUM directory).

SPICE subroutines are also available at ftp://naif.jpl.nasa.gov/pub/naif/toolkit/ to help the use of these kernels and tutorials and documentation can be retrieved from http://naif.jpl.nasa.gov/naif/tutorials.html and http://naif.jpl.nasa.gov/naif/documentation.html.

3 Archive Format and Content

This section describes the format of SPICAM Archive Volumes. Data that comprise the archive will be formatted in accordance with Planetary Data System specifications [2].

3.1 Format and Conventions

3.1.1 Deliveries and Archive Volume Format

3.1.1.1 SPICAM Delivery Schedule

After a final check, the processed data will be delivered to the co-Is and after the priority phase to PSA at ESTEC. The LATMOS is the single point of contact for the PSA archive team and for data distribution (during priority phase).

Deliveries to the PSA will be made by the SPICAM archive team lead by the PI F Montmessin. Data should be delivered in the long term by mission phases scheduled by MPS. Target date for delivery of SPICAM raw data (level 0A) to PSA is 9 months after the last data of a specific Mars mission phase. Level 1A and 1B data will be delivered at the same time or as soon as the data products are ready and validated by the SPICAM team. The level 2 scientific data set will be available to the public after the first major publication of this data set.

An approximate SPICAM archive volume delivery schedule, based on the nominal science mission timeline, is shown below.

Mission phase	date	Delivery date	Data type
Cruise Commissioning			
Near-Earth Commissioning	June/July 2003	January 2005	Level 0A,1A
Cruise Commissioning	July/October 2003	January 2005	Level 0A,1A
Mars Commissioning			
Mars Orbit Commissioning Phase (MOCP, orbits 0001-0482)	January-May 2004	Jan-Feb 2005	Level 0A,1A,1B
Mission Term Planning			
MTP1 (orbits 0483-0582)	June 2004	9 months after last observation	Level 0A,1A,1B
MTP2 (orbits 0583-0683)	July 2004	9 months after last observation	Level 0A,1A,1B
Following phases	Scheduled by MSP	9 months after last observation	Level 0A,1A,1B

3.1.1.2 Archive Volume Format and Concept of Deliveries

The SPICAM archive volume is organized according to the PDS standard for "**one data set, one volume**", **each archive volume corresponding to a specific SPICAM data level** as defined in section 2.3.2 (level 0A, level 1A, level 1B, …) **and to a specific type of data** (UV or IR) ().
Each SPICAM archive volume has the name of the VOLUME_ID (section 3.1.1.3).

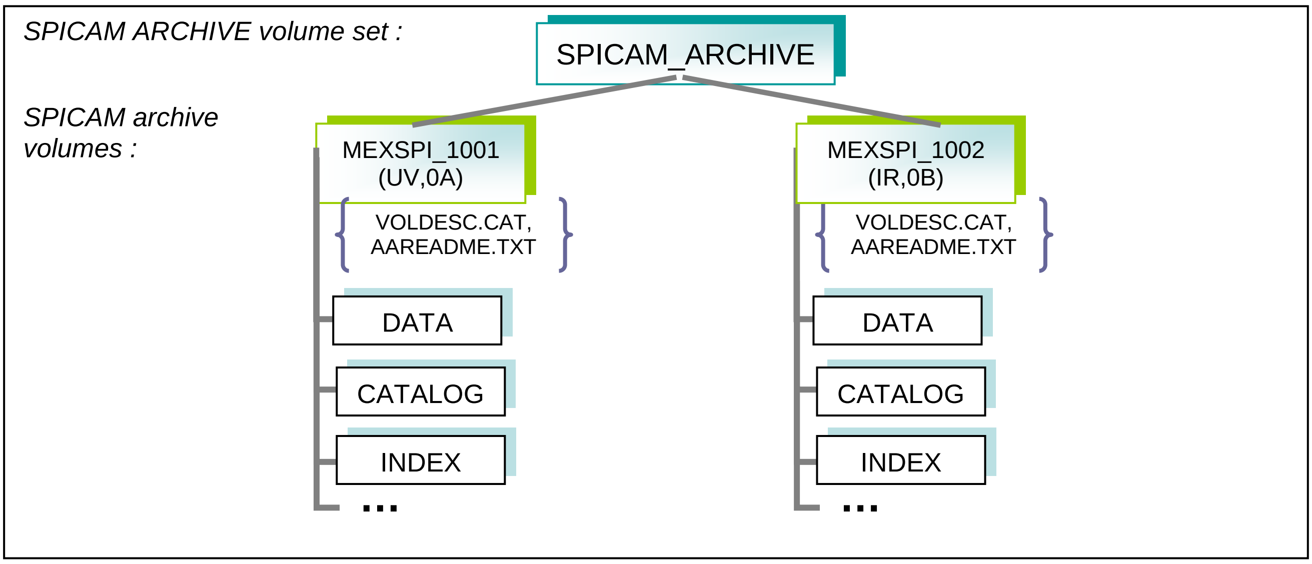
In each archive volume, the following standard directories may be included:

CATALOG	PDS catalog files
INDEX	Indices to assist in locating data of interest
GEOMETRY	Files describing the observational geometry
BROWSE	Reduced resolution versions of data products
DATA	Contains one or more subdirectories of data products. The DATA subdirectory is used to unclutter the root directory of a volume by providing a single entry point to multiple data subdirectories. This directory will contains data and detached label files, and also include files (*.FMT).
DOCUMENT	Documentation, supplementary and ancillary information to assist in understanding and using the data products.
CALIB	Calibration files to process the data

Currently, there is SOFTWARE directory only in the UV dataset. This may be updated and completed in the future.

In the ROOT directory of each archive volume, 2 files give an overview of the archive volume in ASCII format (AAREADME.TXT file) and a description of the volume in PDS format (VOLDESC.CAT file).

Figure 2 SPICAM volume set organization



Within the Planetary Science Archive (PSA) the archive volume represents an online delivery. **Deliveries are based on the concept of a release and a revision of a well-defined period of time**. This concept [4] allows the delivery of experiment data without the delivery of all supplementary information, that has already been delivered at the first initial delivery of a fully PDS compatible archive volume, containing the VOLDESC.CAT file and all necessary CATALOG, DOCUMENT, INDEX, DATA, etc directories and their content. The usage of the release object is not fully compliant with the PDS standard 3.6, however the full data set itself is PDS compatible. This concept should be transparent to the end user.

3.1.1.3 VOLDESC.CAT file

The VOLDESC.CAT file gives a description of the archive volume in a PDS format. Figure 2 gives an example of an initial VOLDESC.CAT file of the MEXSPI_0AUV archive volume.

```
PDS_VERSION_ID                 = PDS3
LABEL_REVISION_NOTE            = "2007-07-25"
RECORD_TYPE                    = FIXED_LENGTH
RECORD_BYTES                   = 70
RELEASE_ID                     = 0001
REVISION_ID                    = 0000

OBJECT                         = VOLUME
  VOLUME_SERIES_NAME           = "MISSION TO MARS"
  VOLUME_SET_NAME              = "MARS EXPRESS SPICAM DATA PRODUCTS"
  VOLUME_SET_ID                = FR_IPSLCNRS_SA_MEXSPI_1000
  VOLUME_NAME                  = "VOLUME 1: SPICAM UV MARS EXPRESS
                                  DATA"
  VOLUME_ID                    = MEXSPI_1001
  VOLUME_VERSION_ID            = 2
  PUBLICATION_DATE             = 2007-07-25
  VOLUMES                      = 1
  MEDIUM_TYPE                  = "ONLINE"
  VOLUME_FORMAT                = "ISO-9660"
  DATA_SET_ID            = "MEX-Y/M-SPI-2-UVEDR-RAWXCRU/MARS-V1.1"

  DESCRIPTION                  = "This volume release contains Mars
                                  Express SPICAM UV Raw Data Products
                                  (level 0A), in ADU units, along
                                  with documentation and other
                                  ancillary information about the
                                  data products."

  OBJECT                       = DATA_PRODUCER
    INSTITUTION_NAME           = "SERVICE D'AERONOMIE, IPSL/CNRS,
                                  FRANCE"
    FACILITY_NAME              = "N/A"
    FULL_NAME                  = "JEAN-LOUP BERTAUX"
    DISCIPLINE_NAME            = "N/A"
    ADDRESS_TEXT               = "BP3
                                  91371 Verrieres le Buisson Cedex
                                  France"
  END_OBJECT                   = DATA_PRODUCER

  OBJECT                       = CATALOG
    ^MISSION_CATALOG           = "MISSION.CAT"
    ^INSTRUMENT_HOST_CATALOG   = "INSTHOST.CAT"
    ^INSTRUMENT_CATALOG        = "INST.CAT"
    ^DATA_SET_CATALOG          = "DATASET.CAT"
    ^PERSONNEL_CATALOG         = "PERS.CAT"
    ^DATA_SET_RELEASE_CATALOG  = "RELEASE.CAT"
    ^REFERENCE_CATALOG         = "REFS.CAT"
    ^TARGET_CATALOG            = "TARGET.CAT"
    ^SOFTWARE_CATALOG          = "SWINV.CAT"
  END_OBJECT                   = CATALOG

END_OBJECT                     = VOLUME

END
```

Figure 2 VOLDESC.CAT example for the initial release (RELEASE_ID=0001, REVISION_ID=0000)

3.1.1.3.a VOLUME_ID

The **VOLUME_ID** of a SPICAM archive volume is composed by combining the following fields, using abbrevations, and separated by underscores:

- The mission identifier (MEX), followed by the instrument identifier (SPI),
- A 4-digit sequence identifier for the volumes corresponding to different data level and sensor :
  1001 => *0AUV* , 1002 => *0BIR*

For example, the VOLUME_ ID of the data level 0A UV SPICAM archive volume is : *MEXSPI_1001*.

If a volume is redone because of errors in the initial production the volume ID should remain the same and the VOLUME_VERSION_ID incremented. This parameter is contained in the VOLDESC.CAT file on the volume.

3.1.1.3.b VOLUME_SET_ID

Each SPICAM archive volume is also identified by a **VOLUME_SET_ID** composed by combining the following fields, using abbrevations, and separated by indents:

- The country of origin, *FR (FRANCE)*
- The government branch, *IPSL-CNRS*
- The discipline within the branch that is producing the archive, SA *(Service d Aeronomie, now called LATMOS)*
- The VOLUME_ID *MEXSPI_1001*

For example, the VOLUME_SET_ID of the data level 0 UV and IR SPICAM archive volume is :

FR_IPSLCNRS_SA_MEXSPI_1000

3.1.1.3.c RELEASE_ID and REVISION_ID

A data set release (or volume release) contains data from a well-defined period of time and is identified by first a RELEASE_ID keyword. The first release (RELEASE_ID = 0001) is a fully validated, complete PSA dataset. A volume release is made of at least one revision : the initial revision. The initial revision contains the initial data of a data set release and is identified by a REVISION_ID equal to 0000.
All labels within the first release will also contain the two keywords

RELEASE_ID = 0001
REVISION_ID = 0000

A following revision of the data set release (updated files, supplementary files, deleted files) would need the value of the REVISION_ID incremented by one (eg. RELEASE_ID = 0001, REVISION_ID = 0001).
Labels of the updated files will have the two keywords

RELEASE_ID = 0001
REVISION_ID = 0001

Any further release covering a following period of time would need the value of the RELEASE_ID incremented by one, with an initial revision (eg. RELEASE_ID = 0002, REVISION_ID = 0000).
The new data labels will contain the keywords

RELEASE_ID = 0002
REVISION_ID = 0000

The VOLDESC.CAT file shall contain the keywords RELEASE_ID and REVISION_ID set to the lastest RELEASE_ID and within this release to the latest REVISION_ID.

3.1.1.3.d CATALOG object

The VOLDESC.CAT file contains a CATALOG object with pointers to catalog files stored in the CATALOG directory. Files in the CATALOG directory provide a top-level understanding of the mission, spacecraft, instruments, and data sets.
One of these files, the RELEASE.CAT catalog file, contains a release object, which fully define the releases and revisions of deliveries.

3.1.1.4 The release object

A release object needs to be included in each archive volume to fully describe each release and revision within this release. This object is not PDS-compliant.

Figure 3 gives an example of the RELEASE.CAT catalog file in the SPICAM UV level 0A (MEXSPI_0AUV) Archive Volume.

```
PDS_VERSION_ID              = PDS3
LABEL_REVISION_NOTE         = "A. REBERAC, 2005-01-21 (original)"
RECORD_TYPE                 = STREAM
RELEASE_ID                  = 0001
REVISION_ID                 = 0000

OBJECT                      = DATA_SET_RELEASE
 DATA_SET_ID                = "MEX-Y/M-SPI-2-UVEDR-RAWXCRUISE/MARS-V1.0"
 RELEASE_ID                 = 0001

 DESCRIPTION                = "
    This release contains the digital numbers (DN) contained in the telemetry
    (TM) packages of the UV SPICAM instrument on board of spacecraft Mars
    Express. Data not been further converted or calibrated. This release
    contains data from the cruise phase of the s/c including all data from the
    Near Earth Verification (EV) and Interplanetary Cruise (IC) phase from
    July 2003 until December 2003. It also contains data collected during the
    Mars Orbit Commissioning Phase, covering orbits 0001 to 0482.

    Revision 0000 contains the original delivery. "

 OBJECT                     = REVISION
    REVISION_ID                 = 0000
    REVISION_DATE               = 2005-01-21
    REVISION_MEDIA              = "ONLINE"
    DESCRIPTION                 = "FIRST DELIVERY: RELEASE 0001,REVISION: 0000"
 END_OBJECT                 = REVISION

END_OBJECT                  = DATA_SET_RELEASE
```

Figure 3 RELEASE.CAT example for the initial release (RELEASE_ID=0001, REVISION_ID=0000)

A release will concern a well-defined period of time, based on the nominal science mission timeline, as shown in the SPICAM archive volume delivery schedule (section 3.1.1.1). Each release will be described in this file by a DATA_SET_RELEASE object, containing all keyword-value pairs that are necessary to identify the release (DATA_SET_ID, RELEASE_ID, DESCRIPTION, …). The DESCRIPTION part of the DATA_SET_RELEASE object will contain the full history of the release including all previous revisions. Each revision of a release is added in the release catalog object and all necessary information about this revision is given by a REVISION object.

A revision of this release might be added after improvement of the data. Figure 4 gives an example of a revision of an initial release.

```
PDS_VERSION_ID                = PDS3
LABEL_REVISION_NOTE           = "A. REBERAC, 2004-12-01 (original)"
RECORD_TYPE                   = STREAM
RELEASE_ID                    = 0001
REVISION_ID                   = 0000
OBJECT                        = DATA_SET_RELEASE
 DATA_SET_ID                  = "MEX-Y/M-SPI-2-UVEDR-RAWXCRUISE/MARS-V1.0"
 RELEASE_ID                   = 0001

DESCRIPTION                  = "
    This release contains the digital numbers (DN) contained in the telemetry
    (TM) packages of the UV SPICAM instrument on board of spacecraft Mars
    Express. Data not been further converted or calibrated. This release
    contains data from the cruise phase of the s/c including all data from the
    Near Earth Verification (EV) and Interplanetary Cruise (IC) phase from
    July 2003 until December 2003. It also contains data collected during the
    Mars Orbit Commissioning Phase, covering orbits 0001 to 0482.

    Revision 0000 contains the original delivery. "
OBJECT                        = REVISION
    REVISION_ID                 = 0000
    REVISION_DATE               = 2004-12-01
    REVISION_MEDIA              = "ONLINE"
    DESCRIPTION                 = "FIRST DELIVERY: RELEASE 0001,REVISION: 0000"
 END_OBJECT                    = REVISION

 OBJECT                        = REVISION
    REVISION_ID                 = 0001
    REVISION_DATE               = 2005-04-13
    REVISION_MEDIA              = "ONLINE"
    DESCRIPTION                 = "FIRST DELIVERY: RELEASE 0001,REVISION: 0001
                                   modification of the data representation in the
                                   label data files"
 END_OBJECT                    = REVISION
END_OBJECT                    = DATA_SET_RELEASE

END
```

Figure 4 RELEASE.CAT example for RELEASE_ID=0001, REVISION_ID=0001

A following release of a new well defined period of time in the archive volume will be described by a new DATA_SET_RELEASE object in the same RELEASE.CAT file as shown in Figure 5.

3.1.1.5 Index files

The PDS standard defines index files (see section 3.4.3.3 for more details) as information that allows a user to locate data of interest. All index table files below the INDEX directory cover all data set releases and revisions. Therefore the index table files will contain at least two columns named RELEASE_ID and REVISION_ID.
The index label files describing the index table files shall contain the keywords RELEASE_ID and REVISION_ID, set to the latest RELEASE_ID and within this release to the latest REVISION_ID (same as the VOLDESC.CAT file).

```
PDS_VERSION_ID                = PDS3
LABEL_REVISION_NOTE           = "A. REBERAC, 2004-12-01 (original)"
RECORD_TYPE                   = STREAM
RELEASE_ID                    = 0002
REVISION_ID                   = 0000
OBJECT                        = DATA_SET_RELEASE
 DATA_SET_ID                  = "MEX-Y/M-SPI-2-UVEDR-RAWXCRUISE/MARS-V1.0"
 RELEASE_ID                   = 0002

 DESCRIPTION                  = "
    This new release contains similar data as release 1 but collected during the
    Medium Term Planning Phase 1 (MTP1), covering orbits 0483 to 0582.
    Data have been stored in the DATA/MARS/MTP1_0483_0582 subdirectory.

    Revision 0000 contains the original delivery. "


 OBJECT                        = REVISION
    REVISION_ID                 = 0000
    REVISION_DATE               = 2005-06-01
    REVISION_MEDIA              = "ONLINE"
    DESCRIPTION                 = "SECOND DELIVERY: RELEASE 0002,REVISION: 0000"
 END_OBJECT                    = REVISION

END_OBJECT                    = DATA_SET_RELEASE


OBJECT                        = DATA_SET_RELEASE
 DATA_SET_ID                  = "MEX-Y/M-SPI-2-UVEDR-RAWXCRUISE/MARS-V1.0"
 RELEASE_ID                   = 0001

 DESCRIPTION                  = "
    This release contains the digital numbers (DN) contained in the telemetry
    (TM) packages of the UV SPICAM instrument on board of spacecraft Mars
    Express. Data not been further converted or calibrated. This release
    contains data from the cruise phase of the s/c including all data from the
    Near Earth Verification (EV) and Interplanetary Cruise (IC) phase from
    July 2003 until December 2003. It also contains data collected during the
    Mars Orbit Commissioning Phase, covering orbits 0001 to 0482 .

    Revision 0000 contains the original delivery. "

 OBJECT                       = REVISION
    REVISION_ID                   = 0000
    REVISION_DATE                 = 2005-01-21
    REVISION_MEDIA                = "ONLINE"
    DESCRIPTION                   = "FIRST DELIVERY: RELEASE 0001,REVISION: 0000"
 END_OBJECT                   = REVISION

 OBJECT                        = REVISION
    REVISION_ID                 = 0001
    REVISION_DATE               = 2005-04-13
    REVISION_MEDIA              = "ONLINE"
    DESCRIPTION                 = "FIRST DELIVERY: RELEASE 0001,REVISION: 0001
                                   modification of the data representation in the
                                   label data files"
 END_OBJECT                    = REVISION

END_OBJECT                    = DATA_SET_RELEASE

END
```

Figure 5 RELEASE.CAT example for RELEASE_ID=0002, REVISION_ID=0000

3.1.2 Data Set Name and Data Set ID Formation

Each PDS data set must have a unique name (DATA_SET_NAME) and a unique identifier (DATA_SET_ID), both formed from up to seven components. The components are listed here:

Instrument host	MEX (Mars Express)
Target	M (Mars) or Y (Sky/CRUISE)
Instrument	SPI (SPICAM)
Data processing level number	see below
Data set type (optional)	see below
Description (optional)	see below
Version number	Vn.m

Within the DATA_SET_ID, acronyms are separated by hyphens. Multiple instrument hosts, instruments, or targets are referenced in a DATA_SET_NAME or DATA_SET_ID by concatenation of the values with a forward slash, "/", which is interpreted as "and."

Data processing level number

Data processing level number is the National Research Council (NRC) Committee on Data Management and Computation (CODMAC) data processing level number :

Level	Type	Data Processing Level Description
1	Raw Data	Telemetry data with data embedded.
2	Edited Data	Corrected for telemetry errors and split or decommutated into a data set for a given instrument. Sometimes called Experimental Data Record (EDR).
3	Calibrated Data	Edited data that are still in units produced by instrument, but that have been corrected so that values are expressed in or are proportional to some physical unit such as radiance. No resampling, so edited data can be reconstructed.
4	Resampled Data	Data that have been resampled in the time or space domains in such a way that the original edited data cannot be reconstructed. Could be calibrated in addition to being resampled.
5	Derived Data	Derived results, as maps, reports, graphics, etc.
6	Ancillary Data	Nonscience data needed to generate calibrated or resampled data sets. Consists of instrument gains, offsets, pointing information for scan platforms, etc.
7	Correlative Data	Other science data needed to interpret space-based data sets.
8	User Description	Description of why the data were required, any peculiarities associated with the data sets, and enough documentation to allow secondary user to extract information from the data.
N	N	Not Applicable

SPICAM data set	Data processing level number
0A**	2
1A**	2

1B**	3
2X**	5

** : UV or IR.

Data set type

Data set type is the concatenation of the data type (UV or IR) and of the PRODUCT_TYPE keyword provided in each PDS data product labels.

SPICAM data set	PRODUCT_TYPE value	Data set type
0A**	EDR	**EDR
1A**	EDR	**EDR
1B**	EDR	**EDR
2X**	RDR	**RDR

** : UV or IR.

Description

The CODMAC level for some of the datasets is the same, and this means the end user has no way of knowing which dataset he is looking at from the data processing level number alone. Therefore, in order to help the end user, the STANDARD_DATA_PRODUCT_ID keyword has been added to all of SPICAM data product labels and the value of this keyword is given in the Description component of the DATA_SET_ID. The value must be no more that 4 characters long.

Description should be always as follows: XXXXCRUISE/MARS, where XXXX is the value of the STANDARD_DATA_PRODUCT_ID keyword.

SPICAM data level	STANDARD_DATA_PRODUCT_ID value
0A	RAWX
1A	CORX
1B	SPEC
2	RDRX

For a data set containing the first version of UV experimental data records collected from the SPICAM instrument on Mars Express during the cruise and Mars nominal phases, the data set name and identifier would be:

DATA_SET_NAME = "MEX SPICAM CRUISE/MARS UV EDR-RAW V1.0"

DATA_SET_ID = "MEX-Y/M-SPI-2-UVEDR-RAWXCRUISE/MARS-V1.0"

For the new version of UV experimental data records generated in January 2012, the data set name and identifier are:

DATA_SET_NAME = "MEX SPICAM CRUISE/MARS UV EDR-RAW V2.0"

DATA_SET_ID = "MEX-Y/M-SPI-2-UVEDR-RAWXCRU/MARS-V2.0"

3.1.3 Data Directory Naming Convention

In the DATA directory, data are stored by mission phase (Figure 6). The CRUISE phase corresponds to data collected before the MOI (Mars Orbit Injection), including the Near Earth Verification (NEV) and

Interplanetary Cruise (IC) phases. After the MOI, the nominal mission, the different Mars mission phases in the MARS subdirectory are the one defined by the MARS EXPRESS mission planning.

In the MARS directory, the following directory naming conventions is used :

XXXX_nnnnn_ppppp data collected during a Mars mission phase from orbit nnnnn to ppppp, with XXXX the abbreviated name of the Mars mission phase XXXX can have the following values :

MOCP : Mars Orbit Commissioning Phase
MTPnnn : Medium Term Planning n (nnn=001,002,003,...)

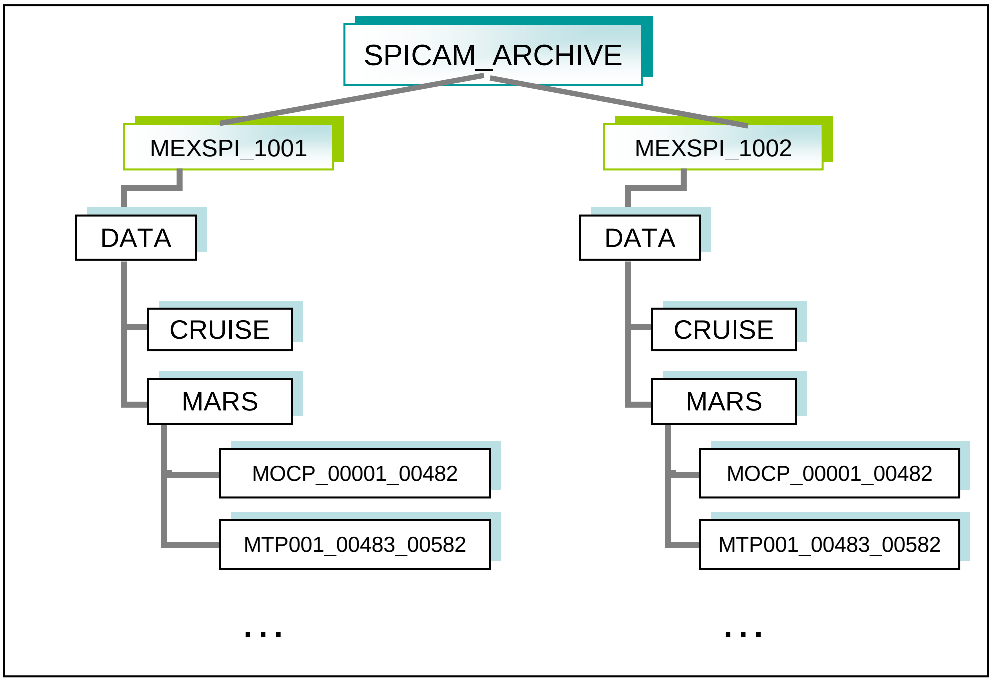


Figure 6. SPICAM DATA directories organization

3.1.4 Filenaming Convention

Data and browse files

Data products provided by the SPICAM team will have the following name:

SPIM_YYT_nnnnnApp_M_vv.DAT

where

YY 2 letters describing the SPICAM data level (eg. 0A, 0B, 1A, 1B, ...)
T 1 letter describing the type of data collected (U for UV and R for IR)
nnnnn 5 digits for the orbit number
App sequence number indicating the order that data were collected for the nnnn orbit (A01, A02,...).
M 1 letter describing the observation mode (eg. E:STAR, S:SUN, L:LIMB, N:NADIR, P:PHOBOS, Y:SKY, C:COMET, T:CALIBRATION)
vv version number of the file

note : For the CRUISE phase, which include the NEV and IC phases, the orbit number is not applicable. The 5 digits will contain the day of the year (2003) of the observation, preceeded by the letter N (for the NEV phase) or the letter C (for the IC phase).

Examples :

SPIM_0AU_0C195A01_Y_04.DAT Sky UV observation on the 13th of July 2003 during the CRUISE phase.
SPIM_0AU_00017A01_E_04.DAT Star UV observation on orbit 17 during the MARS nominal phase.
Associated detached label files and browse files follow the same filenaming convention with the _QL.LBL and _QL.PNG extension respectively.

Geometry files

Geometry files provided by the SPICAM team will have the following name:

SPIM_YYT_nnnnnApp_M_GO_vv.DAT

where

YY	2 letters describing the SPICAM data level (eg. 0A, 0B, 1A, 1B, ...)
T	1 letter describing the type of data collected (U for UV and R for IR)
nnnn	4 digits for the orbit number
App	sequence number indicating the order that data were collected for the nnnn orbit (A01, A02,...).
M	1 letter describing the observation mode (eg. E:STAR, S:SUN, L:LIMB, N:NADIR, P:PHOBOS, Y:SKY)
vv	version number of the file

3.2 Standards Used in Data Product Generation

3.2.1 PDS Standards

The PDS standards used to describe data products in the SPICAM archive is that of PDS version 3.6 [2].
Each PDS archived product is described using label objects that provide information about the data types of stored values.
In order to identify and describe the organization, content, and format of each data product, PDS requires a distinct data product label for each individual data product file. This data product label can be attached or detached from the data. The SPICAM PDS data product label is detached from the data and resides in a separate file which contains a pointer to the data product file. There is one detached label file for every data product file. The label file should have the same base name as its associated data file, but the extension .LBL.
Each PDS label must begin with the PDS_VERSION_ID data element. This element identifies the published version of the Standards to which the label adheres, for purposes of both validation as well as software development and support. For labels adhering to the standards version 3.6 the appropriate value is “PDS3”:

PDS_VERSION_ID = PDS3

PDS data product labels contain data element information that describes important attributes of the physical structure of a data product file. The PDS file characteristic data elements are:
RECORD_TYPE
RECORD_BYTES
FILE_RECORDS

The RECORD_TYPE data element identifies the record characteristics of the data product file. The RECORD_BYTES data element identifies the number of bytes in each physical record in the data product file. The FILE_RECORDS data element identifies the number of physical records in the file.
The following data identification elements must be included in product labels for all spacecraft science data products:
DATA_SET_ID
PRODUCT_ID
INSTRUMENT_HOST_NAME
INSTRUMENT_NAME
TARGET_NAME
START_TIME
STOP_TIME
SPACECRAFT_CLOCK_START_COUNT
SPACECRAFT_CLOCK_STOP_COUNT
PRODUCT_CREATION_TIME

The PDS requires a separate data object definition within the product label for each object in the product, to describe the structure and associated attributes of each constituent object.

Object definitions are of the form:

OBJECT = aaa where aaa is the name of the data object
...
END_OBJECT = aaa

Definitions of all objects and elements used to describe SPICAM data products are in section 4.1.3.

The PDS uses a pointer within the product labels to identify the file location for all objects which are described in the label file. For example,

^SPICAM_FILE_ARRAY = "SPIM_0AU_00017A01_E_04.DAT"

Examples of data product labels can be found in the Data Product Design section 4.1.

3.2.2 Time Standards

3.2.2.1 START_TIME and STOP_TIME Formation

The PDS formation rule for dates and time in UTC is:

YYYY-MM-DDThh:mm:ss.fff or YYYY-DDDThh:mm:ss.fff

With
YYYY year (0000-9999)
MM month (01-12)
DD day of month (01-31)
DDD day of year (001-366)
T date/time separator
hh hour (00-23)
mm minute (00-59)

ss second (00-59)
fff fractions of second (000-999) (restricted to 3 digits)

The START_TIME and STOP_TIME data elements required in data product labels and catalog templates use the UTC format.

Times in any format other than the ISO/DIS 8601 format described above are considered to be in a format native to the data set, and thus "native times".

3.2.2.2 SC_CLOCK_START_COUNT and SC_CLOCK_STOP_COUNT

The spacecraft clock reading often provides the essential timing information for a space-based observation. Therefore, the elements SPACECRAFT_CLOCK_START_COUNT and SPACECRAFT_CLOCK_STOP_COUNT are required in labels describing space-based data. This value is formatted as a string to preserve precision.
Spacecraft clock counts shall be represented as a right-justified character string field with a maximum length of thirty characters.
The SC_CLOCK*COUNTS represent the on-board time counters (OBT) of the spacecraft and instrument computers. This OBT counter is given in the headers of the experiment telemetry source packets. It contains the data acquisition start time as 32 bit of unit seconds followed by 16 bit of fractional seconds. The time resolution of the fractional part is 2^-16 = 1.52×10^-5 seconds. Thus the OBT is represented as a decimal real number in floating-point notation with 5 digits after the decimal point.
A reset of the spacecraft clock is represented by an integer number followed by a slash, e.g. "1/" or "2/".

Example 1:
SPACECRAFT_CLOCK_START_COUNT = "1/21983325.39258"
Example 2:
SPACECRAFT_CLOCK_START_COUNT = "21983325.39258"
Example 3:
SPACECRAFT_CLOCK_START_COUNT = "2/0000325.39008"
Example 1 and Example 2 represents the same time instance.

3.2.2.3 OBT to UTC time conversion

UTC time is a function of the time correlation packages and the on-board time. The time correlation packages are archived and distributed in the SPICE auxiliary data set and contain linear segments that map the on-board time to UTC time. The linear segment is represented by a time offset and a time gradient. The conversion function is:
Time in utc = offset + (obt(seconds) + (obt(fractional part)*2^-16)) *gradient

3.2.3 Reference Systems

The SPICAM data products are not projected into any coordinate system, however some basic geometric parameters are provided in a associated geometry file (see 3.4.3.6.b).

3.3 Data Validation

To ensure that contents and format are free of errors, data validation will be first done via the Instrument to PSA end-to-end test [5] completed in three phases:

1. Individual label, data set structure validation and communication test (May 2004)
2. Full data set ingestion test, containing data from the Near Earth Verification and Interplanetary Cruise phases (May 2004)
3. Complete validation, ingestion and retrieval test (January 2005)

These tests will use the PSA Volume Verifier (PVV) tool [SOP-RSSD-UM-004] that will be used in the long-term to automate the label and dataset validation and the subsequent ingestion to the PSA.

3.4 Content

3.4.1 Volume Set

The SPICAM volume set contains all raw data products collected by the UV and IR SPICAM sensors during the CRUISE and Mars mission phases, and all derived products provided by the SPICAM team.

The Volume Set Name provides the full, formal name of a group of data volumes containing a data set or a collection of related data sets. Volume set names shall be at most 60 characters in length and must be in upper case.

The SPICAM VOLUME_SET_NAME keyword contained in the VOLDESC.CAT file on each volume has the following value :

VOLUME_SET_NAME = "MARS EXPRESS SPICAM DATA PRODUCTS"

A data set is defined for each sensor (UV or IR) and for each data product level (level 0A, 1A, 1B and 2). Therefore, the SPICAM volume set will consist of 8 data volumes containing a single data set.

3.4.2 Data Set

Each data set will contain the accumulation of data products of one sensor (UV or IR) and of one data level (0A, 1A, 1B or 2), ancilliary data, software, and documentation, needed to understand and use the observations.

Files in a data set share a unique data set name, a unique data set identifier, and are described by a single DATASET.CAT catalog object.

3.4.3 Directories

Each SPICAM archive volume (MEXSPI_1001, MEXSPI_1002, …) is a PDS compatible archive volume, containing the VOLDESC.CAT and AAREADME.TXT files and all necessary CATALOG, DOCUMENT, INDEX, DATA, etc directories and their content. The MEXSPI_1001, MEXSPI_1002, …directories are root directories.

3.4.3.1 Root Directory

Files in each ROOT directory include an overview of the archive, a description of the volume for the PDS Catalog, and a list of errata or comments about the archive.
The following files, provided by the SPICAM team, are contained in the ROOT Directory:

```
ROOT
     |
     |- AAREADME.TXT          Volume content and format information
     |
     |- ERRATA.TXT            Description of known anomalies and errors
|                        present on the volume.
     |
     |- AAREADME.LBL          PDS detached label describing AAREADME.TXT
     |
     |- VOLDESC.CAT           Description of the contents of the volume in a PDS
                              format for the PDS Catalog
```

3.4.3.2 Catalog Directory

The files in each CATALOG Directory provide a top-level understanding of the mission, spacecraft, instruments, and data sets.

For example, The CATALOG directory of the MEXSPI_1001 (0AUV) volume archive follows the structure outlined below:

```
|- [CATALOG] A directory containing information about the data set
|      |
|      |- CATINFO.TXT        Description of files in this directory
|      |
|      |- DATASET.CAT        Description of the MEXSPI_1001 data set
|      |                     during the cruise phase
|      |
|      |- RELEASE.CAT        Release object of the MEXSPI_1001 data set
|      |
|      |- MISSION.CAT        Description of the Mars Express mission
|      |
|      |- INSTHOST.CAT       Description of the Mars Express spacecraft
|      |
|      |- INST.CAT           Description of the MEX SPICAM instrument
|      |
|      |- PERS.CAT           Listing of the people involved in the
|      |                     production of this archive volume
|      |- REFS.CAT           List of pertinent references.
|      |
|      |- SWINV.CAT          Description of the software included on the
|      |                     volume.
```

3.4.3.3 Index Directory

Files in the INDEX directory are provided by the SPICAM team to help the user to locate products on the archive volume.
As the typical index file requires to contain only information of the /DATA directory, PSA proposes to create an index file for the BROWSE and GEOMETRY directories.

3.4.3.3.a Structure of the INDEX directory

The INDEX directory of an archive volume follows the structure outlined below:

```
|- [INDEX]            A directory containing an index of data files.
|      |
|      |- INDXINFO.TXT     Description of files in this directory.
|      |
|      |- INDEX.TAB        Index of data files in the DATA directory
```

```
      |      |
      |      |- INDEX.LBL        PDS detached label describing corresponding
      |      |                   *.TAB file
      |      |
      |      |- BROWSE_INDEX.TAB Index of browse files in the BROWSE directory
      |      |
      |      |- BROWSE_INDEX.LBL PDS detached label describing corresponding
      |      |                   *.TAB file
      |      |
      |      |- GEOMETRY_INDEX.TAB  Index of geometry files in the GEOMETRY directory
      |      |
      |      |- GEOMETRY_INDEX.LBL  PDS detached label describing the corresponding
      |      |                      *.TAB file
      |      |- GEO_MARS.TAB        Geometry index file providing geometry and position
|      |                      information to locate the data within the data set
|      |- GEO_MARS.LBL        PDS detached label describing corresponding
                                    *.TAB file
```

3.4.3.3.b Content of Dataset Index Files

Each index table contains a number of columns describing a data product on a volume release. The table is formatted so that it can be read directly into many data management systems. All fields are separated by commas and character fields are enclosed in double quotation marks ("). Character fields are left justified and numeric fields are right justified. Each record (row) ends with ASCII carriage return <CR> (ASCII 13). All fields in the tables are fixed width. This allows the table to be treated as a fixed length record file.

In the data index table (INDEX.TAB) the fields are as follows:

File Specification Name - Pathname to the detached label which identifies this data file
Product ID - The name of the data file, which is unique within this data set
Product Creation Time - Time at which the data file was created
Data Set ID - An identifier unique for the dataset
Release id
Revision id
Start date and time of product observation or event
Stop date and time of product observation or event
Number of records in the data file

In the browse index table (BROWSE_INDEX.TAB) the fields are as follows:

File Specification Name - Pathname to the detached label which identifies this data file
Product ID - The name of the data file, which is unique within this data set
Source Product ID - The name of the source data file, which is unique within this data set
Product Creation Time - Time at which the data file was created
Data Set ID - An identifier unique for the dataset
Release id
Revision id

In the geometry index table (GEOMETRY_INDEX.TAB) the fields are as follows:

File Specification Name - Pathname to the detached label which identifies this data file
Product ID - The name of the data file, which is unique within this data set
Source Product ID - The name of the source data file, which is unique within this data set
Product Creation Time - Time at which the data file was created
Data Set ID - An identifier unique for the dataset
Release id
Revision id

A description of the corresponding PDS label file which describes the content and structure of the fields (name, format, brief definition) is given in section 4.1.3.5.

The geometry index file (GEO_MARS.TAB) provides geometry and position information to locate the data within the data set. This file is required by the PSA. Within the PSA, the geometry index files are read by the database software and allow the ingestion of additional searching parameters into the database. For a detailed description of this file and of its associated label file, please refer to [6].

3.4.3.4 Data Directory

The DATA directory contains data subdirectories in which the Mars Express SPICAM standard data products are stored by mission phases (CRUISE, MARS). The MARS directory is divided in several directories, containing data from the Mars Orbit Commissioning Phase (MOCP) and from the different Medium Term Planning (MTP) phases.
The data subdirectories contain the table data products and corresponding PDS detached label describing the table data.

For example, The DATA directory of the MEXSPI_1001 (0AUV) volume archive follows the structure outlined below:

```
      |- [DATA]       A directory containing the data + associated label files
      |      |
      |      |- DATAINFO.TXT     Description of files in this directory
      |      |
      |      |-[CRUISE]  A directory containing MEX SPICAM level 0A UV data
      |      |     |      collected during the cruise phase
      |      |     |
      |      |     |-- {file(s) *DAT, *.LBL}
      |      |
      |      |
      |      |-[MARS]    A directory containing MEX SPICAM level 0A UV data
      |      |     |      collected during the Mars nominal phase
      |      |     |
      |      |     |-[MOCP_00001_00482]
      |      |     |     |
      |      |     |     |-- {file(s) *DAT, *.LBL}
|     |     |
      |      |     |-[MTP001_00483_00583]
      |      |     |     |
      |      |     |     |-- {file(s) *DAT, *.LBL}
      |      |     ...
```

3.4.3.5 Browse Directory and Browse Files

The BROWSE directory will contain reduced-size, easily viewed versions of data products to be used to help identify products of interest available on the archive volume. The BROWSE directory follows the same naming convention as the DATA directory. The format of the browse files is Portable Network Graphic (PNG). Browse images, provided by the SPICAM team, have the same name of the data product with a _QL.PNG extension. The browse subdirectories contain the browse image products and corresponding PDS detached label describing the browse image.

3.4.3.6 Geometry Directory

3.4.3.6.a Content of the geometry directory

The GEOMETRY directory will contain geometry files associated with data files. Therefore the GEOMETRY subdirectories will follow the same naming convention as the DATA subdirectories. Currently no plans exist for providing geometry files associated to observations obtained during the cruise phase.
For example, The GEOMETRY directory of the MEXSPI_1001 (0AUV) volume archive follows the structure outlined below:

```
      |- [GEOMETRY] A directory containing the geometry + associated label files
      |     |
      |     |- GEOMINFO.TXT     Description of files in this directory
      |     |
      |     |-[MARS]    A directory containing MEX SPICAM level 0A UV geometry
      |     |    |      files associated to data collected during the Mars nominal phase
      |     |    |
      |     |    |-[MOCP_00001_00482]
      |     |    |    |
      |     |    |    |-- {file(s) *TXT, *.LBL}
|     |     |
      |     |    |-[MTP001_00483_00583]
      |     |    |    |
      |     |    |    |-- {file(s) *TXT, *.LBL}
      |     |    ...
```

3.4.3.6.b Content of the geometry files

Geometric parameters are generated with a SPICAM software using SPICE routines and SPICE kernels. Each geometry file contains two blocks: an header (comments) and a data table.

The header (see example in Figure 7), which ends with the "-- End Comments" line, gives information like:

- The name and the version of the software used to generate the geometry file, and the date of the file generation.
- The list of SPICE kernels required to perform the computations
- Solar related parameters (longitude, latitude, distance from the spacecraft…) at the first time of observation.
- The kind of target [NAD/LIMB, SUN, Oxx (name of the star)] : the processing of the geometry file is different for star and nadir,limb,sun observations.
- Parameters definition. The SPICAM team can generate a light (only some main parameters) or a full version of the geometry file. The list and a brief definition of parameters computed is given in the header. The number just before the parameter definition is an internal use (do not care).

The data table, which follows the header, is fully described in the associated detached PDS label file. The data table is in ASCII format and is based on fixed length rows. The number of rows is related with the sampling frequency of the observation. The geometry file has the same sampling resolution as the data file.

3.4.3.6.c Content of the geometry label files

The geometry PDS label files describe the content and structure of the fields (name, format, brief definition) in the geometry file.
The header in each geometry file is described by an HEADER object.
Each field of the geometry data table is then described in a data TABLE by a COLUMN object. gives an example of geometry PDS label file.

```
Geo File : SPIM_0AU_08302A01_E_GO_01.TXT Generation date : Sat Oct  8 01:19:16 2011
Data File source : SPIM_0AU_08302A01_E_04.DAT

Contents of metakernel file KPL/MK
```

```
This is the meta-kernel for Mars 2004 e100, from 2003-12-22
MEXFULL2 = uppercase name

\begindata

PATH_VALUES     = ( '/net/nfs/spicam/orbito/spice/kernels' )

   PATH_SYMBOLS     = ( 'KER_PATH' )

KERNELS_TO_LOAD = ( '$KER_PATH/lsk/NAIF0009.TLS',
                    '$KER_PATH/sclk/MEX_111005_STEP.TSC',
                    '$KER_PATH/spk/DE405.BSP',
                    '$KER_PATH/fk/MEX_V11.TF',
                    '$KER_PATH/spk/ORMM__031222180906_00052.BSP',
                    '$KER_PATH/spk/ORMM__040201000000_00060.BSP',
                    '$KER_PATH/spk/ORMM__040301000000_00068.BSP',
                    '$KER_PATH/spk/ORMM__040401000000_00072.BSP',
                    '$KER_PATH/spk/ORMM__040501000000_00076.BSP',
                    '$KER_PATH/spk/ORMM__040601000000_00080.BSP',
                    '$KER_PATH/spk/ORMM__040701000000_00086.BSP',
                    '$KER_PATH/spk/ORMM__040801000000_00088.BSP',
                    '$KER_PATH/spk/ORMM__040901000000_00091.BSP',
                    '$KER_PATH/spk/ORMM__041001000000_00096.BSP',
                    '$KER_PATH/spk/ORMM__041101000000_00100.BSP',
                    '$KER_PATH/spk/ORMM__041201000000_00105.BSP',
                    '$KER_PATH/spk/ORMM__050101000000_00109.BSP',
                    '$KER_PATH/spk/ORMM__050201000000_00113.BSP',
                    '$KER_PATH/spk/ORMM__050301000000_00117.BSP',
                    '$KER_PATH/spk/ORMM__050401000000_00122.BSP',
                    '$KER_PATH/spk/ORMM__050501000000_00129.BSP',
                    '$KER_PATH/spk/ORMM__050601000000_00136.BSP',
                    '$KER_PATH/spk/ORMM__050701000000_00140.BSP',
                    '$KER_PATH/spk/ORMM__050801000000_00153.BSP',
                    '$KER_PATH/spk/ORMM__050901000000_00165.BSP',
                    '$KER_PATH/spk/ORMM__051001000000_00181.BSP',
                    '$KER_PATH/spk/ORMM__051101000000_00194.BSP',
                    '$KER_PATH/spk/ORMM__051201000000_00203.BSP',
                    '$KER_PATH/spk/ORMM__060101000000_00217.BSP',
                    '$KER_PATH/spk/ORMM__060201000000_00229.BSP',
                    '$KER_PATH/spk/ORMM__060301000000_00241.BSP',
                    '$KER_PATH/spk/ORMM__060401000000_00253.BSP',
                    '$KER_PATH/spk/ORMM__060501000000_00263.BSP',
                    '$KER_PATH/spk/ORMM__060601000000_00274.BSP',
                    '$KER_PATH/spk/ORMM__060701000000_00290.BSP',
                    '$KER_PATH/spk/ORMM__060801000000_00294.BSP',
                    '$KER_PATH/spk/ORMM__060901000000_00307.BSP',
                    '$KER_PATH/spk/ORMM__061001000000_00310.BSP',
                    '$KER_PATH/spk/ORMM__061101000000_00324.BSP',
                    '$KER_PATH/spk/ORMM__061201000000_00336.BSP',
                    '$KER_PATH/spk/ORMM__070101000000_00349.BSP',
                    '$KER_PATH/spk/ORMM__070201000000_00361.BSP',
                    '$KER_PATH/spk/ORMM__070301000000_00371.BSP',
                    '$KER_PATH/spk/ORMM__070401000000_00387.BSP',
                    '$KER_PATH/spk/ORMM__070501000000_00395.BSP',
                    '$KER_PATH/spk/ORMM__070601000000_00403.BSP',
                    '$KER_PATH/spk/ORMM__070701000000_00414.BSP',
                    '$KER_PATH/spk/ORMM__070801000000_00423.BSP',
                    '$KER_PATH/spk/ORMM__070901000000_00431.BSP',
                    '$KER_PATH/spk/ORMM__071001000000_00441.BSP',
                    '$KER_PATH/spk/ORMM__071101000000_00449.BSP',
                    '$KER_PATH/spk/ORMM__071201000000_00457.BSP',
                    '$KER_PATH/spk/ORMM__080101000000_00465.BSP',
                    '$KER_PATH/spk/ORMM__080201000000_00474.BSP',
                    '$KER_PATH/spk/ORMM__080301000000_00484.BSP',
                    '$KER_PATH/spk/ORMM__080401000000_00490.BSP',
                    '$KER_PATH/spk/ORMM__080501000000_00498.BSP',
                    '$KER_PATH/spk/ORMM__080601000000_00508.BSP',
                    '$KER_PATH/spk/ORMM__080701000000_00516.BSP',
                    '$KER_PATH/spk/ORMM__080801000000_00525.BSP',
                    '$KER_PATH/spk/ORMM__080901000000_00536.BSP',
                    '$KER_PATH/spk/ORMM__081001000000_00544.BSP',
                    '$KER_PATH/spk/ORMM__081101000000_00549.BSP',
                    '$KER_PATH/spk/ORMM__081201000000_00553.BSP',
```

```
                                 '$KER_PATH/spk/ORMM__090101000000_00562.BSP',
                                 '$KER_PATH/spk/ORMM__090201000000_00570.BSP',
                                 '$KER_PATH/spk/ORMM__090301000000_00580.BSP',
                                 '$KER_PATH/spk/ORMM__090401000000_00586.BSP',
                                 '$KER_PATH/spk/ORMM__090501000000_00594.BSP',
                                 '$KER_PATH/spk/ORMM__090601000000_00602.BSP',
                                 '$KER_PATH/spk/ORMM__090701000000_00611.BSP',
                                 '$KER_PATH/spk/ORMM__090801000000_00619.BSP',
                                 '$KER_PATH/spk/ORMM__090901000000_00628.BSP',
                                 '$KER_PATH/spk/ORMM__091001000000_00637.BSP',
                                 '$KER_PATH/spk/ORMM__091101000000_00648.BSP',
                                 '$KER_PATH/spk/ORMM__091201000000_00654.BSP',
                                 '$KER_PATH/spk/ORMM__100101000000_00662.BSP',
                                 '$KER_PATH/spk/ORMM__100201000000_00674.BSP',
                                 '$KER_PATH/spk/ORMM__100301000000_00682.BSP',
                                 '$KER_PATH/spk/ORMM__100401000000_00688.BSP',
                                 '$KER_PATH/spk/ORMM__100501000000_00696.BSP',
                                 '$KER_PATH/spk/ORMM__100601000000_00704.BSP',
                                 '$KER_PATH/spk/ORMM__100701000000_00712.BSP',
                                 '$KER_PATH/spk/ORMM__100801000000_00723.BSP',
                                 '$KER_PATH/spk/ORMM__100901000000_00731.BSP',
                                 '$KER_PATH/spk/ORMM__101001000000_00739.BSP',
                                 '$KER_PATH/spk/ORMM__101101000000_00749.BSP',
                                 '$KER_PATH/spk/ORMM__101201000000_00755.BSP',
                                 '$KER_PATH/spk/ORMM__110101000000_00758.BSP',
                                 '$KER_PATH/spk/ORMM__110201000000_00766.BSP',
                                 '$KER_PATH/spk/ORMM__110301000000_00774.BSP',
                                 '$KER_PATH/spk/ORMM__110401000000_00780.BSP',
                                 '$KER_PATH/spk/ORMM__110501000000_00788.BSP',
                                 '$KER_PATH/spk/ORMM__110601000000_00794.BSP',
                                 '$KER_PATH/spk/ORMM__110701000000_00802.BSP',
                                 '$KER_PATH/spk/ORMM__110801000000_00815.BSP',
                                 '$KER_PATH/spk/ORMM__110901000000_00822.BSP',
                                 '$KER_PATH/spk/ORMM__111001000000_00822.BSP',
                                 '$KER_PATH/ck/ATNM_P030602191822_00135.BC',
                                 '$KER_PATH/ck/ATNM_P050401000000_00260.BC',
                                 '$KER_PATH/ck/ATNM_P060401000000_00822.BC',
                                 '$KER_PATH/pck/PCK00009.TPC',
                                 '$KER_PATH/pck/MARS_IAU2000_V0.TPC')
\begintext

SUN...
1 AU (from Near Earth Objects Program) = 149 597 870.691 km
LS (deg) at first time 2010-06-27T16:44:48.730:  110.389
SUN apparent position on planet (IAU_MARS) at first time: Long (deg), Lat (deg), Dist
(AU) :  52.987,   23.514,  1.6280
SUN ra, dec (deg, EMEJ2000) at first time :  14.629,    5.126

TARGET... O060
CENTER of slit, mechanical offsets in SC axes (in degrees) :   90.000  89.830

UV: codop, x0(first CCD column read), y0(first CCD line read), binning value for each
band, width, height : 101   0 133   4   4   4   4   4 408   5

Parameters definition...
1stB, 2ndB, 3rdB, 4thB, and 5thB are center of UV Bands (binning included).
For all kind of observations, the line of sight (LOS) emanating from the center of a UV
band is defined by SC attitude.
In the case of star observations, geometry parameters are also computed for a LOS
emanating from the UV CCD center,
but defined by S/C position and Star direction. (This LOS is called LOSE in the following
description of parameters
to distinguish from LOS defined by SC attitude).

Planproj is the projection plane (u,v,w frame) defined as the plane at the nearest point
on MARS
to vdir and perpendicular to vdir (view direction from MEX); with w = -vdir , v = North
pole, u = right handed.
The view direction is LOS emanating from the center of the CCD and defined by SC
attitude.
```

```
Time UTC   (A23) + (I5, F9.1, 2F8.2, F7.1, F8.2, F7.2, F7.1, F10.1, F11.2, F8.2,
2F9.3,F7.2, 2F8.2, F6.2, F7.2, 2F10.1,F7.2, F8.2, F7.2, F11.2,2F9.3, F8.2, F7.2,
F11.2,2F9.3, F8.2, F7.2, F11.2,2F9.3, F8.2, F7.2, F11.2,2F9.3, 9F11.6, F8.2,F8.2,
10F10.2, 6F8.2, F8.2, F7.2, F7.1, F10.1, F11.2, F8.2, 2F9.3,F7.2, 2F8.2, F6.2, F7.2,
F10.1)

Number of parameters (without Time): 82
Reference number in geometry software, Column number, Label
  0  1 Record number
 19  2 Altitude  of the spacecraft above PLANET ellipsoid (in km, IAU_MARS)
 17  3 Longitude of the sub-spacecraft point (in degrees, increases toward East from 0 to
360, IAU_MARS)
 18  4 Latitude  of the sub-spacecraft point (in degrees, IAU_MARS)
 20  5 Solar Zenith Angle at sub-spacecraft point (in degrees, IAU_MARS)
141  6 Longitude of nearest point on MARS ellipsoid to LOS emanating from the center of
3rdB band (in degrees, IAU_MARS)
142  7 Latitude  of nearest point on MARS ellipsoid to LOS emanating from the center of
3rdB band (in degrees, IAU_MARS)
145  8 Solar zenith angle at nearest point on MARS ellipsoid to LOS emanating from the
center of 3rdB band (in degrees, IAU_MARS)
144  9 Distance  from MEX to nearest point on MARS ellipsoid to LOS emanating from the
center of 3rdB band (in kms, IAU_MARS, < 0 if behind SC)
143 10 Altitude  above the nearest point on MARS ellipsoid of LOS emanating from the
center of 3rdB band (in kms, IAU_MARS, < 0 IF intersection)
146 11 Pixel (0.01 deg) size at nearest point on MARS ellipsoid to LOS emanating from the
center of 3rdB band (in kms, IAU_MARS)
147 12 Right ascension of LOS emanating from the center of 3rdB band (in degrees,
EMEJ2000)
148 13 Declination       of LOS emanating from the center of 3rdB band (in degrees,
EMEJ2000)
149 14 Angle between S/C-SUN vector and LOS emanating from the center of 3rdB band (in
degrees, IAU_MARS)
150 15 Phase angle between the SUN and the Observer measured at the nearest point on MARS
ellipsoid to LOS emanating from the center of 3rdB band (in degrees)
151 16 Solar incidence angle between SUN and Normal at nearest point on MARS ellipsoid to
LOS emanating from the center of 3rdB band (in degrees)
152 17 Solar local time at nearest point on MARS ellipsoid to LOS emanating from the
center of 3rdB band (in degrees)
153 18 Emission angle between Normal and Observer at nearest point on MARS ellipsoid to
LOS emanating from the center of 3rdB band (in degrees)
155 19 Distance between the nearest point on LOS emanating from the center of 3rdB band
(in degrees) and center of MARS (in kms)
154 20 Distance between MEX position and center of MARS (in kms)
156 21 Azimut    of SUN in MEX axes (relative to X, in degrees)
101 22 Longitude of nearest point on MARS ellipsoid to LOS emanating from the center of
1stB band (in degrees, IAU_MARS)
102 23 Latitude  of nearest point on MARS ellipsoid to LOS emanating from the center of
1stB band (in degrees, IAU_MARS)
103 24 Altitude  above the nearest point on MARS ellipsoid of LOS emanating from the
center of 1stB band (in kms, IAU_MARS, < 0 IF intersection)
107 25 Right ascension of LOS emanating from the center of 1stB band (in degrees,
EMEJ2000)
108 26 Declination       of LOS emanating from the center of 1stB band (in degrees,
EMEJ2000)
121 27 Longitude of nearest point on MARS ellipsoid to LOS emanating from the center of
2ndB band (in degrees, IAU_MARS)
122 28 Latitude  of nearest point on MARS ellipsoid to LOS emanating from the center of
2ndB band (in degrees, IAU_MARS)
123 29 Altitude  above the nearest point on MARS ellipsoid of LOS emanating from the
center of 2ndB band (in kms, IAU_MARS, < 0 IF intersection)
127 30 Right ascension of LOS emanating from the center of 2ndB band (in degrees,
EMEJ2000)
128 31 Declination       of LOS emanating from the center of 2ndB band (in degrees,
EMEJ2000)
161 32 Longitude of nearest point on MARS ellipsoid to LOS emanating from the center of
4thB band (in degrees, IAU_MARS)
162 33 Latitude  of nearest point on MARS ellipsoid to LOS emanating from the center of
4thB band (in degrees, IAU_MARS)
163 34 Altitude  above the nearest point on MARS ellipsoid of LOS emanating from the
center of 4thB band (in kms, IAU_MARS, < 0 IF intersection)
167 35 Right ascension of LOS emanating from the center of 4thB band (in degrees,
EMEJ2000)
```

168 36 Declination of LOS emanating from the center of 4thB band (in degrees, EMEJ2000)
181 37 Longitude of nearest point on MARS ellipsoid to LOS emanating from the center of 5thB band (in degrees, IAU_MARS)
182 38 Latitude of nearest point on MARS ellipsoid to LOS emanating from the center of 5thB band (in degrees, IAU_MARS)
183 39 Altitude above the nearest point on MARS ellipsoid of LOS emanating from the center of 5thB band (in kms, IAU_MARS, < 0 IF intersection)
187 40 Right ascension of LOS emanating from the center of 5thB band (in degrees, EMEJ2000)
188 41 Declination of LOS emanating from the center of 5thB band (in degrees, EMEJ2000)
87 42 X component of the unit inertial pointing vector (1,0,0) in MEX coordinates relative to MARSIAU frame
88 43 Y component of the unit inertial pointing vector (1,0,0) in MEX coordinates relative to MARSIAU frame
89 44 Z component of the unit inertial pointing vector (1,0,0) in MEX coordinates relative to MARSIAU frame
90 45 X component of the unit inertial pointing vector (0,1,0) in MEX coordinates relative to MARSIAU frame
91 46 Y component of the unit inertial pointing vector (0,1,0) in MEX coordinates relative to MARSIAU frame
92 47 Z component of the unit inertial pointing vector (0,1,0) in MEX coordinates relative to MARSIAU frame
93 48 X component of the unit inertial pointing vector (0,0,1) in MEX coordinates relative to MARSIAU frame
94 49 Y component of the unit inertial pointing vector (0,0,1) in MEX coordinates relative to MARSIAU frame
95 50 Z component of the unit inertial pointing vector (0,0,1) in MEX coordinates relative to MARSIAU frame
312 51 Angle between the S/C X axis and the local verticale at MARS Nearest Point (in degrees)
301 52 Angle between the projection plane U axis and the S/C X axis projected on this plane (in degrees)
302 53 P1 u horizon point component in Planproj
303 54 P1 v horizon point component in Planproj
304 55 P2 u horizon point component in Planproj
305 56 P2 v horizon point component in Planproj
306 57 P3 u horizon point component in Planproj
307 58 P3 v horizon point component in Planproj
308 59 P4 u horizon point component in Planproj
309 60 P4 v horizon point component in Planproj
310 61 P5 u horizon point component in Planproj
311 62 P5 v horizon point component in Planproj
320 63 X ra component of transformation matrix from IAU_MARS to EMEJ2000
321 64 X dec component of transformation matrix from IAU_MARS to EMEJ2000
322 65 Y ra component of transformation matrix from IAU_MARS to EMEJ2000
323 66 Y dec component of transformation matrix from IAU_MARS to EMEJ2000
324 67 Z ra component of transformation matrix from IAU_MARS to EMEJ2000
325 68 Z dec component of transformation matrix from IAU_MARS to EMEJ2000
31 69 Longitude of nearest point on MARS ellipsoid to LOSE emanating from the CCD (in degrees, IAU_MARS)
32 70 Latitude of nearest point on MARS ellipsoid to LOSE emanating from the CCD (in degrees, IAU_MARS)
35 71 Solar zenith angle at nearest point on MARS ellipsoid to LOSE emanating from the CCD (in degrees, IAU_MARS)
34 72 Distance from MEX to nearest point on MARS ellipsoid to LOSE emanating from the CCD (in kms, IAU_MARS, < 0 if behind SC)
33 73 Altitude above the nearest point on MARS ellipsoid of LOSE emanating from the CCD (in kms, IAU_MARS, < 0 IF intersection)
36 74 Pixel (0.01 deg) size at nearest point on MARS ellipsoid to LOSE emanating from the CCD (in kms, IAU_MARS)
37 75 Right ascension of LOSE emanating from the CCD (in degrees, EMEJ2000)
38 76 Declination of LOSE emanating from the CCD (in degrees, EMEJ2000)
39 77 Angle between S/C-SUN vector and LOSE emanating from the CCD (in degrees, IAU_MARS)
40 78 Phase angle between the SUN and the Observer measured at the nearest point on MARS ellipsoid to LOSE emanating from the CCD (in degrees)
41 79 Solar incidence angle between SUN and Normal at nearest point on MARS ellipsoid to LOSE emanating from the CCD (in degrees)
42 80 Solar local time at nearest point on MARS ellipsoid to LOSE emanating from the CCD (in degrees)

```
 43 81 Emission angle between Normal and Observer at nearest point on MARS ellipsoid to
LOSE emanating from the CCD (in degrees)
 45 82 Distance between the nearest point on LOSE emanating from the CCD (in degrees) and
center of MARS (in kms)

       Time (UTC)           1          2         3         4        5        6       7       8
-- End Comments
2010-06-27T16:44:48.730     1     476.6   133.29   -42.12    98.8   132.38 -37.67    96.5     -
2010-06-27T16:44:49.730     2     475.9   133.29   -42.06    98.8   132.39 -37.67    96.5     -
2010-06-27T16:44:50.730     3     475.3   133.29   -42.00    98.7   132.40 -37.67    96.5     -
2010-06-27T16:44:51.730     4    474.6  133.29   -41.93   98.7  132.42 -37.67   96.5    -
2010-06-27T16:44:52.730     5    473.9  133.29   -41.87   98.7  132.43 -37.67   96.5    -
```

Figure 7. Geometry file header example.

```
PDS_VERSION_ID = PDS3

RECORD_TYPE   = FIXED_LENGTH
RECORD_BYTES  = 743
^HEADER                     = ("SPIM_0AU_08302A01_E_GO_01.TXT",1<BYTES>)
^TABLE                      = ("SPIM_0AU_08302A01_E_GO_01.TXT",18067<BYTES>)


FILE_NAME                      = "SPIM_0AU_08302A01_E_GO_01.TXT"
DATA_SET_ID                    = "MEX-M-SPI-2-UVEDR-RAWXMARS-EXT3-V2.0"
DATA_SET_NAME                  = "MEX EXT 3 SPICAM MARS UV EDR-RAW V2.0"
RELEASE_ID                     = 0001
REVISION_ID                    = 0000

PRODUCT_ID                     = "SPIM_0AU_08302A01_E_GO_01.TXT"
PRODUCT_CREATION_TIME          = 2011-10-08T01:19:27.000
MISSION_NAME                   = "MARS EXPRESS"
INSTRUMENT_HOST_NAME           = "MARS EXPRESS"
INSTRUMENT_HOST_ID             =  MEX
MISSION_PHASE_NAME             = "ME Phase 21"
INSTRUMENT_NAME                = "SPICAM"
DISTRIBUTION_TYPE              = GEOMETRY

DESCRIPTION   = "This file contains geometry and position information of a
                UV SPICAM observation. The geometry file has the same sampling
                resolution as the data file."


OBJECT     = HEADER
  BYTES              = 18067
  RECORDS            = 229
  HEADER_TYPE        = TEXT
  INTERCHANGE_FORMAT = ASCII
  DESCRIPTION        = "The header, which ends with the --End Comments line,
                        gives information like: the name and the version of
                        the software used to generate the geometry file, and
                        the date of the file generation; the list of SPICE
                        kernels required to perform the computations, solar
                        related parameters (longitude, latitude, distance from
                        the spacecraft) at the first time of observation; the
                        kind of target [NAD/LIMB, SUN, Oxx(name of the star)]:
                        the processing of the geometry file is different for
                        star and sun observations; parameters definition : the
                        list and a brief definition of parameters computed is
                        given. The number just before the parameter definition
                        is an internal use (do not care)."
END_OBJECT = HEADER

OBJECT     = TABLE
  NAME               = GEOMETRY
  INTERCHANGE_FORMAT = ASCII
  ROWS               = 641
  COLUMNS            =  83
```

```
ROW_BYTES            = 743

OBJECT      = COLUMN
  NAME           = GEOMETRY_EPOCH
  COLUMN_NUMBER = 1
  DATA_TYPE      = TIME
  START_BYTE     = 1
  BYTES          = 23
  FORMAT         = "A23"
  DESCRIPTION    = "UTC time when the geometrical and position parameters are
                    computed"
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = RECORD_NUMBER
  COLUMN_NUMBER = 2
  DATA_TYPE      = INTEGER
  START_BYTE     = 24
  BYTES          = 6
  FORMAT         = "I6"
  DESCRIPTION    = "Record number"
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = SPACECRAFT_ALTITUDE
  COLUMN_NUMBER = 3
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 30
  BYTES          = 9
  FORMAT         = "F9.1"
  DESCRIPTION    = "Altitude of the spacecraft above Mars ellipsoid
                    (in kms, IAU_MARS frame)."
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = SUB_SPACECRAFT_LONGITUDE
  COLUMN_NUMBER = 4
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 39
  BYTES          = 8
  FORMAT         = "F8.2"
  MINIMUM        = 0
  MAXIMUM        = 359.999
  DESCRIPTION    = "Longitude of the sub-spacecraft point.
                    Longitude increases towards East.
                    (in degrees, IAU_MARS frame)"
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = SUB_SPACECRAFT_LATITUDE
  COLUMN_NUMBER = 5
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 47
  BYTES          = 8
  FORMAT         = "F8.2"
  MINIMUM        = -90.000
  MAXIMUM        = 90.000
  DESCRIPTION    = "Latitude of the sub-spacecraft point.
                    (in degrees, IAU_MARS frame)"
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = SOLAR_ZENITH_ANGLE
  COLUMN_NUMBER = 6
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 55
  BYTES          = 7
  FORMAT         = "F7.1"
  DESCRIPTION    = "Solar Zenith Angle at sub-spacecraft point.
                    (in degrees,IAU_MARS frame)"
END_OBJECT = COLUMN

OBJECT      = COLUMN
```

```
    NAME          = B3_MNP_LONGITUDE
    COLUMN_NUMBER = 7
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 62
    BYTES         = 8
    FORMAT        = "F8.2"
    DESCRIPTION   = "Longitude of nearest point on MARS ellipsoid to LOS
                     emanating from the center of 3rd band.
                     (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME          = B3_MNP_LATITUDE
    COLUMN_NUMBER = 8
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 70
    BYTES         = 7
    FORMAT        = "F7.2"
    DESCRIPTION   = "Latitude  of nearest point on MARS ellipsoid to LOS
                     emanating from the center of 3rd band.
                     (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME          = B3_MNP_SZA
    COLUMN_NUMBER = 9
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 77
    BYTES         = 7
    FORMAT        = "F7.1"
    DESCRIPTION   = "Solar zenith angle at nearest point on MARS ellipsoid to
                       LOS emanating from the center of 3rd band.
                       (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

 OBJECT      = COLUMN
    NAME        = B3_SC_MNP_DISTANCE
    COLUMN_NUMBER = 10
    DATA_TYPE   = ASCII_REAL
    START_BYTE  = 84
    BYTES       = 10
    FORMAT      = "F10.1"
    DESCRIPTION = "Distance  from MEX to nearest point on MARS ellipsoid to
                   LOS emanating from the center of 3rd band.
                   (in kms, IAU_MARS, < 0 if behind SC)"
  END_OBJECT = COLUMN

 OBJECT      = COLUMN
    NAME        = B3_MNP_ALTITUDE
    COLUMN_NUMBER = 11
    DATA_TYPE   = ASCII_REAL
    START_BYTE  = 94
    BYTES       = 10
    FORMAT      = "F10.1"
    DESCRIPTION = "Altitude  above the nearest point on MARS ellipsoid of LOS
                   emanating from the center of 3rd band.
                   (in kms, IAU_MARS, < 0 IF intersection)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME          = B3_PIXEL_SIZE
    COLUMN_NUMBER = 12
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 104
    BYTES         = 8
    FORMAT        = "F8.2"
    DESCRIPTION   = "Pixel (0.01 deg) size at nearest point on MARS ellipsoid
                     to LOS emanating from the center of 3rd band.
                     (in kms, IAU_MARS)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME          = B3_LOS_RA
```

```
    COLUMN_NUMBER = 13
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 112
    BYTES         = 9
    FORMAT        = "F9.3"
    DESCRIPTION   = "Right ascension of LOS emanating from the center of 3rd
                     band.(in degrees, EMEJ2000)"
  END_OBJECT = COLUMN

  OBJECT     = COLUMN
    NAME          = B3_LOS_DEC
    COLUMN_NUMBER = 14
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 121
    BYTES         = 9
    FORMAT        = "F9.3"
    DESCRIPTION   = "Declination of LOS emanating from the center of 3rd band.
                     (in degrees, EMEJ2000)"
  END_OBJECT = COLUMN

  OBJECT     = COLUMN
    NAME          = B3_MNP_SUN_ANGLE
    COLUMN_NUMBER = 15
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 130
    BYTES         = 7
    FORMAT        = "F7.2"
    DESCRIPTION   = "Angle between S/C-SUN vector and LOS emanating from the
                     center of 3rd band. (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

  OBJECT     = COLUMN
    NAME          = B3_MNP_PHASE_ANGLE
    COLUMN_NUMBER = 16
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 137
    BYTES         = 8
    FORMAT        = "F8.2"
    DESCRIPTION   = "Phase angle between the SUN and the Observer measured at
                     the nearest point on MARS ellipsoid to LOS emanating
                     from the center of 3rd band. (in degrees)"
  END_OBJECT = COLUMN

  OBJECT     = COLUMN
    NAME          = B3_MNP_INCIDENCE_ANGLE
    COLUMN_NUMBER = 17
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 145
    BYTES         = 8
    FORMAT        = "F8.2"
    DESCRIPTION   = "Solar incidence angle between SUN and Normal at nearest
                     point on MARS ellipsoid to LOS emanating from the center
                     of 3rd band. (in degrees)"
  END_OBJECT = COLUMN

  OBJECT     = COLUMN
    NAME          = B3_MNP_SOLAR_LOCAL_TIME
    COLUMN_NUMBER = 18
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 153
    BYTES         = 6
    FORMAT        = "F6.2"
    DESCRIPTION   = "Solar local time at nearest point on MARS ellipsoid to
                     LOS emanating from the center of 3rdB band (in degrees)"
  END_OBJECT = COLUMN

  OBJECT     = COLUMN
    NAME          = B3_MNP_EMISSION_ANGLE
    COLUMN_NUMBER = 19
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 159
    BYTES         = 7
    FORMAT        = "F7.2"
```

```
    DESCRIPTION    = "Emission angle between Normal and Observer at nearest
                      point on MARS ellipsoid to LOS emanating from the center
                      of 3rd band. (in degrees)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = B3_MNP_MARS_DISTANCE
    COLUMN_NUMBER = 20
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 166
    BYTES          = 10
    FORMAT         = "F10.1"
    DESCRIPTION    = "Distance between the nearest point on LOS emanating from
                      the center of 3rdB band (in degrees) and center of MARS.
                      (in kms)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = MEX_MARS_DISTANCE
    COLUMN_NUMBER = 21
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 176
    BYTES          = 10
    FORMAT         = "F10.1"
    DESCRIPTION    = "Distance between MEX position and center of MARS.
                      (in kms)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = AZIMUT_SUN
    COLUMN_NUMBER = 22
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 186
    BYTES          = 7
    FORMAT         = "F7.2"
    DESCRIPTION    = "Azimut of SUN in MEX axes. (relative to X, in degrees)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = B1_MNP_LONGITUDE
    COLUMN_NUMBER = 23
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 193
    BYTES          = 8
    FORMAT         = "F8.2"
    DESCRIPTION    = "Longitude of nearest point on MARS ellipsoid to LOS
                      emanating from the center of 1st band.
                      (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = B1_MNP_LATITUDE
    COLUMN_NUMBER = 24
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 201
    BYTES          = 7
    FORMAT         = "F7.2"
    DESCRIPTION    = "Latitude  of nearest point on MARS ellipsoid to LOS
                      emanating from the center of 1st band.
                      (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = B1_MNP_ALTITUDE
    COLUMN_NUMBER = 25
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 208
    BYTES          = 10
    FORMAT         = "F10.1"
    DESCRIPTION    = "Altitude  above the nearest point on MARS ellipsoid of
                      LOS emanating from the center of 1st band.
                      (in kms, IAU_MARS, < 0 IF intersection)"
  END_OBJECT = COLUMN
```

```
 OBJECT      = COLUMN
   NAME            = B1_LOS_RA
   COLUMN_NUMBER = 26
   DATA_TYPE      = ASCII_REAL
   START_BYTE     = 218
   BYTES          = 9
   FORMAT         = "F9.3"
   DESCRIPTION    = "Right ascension of LOS emanating from the center of 1st
                     band. (in degrees, EMEJ2000)"
 END_OBJECT = COLUMN

 OBJECT      = COLUMN
   NAME            = B1_LOS_DEC
   COLUMN_NUMBER = 27
   DATA_TYPE      = ASCII_REAL
   START_BYTE     = 227
   BYTES          = 9
   FORMAT         = "F9.3"
   DESCRIPTION    = "Declination of LOS emanating from the center of 1st band.
                     (in degrees, EMEJ2000)"
 END_OBJECT = COLUMN

 OBJECT      = COLUMN
   NAME            = B2_MNP_LONGITUDE
   COLUMN_NUMBER = 28
   DATA_TYPE      = ASCII_REAL
   START_BYTE     = 236
   BYTES          = 8
   FORMAT         = "F8.2"
   DESCRIPTION    = "Longitude of nearest point on MARS ellipsoid to LOS
                     emanating from the center of 2nd band.
                     (in degrees, IAU_MARS)"
 END_OBJECT = COLUMN

 OBJECT      = COLUMN
   NAME            = B2_MNP_LATITUDE
   COLUMN_NUMBER = 29
   DATA_TYPE      = ASCII_REAL
   START_BYTE     = 244
   BYTES          = 7
   FORMAT         = "F7.2"
   DESCRIPTION    = "Latitude  of nearest point on MARS ellipsoid to LOS
                     emanating from the center of 2nd band.
                     (in degrees, IAU_MARS)"
 END_OBJECT = COLUMN

OBJECT      = COLUMN
   NAME            = B2_MNP_ALTITUDE
   COLUMN_NUMBER = 30
   DATA_TYPE      = ASCII_REAL
   START_BYTE     = 251
   BYTES          = 10
   FORMAT         = "F10.1"
   DESCRIPTION    = "Altitude  above the nearest point on MARS ellipsoid of
                     LOS emanating from the center of 2nd band.
                     (in kms, IAU_MARS, < 0 IF intersection)"
 END_OBJECT = COLUMN

 OBJECT      = COLUMN
   NAME            = B2_LOS_RA
   COLUMN_NUMBER = 31
   DATA_TYPE      = ASCII_REAL
   START_BYTE     = 261
   BYTES          = 9
   FORMAT         = "F9.3"
   DESCRIPTION    = "Right ascension of LOS emanating from the center of 2nd
                     band. (in degrees, EMEJ2000)"
 END_OBJECT = COLUMN

 OBJECT      = COLUMN
   NAME            = B2_LOS_DEC
   COLUMN_NUMBER = 32
```

```
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 270
    BYTES          = 9
    FORMAT         = "F9.3"
    DESCRIPTION    = "Declination of LOS emanating from the center of 2nd band.
                      (in degrees, EMEJ2000)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = B4_MNP_LONGITUDE
    COLUMN_NUMBER = 33
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 279
    BYTES          = 8
    FORMAT         = "F8.2"
    DESCRIPTION    = "Longitude of nearest point on MARS ellipsoid to LOS
                      emanating from the center of 4th band.
                      (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = B4_MNP_LATITUDE
    COLUMN_NUMBER = 34
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 287
    BYTES          = 7
    FORMAT         = "F7.2"
    DESCRIPTION    = "Latitude of nearest point on MARS ellipsoid to LOS
                      emanating from the center of 4th band.
                      (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

 OBJECT      = COLUMN
    NAME           = B4_MNP_ALTITUDE
    COLUMN_NUMBER = 35
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 294
    BYTES          = 10
    FORMAT         = "F10.1"
    DESCRIPTION    = "Altitude  above the nearest point on MARS ellipsoid of
                      LOS emanating from the center of 4th band.
                      (in kms, IAU_MARS, < 0 IF intersection)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = B4_LOS_RA
    COLUMN_NUMBER = 36
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 304
    BYTES          = 9
    FORMAT         = "F9.3"
    DESCRIPTION    = "Right ascension of LOS emanating from the center of 4th
                      band. (in degrees, EMEJ2000)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = B4_LOS_DEC
    COLUMN_NUMBER = 37
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 313
    BYTES          = 9
    FORMAT         = "F9.3"
    DESCRIPTION    = "Declination of LOS emanating from the center of 4th band.
                      (in degrees, EMEJ2000)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = B5_MNP_LONGITUDE
    COLUMN_NUMBER = 38
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 322
    BYTES          = 8
    FORMAT         = "F8.2"
```

```
    DESCRIPTION    = "Longitude of nearest point on MARS ellipsoid to LOS
                       emanating from the center of 5th band.
                       (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = B5_MNP_LATITUDE
    COLUMN_NUMBER = 39
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 330
    BYTES          = 7
    FORMAT         = "F7.2"
    DESCRIPTION    = "Latitude of nearest point on MARS ellipsoid to LOS
                       emanating from the center of 5th band.
                       (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

 OBJECT      = COLUMN
    NAME           = B5_MNP_ALTITUDE
    COLUMN_NUMBER = 40
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 337
    BYTES          = 10
    FORMAT         = "F10.1"
    DESCRIPTION    = "Altitude  above the nearest point on MARS ellipsoid of
                       LOS emanating from the center of 5th band.
                       (in kms, IAU_MARS, < 0 IF intersection)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = B5_LOS_RA
    COLUMN_NUMBER = 41
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 347
    BYTES          = 9
    FORMAT         = "F9.3"
    DESCRIPTION    = "Right ascension of LOS emanating from the center of 5th
                       band. (in degrees, EMEJ2000)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = B5_LOS_DEC
    COLUMN_NUMBER = 42
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 356
    BYTES          = 9
    FORMAT         = "F9.3"
    DESCRIPTION    = "Declination of LOS emanating from the center of 5th band.
                       (in degrees, EMEJ2000)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = XSC_X
    COLUMN_NUMBER = 43
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 365
    BYTES          = 11
    FORMAT         = "F11.6"
    DESCRIPTION    = "X component of the unit inertial pointing vector (1,0,0)
                       in MEX coordinates relative to MARSIAU frame."
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = XSC_Y
    COLUMN_NUMBER = 44
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 376
    BYTES          = 11
    FORMAT         = "F11.6"
    DESCRIPTION    = "Y component of the unit inertial pointing vector (1,0,0)
                       in MEX coordinates relative to MARSIAU frame."
  END_OBJECT = COLUMN
```

```
OBJECT      = COLUMN
  NAME           = XSC_Z
  COLUMN_NUMBER = 45
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 387
  BYTES          = 11
  FORMAT         = "F11.6"
  DESCRIPTION    = "Z component of the unit inertial pointing vector (1,0,0)
                    in MEX coordinates relative to MARSIAU frame."
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = YSC_X
  COLUMN_NUMBER = 46
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 398
  BYTES          = 11
  FORMAT         = "F11.6"
  DESCRIPTION    = "X component of the unit inertial pointing vector (0,1,0)
                    in MEX coordinates relative to MARSIAU frame."
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = YSC_Y
  COLUMN_NUMBER = 47
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 409
  BYTES          = 11
  FORMAT         = "F11.6"
  DESCRIPTION    = "Y component of the unit inertial pointing vector (0,1,0)
                    in MEX coordinates relative to MARSIAU frame."
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = YSC_Z
  COLUMN_NUMBER = 48
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 420
  BYTES          = 11
  FORMAT         = "F11.6"
  DESCRIPTION    = "Z component of the unit inertial pointing vector (0,1,0)
                    in MEX coordinates relative to MARSIAU frame."
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = ZSC_X
  COLUMN_NUMBER = 49
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 431
  BYTES          = 11
  FORMAT         = "F11.6"
  DESCRIPTION    = "X component of the unit inertial pointing vector (0,0,1)
                    in MEX coordinates relative to MARSIAU frame."
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = ZSC_Y
  COLUMN_NUMBER = 50
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 442
  BYTES          = 11
  FORMAT         = "F11.6"
  DESCRIPTION    = "Y component of the unit inertial pointing vector (0,0,1)
                    in MEX coordinates relative to MARSIAU frame."
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = ZSC_Z
  COLUMN_NUMBER = 51
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 453
  BYTES          = 11
  FORMAT         = "F11.6"
```

```
  DESCRIPTION    = "Z component of the unit inertial pointing vector (0,0,1)
                    in MEX coordinates relative to MARSIAU frame."
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = XSC_LV_MNP_ANGLE
  COLUMN_NUMBER = 52
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 464
  BYTES          = 8
  FORMAT         = "F8.2"
  DESCRIPTION    = "Angle between the S/C X axis and the local verticale at
                    MARS Nearest Point. (in degrees)"
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = UPLAN_XSC_ANGLE
  COLUMN_NUMBER = 53
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 472
  BYTES          = 8
  FORMAT         = "F8.2"
  DESCRIPTION    = "Angle between XSC and the projection plane U axis
                   (in degrees). The projection plane (u,v,w frame) is
                    defined as the plane at the nearest point on MARS and
                    perpendicular to vdir (view direction from MEX), with
                    w = -vdir,v = north pole , u = right handed  "
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = P1_U
  COLUMN_NUMBER = 54
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 480
  BYTES          = 10
  FORMAT         = "F10.2"
  DESCRIPTION    = "The horizon is described by 5 points in the projection
                    plane. P1_U is the u component of Point1 in the
                    projection plane (see definition above)"
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = P1_V
  COLUMN_NUMBER = 55
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 490
  BYTES          = 10
  FORMAT         = "F10.2"
  DESCRIPTION    = "The horizon is described by 5 points in the projection
                    plane. P1_V is the v component of Point1 in the
                    projection plane (see definition above)"
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = P2_U
  COLUMN_NUMBER = 56
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 500
  BYTES          = 10
  FORMAT         = "F10.2"
  DESCRIPTION    = "The horizon is described by 5 points in the projection
                    plane. P2_U is the u component of Point2 in the
                    projection plane (see definition above)"
END_OBJECT = COLUMN

OBJECT      = COLUMN
  NAME           = P2_V
  COLUMN_NUMBER = 57
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 510
  BYTES          = 10
  FORMAT         = "F10.2"
  DESCRIPTION    = "The horizon is described by 5 points in the projection
```

```
                           plane. P2_V is the v component of Point2 in the
                           projection plane (see definition above)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = P3_U
    COLUMN_NUMBER = 58
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 520
    BYTES         = 10
    FORMAT        = "F10.2"
    DESCRIPTION   = "The horizon is described by 5 points in the projection
                     plane. P3_U is the u component of Point3 in the
                     projection plane (see definition above)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = P3_V
    COLUMN_NUMBER = 59
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 530
    BYTES         = 10
    FORMAT        = "F10.2"
    DESCRIPTION   = "The horizon is described by 5 points in the projection
                     plane. P3_V is the v component of Point3 in the
                     projection plane (see definition above)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = P4_U
    COLUMN_NUMBER = 60
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 540
    BYTES         = 10
    FORMAT        = "F10.2"
    DESCRIPTION   = "The horizon is described by 5 points in the projection
                     plane. P4_U is the u component of Point4 in the
                     projection plane (see definition above) "
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = P4_V
    COLUMN_NUMBER = 61
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 550
    BYTES         = 10
    FORMAT        = "F10.2"
    DESCRIPTION   = "The horizon is described by 5 points in the projection
                     plane. P4_V is the v component of Point4 in the
                     projection plane (see definition above)"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = P5_U
    COLUMN_NUMBER = 62
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 560
    BYTES         = 10
    FORMAT        = "F10.2"
    DESCRIPTION   = "The horizon is described by 5 points in the projection
                     plane. P5_U is the u component of Point5 in the
                     projection plane (see definition above) "
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME            = P5_V
    COLUMN_NUMBER = 63
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 570
    BYTES         = 10
    FORMAT        = "F10.2"
    DESCRIPTION   = "The horizon is described by 5 points in the projection
                     plane. P5_V is the v component of Point5 in the
```

```
                        projection plane (see definition above)"
END_OBJECT = COLUMN

OBJECT     = COLUMN
  NAME            = X_RA_TR
  COLUMN_NUMBER = 64
  DATA_TYPE       = ASCII_REAL
  START_BYTE      = 580
  BYTES           = 8
  FORMAT          = "F8.2"
  DESCRIPTION     = " The transformation matrix from IAU_VENUS to EMEJ2000 is
                    defined as | Xra   Xdec |
                               | Yra   Ydec |
                               | Zra   Zdec |
                    X_RA_TR, is the Xra component of the transformation
                    matrix "
END_OBJECT = COLUMN

OBJECT     = COLUMN
  NAME            = X_DEC_TR
  COLUMN_NUMBER = 65
  DATA_TYPE       = ASCII_REAL
  START_BYTE      = 588
  BYTES           = 8
  FORMAT          = "F8.2"
  DESCRIPTION     = "X_DEC_TR ,is the Xdec component of the transformation
                    matrix (see above) "
END_OBJECT = COLUMN

OBJECT     = COLUMN
  NAME            = Y_RA_TR
  COLUMN_NUMBER = 66
  DATA_TYPE       = ASCII_REAL
  START_BYTE      = 596
  BYTES           = 8
  FORMAT          = "F8.2"
  DESCRIPTION     = "Y_RA_TR ,is the Yra component of the transformation
                    matrix (see above) "
END_OBJECT = COLUMN

OBJECT     = COLUMN
  NAME            = Y_DEC_TR
  COLUMN_NUMBER = 67
  DATA_TYPE       = ASCII_REAL
  START_BYTE      = 604
  BYTES           = 8
  FORMAT          = "F8.2"
  DESCRIPTION     = "Y_DEC_TR ,is the Ydec component of the transformation
                    matrix (see above) "
END_OBJECT = COLUMN

OBJECT     = COLUMN
  NAME            = Z_RA_TR
  COLUMN_NUMBER = 68
  DATA_TYPE       = ASCII_REAL
  START_BYTE      = 612
  BYTES           = 8
  FORMAT          = "F8.2"
  DESCRIPTION     = "Z_RA_TR ,is the Zra component of the transformation
                    matrix (see above)"
END_OBJECT = COLUMN

OBJECT     = COLUMN
  NAME            = Z_DEC_TR
  COLUMN_NUMBER = 69
  DATA_TYPE       = ASCII_REAL
  START_BYTE      = 620
  BYTES           = 8
  FORMAT          = "F8.2"
  DESCRIPTION     = "Z_DEC_TR ,is the Zdec component of the transformation
                    matrix (see above) "
END_OBJECT = COLUMN
```

```
 OBJECT      = COLUMN
   NAME            = LOS_MNP_LONGITUDE
   COLUMN_NUMBER = 70
   DATA_TYPE       = ASCII_REAL
   START_BYTE      = 628
   BYTES           = 8
   FORMAT          = "F8.2"
   DESCRIPTION     = "Longitude of nearest point on MARS ellipsoid to LOSE
                      emanating from the CCD. (in degrees, IAU_MARS)"
 END_OBJECT = COLUMN

 OBJECT      = COLUMN
   NAME            = LOS_MNP_LATITUDE
   COLUMN_NUMBER = 71
   DATA_TYPE       = ASCII_REAL
   START_BYTE      = 636
   BYTES           = 7
   FORMAT          = "F7.2"
   DESCRIPTION     = "Latitude of nearest point on MARS ellipsoid to LOSE
                      emanating from the CCD. (in degrees, IAU_MARS)"
 END_OBJECT = COLUMN

 OBJECT      = COLUMN
   NAME            = LOS_MNP_SZA
   COLUMN_NUMBER = 72
   DATA_TYPE       = ASCII_REAL
   START_BYTE      = 643
   BYTES           = 7
   FORMAT          = "F7.1"
   DESCRIPTION     = "Solar zenith angle at nearest point on MARS ellipsoid to
                      LOSE emanating from the CCD. (in degrees, IAU_MARS)"
 END_OBJECT = COLUMN

 OBJECT      = COLUMN
   NAME            = LOS_SC_MNP_DISTANCE
   COLUMN_NUMBER = 73
   DATA_TYPE       = ASCII_REAL
   START_BYTE      = 650
   BYTES           = 10
   FORMAT          = "F10.1"
   DESCRIPTION     = "Distance  from MEX to nearest point on MARS ellipsoid to
                      LOSE emanating from the CCD.
                      (in kms, IAU_MARS, < 0 if behind SC)"
 END_OBJECT = COLUMN

OBJECT      = COLUMN
   NAME            = LOS_MNP_ALTITUDE
   COLUMN_NUMBER = 74
   DATA_TYPE       = ASCII_REAL
   START_BYTE      = 660
   BYTES           = 10
   FORMAT          = "F10.1"
   DESCRIPTION     = "Altitude  above the nearest point on MARS ellipsoid of
                      LOSE emanating from the CCD.
                      (in kms, IAU_MARS, < 0 IF intersection)"
 END_OBJECT = COLUMN

OBJECT      = COLUMN
   NAME            = LOS_PIXEL_SIZE
   COLUMN_NUMBER = 75
   DATA_TYPE       = ASCII_REAL
   START_BYTE      = 670
   BYTES           = 8
   FORMAT          = "F8.2"
   DESCRIPTION     = "Pixel (0.01 deg) size at nearest point on MARS ellipsoid
                      to LOSE emanating from the CCD.
                      (in kms, IAU_MARS)"
 END_OBJECT = COLUMN

OBJECT      = COLUMN
   NAME            = LOS_RA
   COLUMN_NUMBER = 76
   DATA_TYPE       = ASCII_REAL
```

```
    START_BYTE     = 678
    BYTES          = 9
    FORMAT         = "F9.3"
    DESCRIPTION    = "Right ascension of LOSE emanating from the CCD.
                      (in degrees, EMEJ2000)"
  END_OBJECT = COLUMN

OBJECT      = COLUMN
    NAME           = LOS_DEC
    COLUMN_NUMBER = 77
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 687
    BYTES          = 9
    FORMAT         = "F9.3"
    DESCRIPTION    = "Declination of LOSE emanating from the CCD.
                      (in degrees, EMEJ2000)"
  END_OBJECT = COLUMN

OBJECT      = COLUMN
    NAME           = LOS_MNP_SUN_ANGLE
    COLUMN_NUMBER = 78
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 696
    BYTES          = 7
    FORMAT         = "F7.2"
    DESCRIPTION    = "Angle between S/C-SUN vector and LOSE emanating from the
                      CCD. (in degrees, IAU_MARS)"
  END_OBJECT = COLUMN

OBJECT      = COLUMN
    NAME           = LOS_MNP_PHASE_ANGLE
    COLUMN_NUMBER = 79
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 703
    BYTES          = 8
    FORMAT         = "F8.2"
    DESCRIPTION    = "Phase angle between the SUN and the Observer measured at
                      the nearest point on MARS ellipsoid to LOSE emanating
                      from the CCD. (in degrees)"
  END_OBJECT = COLUMN

OBJECT      = COLUMN
    NAME           = LOS_MNP_INCIDENCE_ANGLE
    COLUMN_NUMBER = 80
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 711
    BYTES          = 8
    FORMAT         = "F8.2"
    DESCRIPTION    = "Solar incidence angle between SUN and Normal at nearest
                      point on MARS ellipsoid to LOSE emanating from the CCD.
                      (in degrees)"
  END_OBJECT = COLUMN

OBJECT      = COLUMN
    NAME           = LOS_MNP_SOLAR_LOCAL_TIME
    COLUMN_NUMBER = 81
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 719
    BYTES          = 6
    FORMAT         = "F6.2"
    DESCRIPTION    = "Solar local time at nearest point on MARS ellipsoid to
                      LOSE emanating from the CCD. (in degrees)"
  END_OBJECT = COLUMN

OBJECT      = COLUMN
    NAME           = LOS_EMISSION_ANGLE
    COLUMN_NUMBER = 82
    DATA_TYPE      = ASCII_REAL
    START_BYTE     = 725
    BYTES          = 7
    FORMAT         = "F7.2"
    DESCRIPTION    = "Emission angle between Normal and Observer at nearest
                      point on MARS ellipsoid to LOSE emanating from the CCD.
```

```
                     (in degrees)"
  END_OBJECT = COLUMN

OBJECT     = COLUMN
    NAME          = LOS_MARS_DISTANCE
    COLUMN_NUMBER = 83
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 732
    BYTES         = 10
    FORMAT        = "F10.1"
    DESCRIPTION   = "Distance between the nearest point on LOSE emanating from
                     the CCD and center of MARS. (in kms)"
  END_OBJECT = COLUMN

END_OBJECT = TABLE

END
```

Figure 8. Geometry PDS label file example.

3.4.3.7 Software Directory

The SOFTWARE directory contains IDL routines to read the SPICAM UV data files, as a ZIP file SPICAM_READPDSZIP and its corresponding label file, SPICAM_READPDS.LBL.This zip file contains IDL software routines able to read the Mars Express SPICAM-UV PDS data and label files under Windows (not tested under other OS). The software requires RSI/IDL version 6.x. When unzipped, the software is located in the ROOT/SOFTWARE/SPICAM_READPDS directory. Instructions for running the routines are located in the file SPICAM_READPDS_README.TXT, located in the same directory. The main routine readPDS_SPICAM_UV.pro has been developed by the SPICAM team and calls the set of IDL procedures developed at the SBN **(http://pdssbn.astro.umd.edu/nodehtml/software.shtml)** and stored in the readpdsx_4.3 directory.
The DATA directory contains 2 examples of SPICAM data files and associated label filed. The LABEL directory contains the FMT included file describing the structure of the HEADER_ARRAY object in the SPICAM level 0AUV data products.
Version 01 of readPDS_SPICAM_UV works with readPDS version 4.3 Package. Nevertheless note that a small modification has been performed in the pointpds.pro routine on lines 150 and 175. (bug with call to the stregex routine under windows). That's the reason why the readPDS 4.3 Package is archived in the SPICAM UV dataset while it has not been updated by the SBN team. Please not that we do not guarantee that the readPDS_SPICAM_UV SPICAM routine version 01 works with previous or future versions of the readPDS package.

3.4.3.8 Calibration Directory

All calibration documentation needed to use the data will be stored in the DOCUMENT directory of each archive volume. Calibration data files mentioned in the documentation are contained in the CALIB directory of the archive volume.

3.4.3.9 Label Directory

N/A. All PDS detached label files describing data or document files in a volume are in the corresponding directory.
Include files (*.FMT (FORMAT)), containing additional description of data object and referenced by a pointer in a PDS label will be also stored in the corresponding directory of the label file.

3.4.3.10 Document Directory

The DOCUMENT directory contains at least :

- documentation to help the user to understand and use the archive data (this document).
- An ASCII SPICAM UV or IR data files description (eg. SPICAM_UVDATAFILE_DESC.TXT)
- An ASCII SPICAM geometry documentation (eg. SPICAM_GEOMETRY_DESC.TXT)
- An ASCII SPICAM UV or IR calibration documentation (eg. SPICAM_UVCALIB_DESC.TXT)
- An ASCII SPICAM UV operating mode description (SPICAM_UVMODE_DESC.TXT)
- An ASCII Flight User Manual (SPFUM408.PDF)
- An ASCII file informing on the usage of the spacecraft orientation on Mars Express (MEX_ORIENTATION_DESC.TXT)

The SPICAM EAICD document will be provided in both PDF (Adobe Portable Document Format) and ASCII formats, the ASCII version being strongly required by the PSA. PNG files for drawings or tables referenced in it will be also available.
Data file, geometry and calibration documentation will be provided in ASCII format, and the SPICAM flight user manual (FUM) in PDF format only.
Other helpful technical SPICAM documentation provided by the SPICAM team will be provided in the DOCUMENT directory.

4 Detailed Interface Specifications

4.1 Data Product Design

Following sections contain example labels for each of our different data product (for each sensor, and for each data product level). Definitions of individual items contained in the label are given in section 4.1.3. Valid values for each item are shown in brackets [ ], as appropriate.

4.1.1 Data product design and example label of a 0AUV data product

Data product design

A SPICAM 0AUV data product file contains one or several records of an observation. One SPICAM 0AUV record contains all the header and data information from one spicam UV integration result of one sequence of measurement. The header length is 256 bytes and the data length is 4096 bytes. More exactly, the valid data table consists in a array of 5 rows and 408 columns(2040*2 bytes) representing 5 bands of the CCD, each band containing 408 pixels. The last 16 bytes are ignored. The header has 128 elements which contain operation mode, date of observation informations, time exposure, etc ().
The internal representation of each value is integer with LOW byte first (LSB_INTEGER).

For more detailed information, see document SPICAM_UVDATAFILE_DESC.TXT

In the label, a SPICAM 0AUV data product is considered as an ARRAY object of one dimension, containing n records (Figure 9). Each record is then described by a COLLECTION object containing 3 ARRAY objects: HEADER_ARRAY, DATA_ARRAY, and SPARE_ARRAY. In the HEADER_ARRAY a statement pointer points to a file named “HEADER_ARRAY.FMT” that contains a description of the structure of the header array and information on how to access the time and date or peltier and CCD temperatures values. The other more relevant parameters of the header are described in the label as keywords:

MEX:SPICAM_UV_EXPOSURE_TIME = HEADER_ARRAY[42]
MEX:SPICAM_UV_FIRST_BAND = HEADER_ARRAY[44]
MEX:SPICAM_UV_CCD_ROWS_BINNED = HEADER_ARRAY[47]
(Number of physical CCD row binned and contained in one band. = 0 in the case of BINNINGP mode)
MEX:SPICAM_UV_HT = HEADER_ARRAY[55]

The DATA_ARRAY is an ARRAY object of two dimensions, containing the 408*5 data values. The SPARE_ARRAY contains the 16 bytes not used.

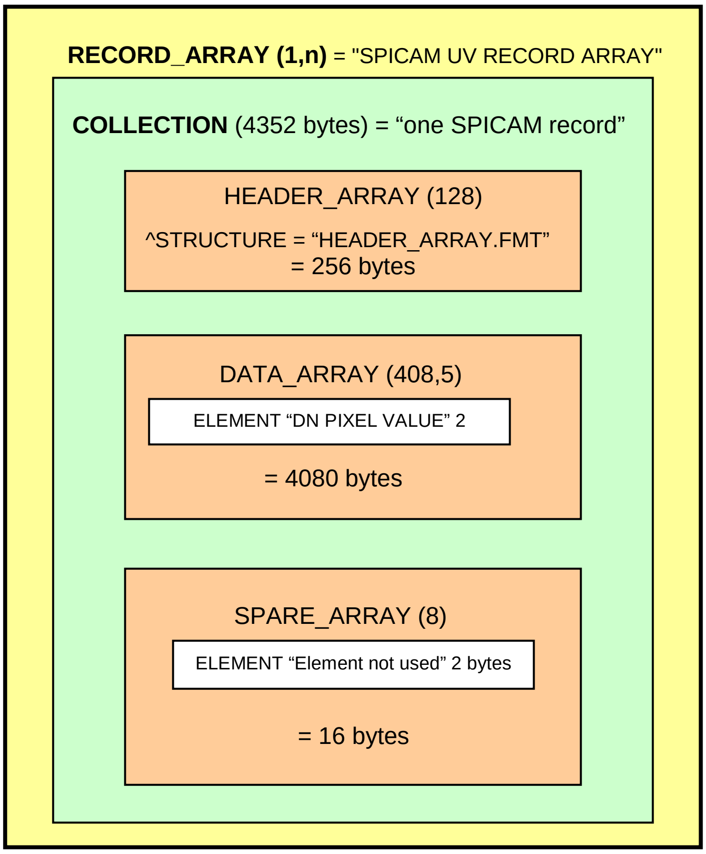


Figure 9. SPICAM 0AUV data representation in the label file.

Example label of level 0A UV data product

```
PDS_VERSION_ID                 = PDS3

/* FILE_RECORDS = n                                                         */
/* RECORD_BYTES = 256+4080+16                                               */
/*            ______________________________________                        */
/*            |                                    | record 1               */
/*            |           HEADER_ARRAY             |                        */
/*            |           =256 bytes               |                        */
/*            |____________________________________|                        */
/*            |                                    |                        */
/*            |           DATA_ARRAY               |                        */
/*            |           =4080 bytes              |                        */
/*            |____________________________________|                        */
/*            |                                    |                        */
/*            |           SPARE_ARRAY              |                        */
/*            |           =16 bytes                |                        */
/*            |____________________________________|                        */
/*     ...    .               ...                  .  ...                   */
/*            ______________________________________                        */
/*            |                                    | record n               */
/*            |           HEADER_ARRAY             |                        */
/*            |           =256 bytes               |                        */
/*            |____________________________________|                        */
```

```
/*              |                                     |                         */
/*              |           DATA_ARRAY                |                         */
/*              |           =4080 bytes               |                         */
/*              |_____________________________________|                         */
/*              |                                     |                         */
/*              |           SPARE_ARRAY               |                         */
/*              |           =16 bytes                 |                         */
/*              |_____________________________________|                         */

/*   FILE CHARACTERISTICS DATA ELEMENTS    */
RECORD_TYPE                    = FIXED_LENGTH
RECORD_BYTES                   = 4352
FILE_RECORDS                   = 520


/* DATA OBJECT POINTERS IDENTIFICATION DATA ELEMENTS    */
^RECORD_ARRAY                  = "SPIM_0AU_2385A01_N_04.DAT"


FILE_NAME                      = "SPIM_0AU_2385A01_N_04.DAT"
DATA_SET_ID                    = "MEX-Y/M-SPI-2-UVEDR-RAWXCRU/MARS-V1.1"
DATA_SET_NAME                  = "MEX SPICAM CRUISE/MARS UV EDR-RAW V1.1"
RELEASE_ID                     = 0001
REVISION_ID                    = 0000
DISTRIBUTION_TYPE              = DATA

PRODUCT_ID                     = "SPIM_0AU_2385A01_N_04.DAT"
PRODUCT_CREATION_TIME          = 2007-07-24T18:10:08.000
MISSION_NAME                   = "MARS EXPRESS"
INSTRUMENT_HOST_NAME           = "MARS EXPRESS"
INSTRUMENT_HOST_ID             =  MEX
MISSION_PHASE_NAME             = "MR Phase 8"

TARGET_NAME                    = "MARS"
TARGET_TYPE                    = PLANET
^MEX_ORIENTATION_DESC          = "MEX_ORIENTATION_DESC.TXT"
SPACECRAFT_POINTING_MODE       = "NADIR"
SPACECRAFT_POINTING_MODE_DESC  = "This pointing mode is used for science
                                  observations nominally around the
                                  pericentre. In this pointing mode the Z-axis
                                  of the spacecraft points towards the centre
                                  of Mars and the X-axis perpendicular to the
                                  ground track."
RIGHT_ASCENSION                = "N/A"
DECLINATION                    = "N/A"

PRODUCT_TYPE                   = EDR
STANDARD_DATA_PRODUCT_ID       = RAWX
START_TIME                     = 2005-11-21T13:05:08.000
STOP_TIME                      = 2005-11-21T13:13:47.000
SPACECRAFT_CLOCK_START_COUNT   = 1/0080658303.06897
SPACECRAFT_CLOCK_STOP_COUNT    = 1/0080658822.06898
ORBIT_NUMBER                   = 2385
PRODUCER_ID                    = MEX_SPI_TEAM
PRODUCER_FULL_NAME             = "FRANCK MONTMESSIN"
PRODUCER_INSTITUTION_NAME      = "LATMOS, IPSL/CNRS,FRANCE"
INSTRUMENT_ID                  = SPICAM
INSTRUMENT_NAME                = "SPICAM"
INSTRUMENT_TYPE                = "SPECTROMETER"
DESCRIPTION                    = "This file contains all records of a UV
                                  SPICAM observation; for completness, each
                                  record consists of a SPICAM header array,
                                  followed by the SPICAM spectra."

DATA_QUALITY_ID                = 11000000
DATA_QUALITY_DESC              = "See definitions in DATA_QUALITY_ID_DESC.TXT"

/* INSTRUMENT AND DETECTOR DESCRIPTIVE DATA ELEMENTS    */
CHANNEL_ID                     = "UV"
INSTRUMENT_MODE_ID             = BINNING_S
^SPICAM_MODE_DESC              = "SPICAM_UVMODE_DESC.TXT"
```

```
MEX:SPICAM_UV_EXPOSURE_TIME    = 45  /* (*10 msec)                          */
MEX:SPICAM_UV_FIRST_BAND       = 135 /*First band position                  */
MEX:SPICAM_UV_CCD_ROWS_BINNED  = 4   /*Number of physical CCD row binned    */
          /* and contained in one band. (=0 in the case of BINNINGP mode)  */
MEX:SPICAM_UV_HT               = 20  /*High Voltage put on the intensifier */
                                     /*of the CCD                           */


/* DATA OBJECT DEFINITION  */

OBJECT                    = RECORD_ARRAY
  NAME                    = "SPICAM UV RECORD ARRAY"
  INTERCHANGE_FORMAT      = BINARY
  AXES                    = 1
  AXIS_ITEMS              = 520
  DESCRIPTION             = "This file contains all records of a UV SPICAM
                            observation. A record is described by a COLLECTION
                            object."

  OBJECT                  = COLLECTION
    NAME                  = "ONE SPICAM UV RECORD"
    BYTES                 = 4352
    DESCRIPTION           = "One spicam UV record contains all the header and
                            data information from one spicam UV integration
                            result of one sequence of measurement. The header
                            length is 256 (HEADER_ARRAY) and the data length
                            is 4080 (DATA_ARRAY). The last 16 bytes are
                            ignored (SPARE_ARRAY)."

    OBJECT                = HEADER_ARRAY
      ^STRUCTURE          = "HEADER_ARRAY.FMT"
    END_OBJECT            = HEADER_ARRAY


    OBJECT                = DATA_ARRAY
      NAME                = "DATA ARRAY"
      AXES                = 2
      AXIS_ITEMS          = (408,5)
      AXIS_NAME           = (SAMPLE,BAND)
      START_BYTE          = 257
      DESCRIPTION         = "  A data table is contained in the last 4096
                               bytes of each EDR SPICAM record. More exactly,
                               the valid data table consists in a array of 5
                               rows and 408 columns(2040*2 bytes) representing
                               a band of 5 rows of the CCD,each row containing
                               408 pixels."

      OBJECT              = ELEMENT
        NAME              = "DN PIXEL VALUE"
        DESCRIPTION       = "Pixel of a line of the CCD - the DN pixel value
                             describes the value of analog to digital
                             conversion of the charged collected by one pixel
                             of a CCD during the integration time as a
                             digital number"
        DATA_TYPE         = LSB_INTEGER
        BYTES             = 2
        END_OBJECT        = ELEMENT

    END_OBJECT            = DATA_ARRAY

    OBJECT                = SPARE_ARRAY
      NAME                = "SPARE ARRAY"
      AXES                = 1
      AXIS_ITEMS          = 8
      START_BYTE          = 4337
      DESCRIPTION         = "This array contains the 16 bytes not used or
                             ignored"

      OBJECT              = ELEMENT
        NAME              = "SPARE ELEMENT"
        DESCRIPTION       = "Element not used"
```

```
        DATA_TYPE           = LSB_INTEGER
        BYTES               = 2
        END_OBJECT          = ELEMENT

    END_OBJECT              = SPARE_ARRAY


  END_OBJECT                = COLLECTION

END_OBJECT                  = RECORD_ARRAY

END
```

SPIM_0AU_2385A01_N_04.LBL file (nadir observation in orbit 2385)

```
      NAME                  = "HEADER ARRAY"
      AXES                  = 1
      AXIS_ITEMS            = 128
      START_BYTE            = 1
      DESCRIPTION           = "The header has 128 elements giving operation
                              mode, date of observation, time exposure, peltier
                              and CCD temperatures, etc. informations.
                              All relevant parameters are in the label as
                              keyword. Time of each record (year,month,day,hour,
                              minute,second,centisecond) is given by the
                              elements HEADER_ARRAY[61:67*]. Peltier and CCD
                              temperatures are given by the elements
                              HEADER_ARRAY[50:51*] (*count from 1).
                              See SPICAM EAICD document in the /DOCUMENT
                              directory for more informations."

      OBJECT                = ELEMENT
        NAME                = "HEADER ELEMENT"
        DESCRIPTION         = "Element of the header"
        DATA_TYPE           = LSB_INTEGER
        BYTES               = 2
        END_OBJECT          = ELEMENT
```

HEADER_ARRAY.FMT file

4.1.2 Data product design and example label of a 0BIR data product

Data product design

A SPICAM 0BIR data product file contains a general information header followed by a general frequency array and by one or several records of an observation from the two detectors of the infrared channel.

The spicam IR general header contains all the general information from one SPICAM IR sequence of measurement. The general header length is 50 x 2 bytes. They are command parameters and informations about the number of channels used, the expected points per spectrum, the number of spectra and the number of sessions per spectrum. The frequency array length is 4*expected_points bytes.

Each record contains : a header table (58 bytes), giving time and system monitor's values information and some satellite’s parameters (temerature, current, …), information at the beginning of each communication cycle. The header is followed by one or two data arrays, depending on the number of detector activated.
Spectrum measurement can be done on three frequency windows, characterized by 3 parameters: FREQUENCY, POINTS and STEP. Along with spectrum measurement in three frequency windows a set of specturm dots can be obtained during measurement cycle. Each dot represents a few adjacent spectrum points and can be viewed as a small window with predefined starting frequency, points number and

frequency step. Height various sets of spectrum dots are predefined, with the possibility of 'no dots' measurement configuration.

Spectrum points recorded by a detector for one measurement cycle are stored in the following order : spectrum points of window 0, spectrum points of window 1, spectrum points of window 2 and spectrum points of dots set defined by the command.

The frequency array contains frequencies in the following order: frequencies of window 0, frequencies of window 1, frequencies of window 2 and frequencies of dots set defined by the command

A label associated to a SPICAM 0B IR data product contains 2 ARRAY objects : FREQUENCY_ARRAY and RECORD_ARRAY. The FREQUENCY_ARRAY contains all the frequency values, and the RECORD_ARRAY contains all the records. A SPICAM 0BIR record is then described by a COLLECTION object, containing 13 ELEMENTS objects, providing time and system monitor's values information at the beginning of each communication cycle, and one DATA_ARRAY containing the spectrum points recorded by the detectors.
The internal representation of each value is integer or float with LOW byte first (LSB_INTEGER or PC_REAL).

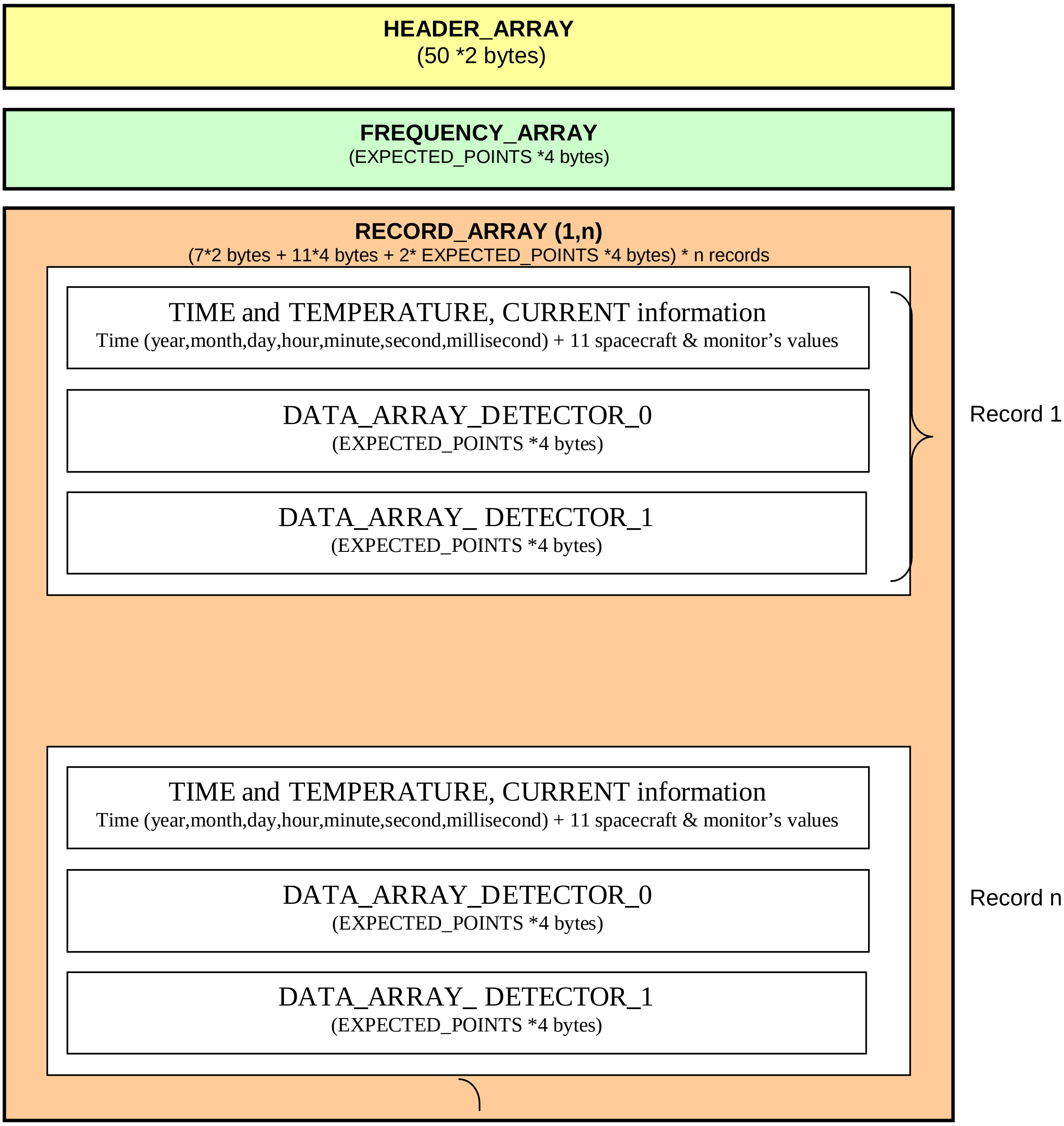


Figure 11. SPICAM 0BIR data representation in the label file.

Example label of level 0B IR data product

```
PDS_VERSION_ID                  = PDS3

/* FILE_RECORDS = n    (1 record = 1 header + 1 or 2 data arrays)            */
/* RECORD_BYTES = 58+(2*Expected_points*4 bytes)*number of records            */
/*                                                                            */
/*                                                                            */
/*                                                                            */
/*            __________________________________________                      */
/*           |              HEADER ARRAY                |                     */
/*           |              (50 *2 bytes)               |                     */
/*           |                                          |                     */
/*           |__________________________________________|                     */
/*            __________________________________________                      */
/*           |              FREQUENCY ARRAY             |                     */
/*           |    =(4*expected_points/spectrum) bytes   |                     */
/*           |__________________________________________|                     */
/*            __________________________________________                      */
/*           |                 RECORD ARRAY (1,n)       |                     */
/*           | (7*2bytes+11*4+2*EXPECTED_POINTS*4bytes) |                     */
/*           |          * n records                     |                     */
/*           |   ____________________________________   |                     */
/*           |  |                                    |  | record 1            */
/*           |  |        TIME and TEMPERATURE,       |  |                     */
/*           |  |        CURRENT information         |  |                     */
/*           |  |  Time and system monitor's values  |  |                     */
/*           |  |  information                       |  |                     */
/*           |  |____________________________________|  |                     */
/*           |  |                                    |  |                     */
/*           |  |        DATA ARRAY_DETECTOR0        |  |                     */
/*           |  |    (Expected_points *4 bytes)      |  |                     */
/*           |  |____________________________________|  |                     */
/*           |  |                                    |  |                     */
/*           |  |        DATA ARRAY_DETECTOR1        |  |                     */
/*           |  |      (Expected_points *4 bytes)    |  |                     */
/*           |  |                                    |  |                     */
/*           |  |____________________________________|  |                     */
/*           |                                          |                     */
/*           |  .               ...                  .  |                     */
/*           |   ____________________________________   |                     */
/*           |  |                                    |  |                     */
/*           |  |         TIME and TEMPERATURE,      |  | record n            */
/*           |  |         CURRENT information        |  |                     */
/*           |  |   Time and system monitor's values |  |                     */
/*           |  |   information                      |  |                     */
/*           |  |____________________________________|  |                     */
/*           |  |                                    |  |                     */
/*           |  |       DATA ARRAY_DETECTOR0         |  |                     */
/*           |  |     (Expected_points *4 bytes)     |  |                     */
/*           |  |____________________________________|  |                     */
/*           |  |                                    |  |                     */
/*           |  |        DATA ARRAY_DETECTOR1        |  |                     */
/*           |  |     (Expected_points *4 bytes)     |  |                     */
/*           |  |                                    |  |                     */
/*           |  |____________________________________|  |                     */
/*           |__________________________________________|                     */

/*   FILE CHARACTERISTICS DATA ELEMENTS    */
RECORD_TYPE                     = FIXED_LENGTH
RECORD_BYTES                    = 8026
```

```
FILE_RECORDS                   = 87


FILE_NAME                      = "SPIM_0BR_2385A01_N_04.DAT"
DATA_SET_ID                    = "MEX-Y/M-SPI-2-UVEDR-RAWXCRU/MARS-V1.1"
DATA_SET_NAME                  = "MEX SPICAM CRUISE/MARS UV EDR-RAW V1.1"
RELEASE_ID                     = 0001
REVISION_ID                    = 0000
DISTRIBUTION_TYPE              = DATA

PRODUCT_ID                     = "SPIM_0BR_2385A01_N_04.DAT"
PRODUCT_CREATION_TIME          = 2007-07-24T18:10:26.000
MISSION_NAME                   = "MARS EXPRESS"
INSTRUMENT_HOST_NAME           = "MARS EXPRESS"
INSTRUMENT_HOST_ID             =  MEX
MISSION_PHASE_NAME             = "MR Phase 8"

TARGET_NAME                    = "MARS"
TARGET_TYPE                    = PLANET

^MEX_ORIENTATION_DESC          = "MEX_ORIENTATION_DESC.TXT"
SPACECRAFT_POINTING_MODE       = "NADIR"
SPACECRAFT_POINTING_MODE_DESC  = "This pointing mode is used for science
                                 observations nominally around the
                                 pericentre. In this pointing mode the Z-axis
                                 of the spacecraft points towards the centre
                                 of Mars and the X-axis perpendicular to the
                                 ground track."
RIGHT_ASCENSION                = "N/A"
DECLINATION                    = "N/A"

PRODUCT_TYPE                   = EDR
STANDARD_DATA_PRODUCT_ID       = RAWX
START_TIME                     = 2005-11-21T13:05:07.300
STOP_TIME                      = 2005-11-21T13:13:43.300
SPACECRAFT_CLOCK_START_COUNT   = 1/0080658302.26558
SPACECRAFT_CLOCK_STOP_COUNT    = 1/0080658818.26559
ORBIT_NUMBER                   = 2385
PRODUCER_ID                    = MEX_SPI_TEAM
PRODUCER_FULL_NAME             = "FRANCK MONTMESSIN"
PRODUCER_INSTITUTION_NAME      = "LATMOS, IPSL/CNRS,FRANCE"
INSTRUMENT_ID                  = SPICAM
INSTRUMENT_NAME                = "SPICAM"
INSTRUMENT_TYPE                = "SPECTROMETER"

DESCRIPTION                    = "This file contains a general header and a
                                 frequency array followed by all records of a
                                 IR SPICAM observation. A measurement
                                 requires several communication sessions to
                                 collect and transmit measurement data
                                 (a spectrum).
                                 Sessions of one spectrum are collected and
                                 transmitted in one measurement cycle.
                                 Each record consists of first a header
                                 providing the time of the beginning of the
                                 measurement cycle and six system monitor's
                                 values measured one time at the beginning of
                                 each measurement cycle. This header is then
                                 followed by detector 0 and/or 1 spectra."

DATA_QUALITY_ID                = 00000000
DATA_QUALITY_DESC              = "See definitions in DATA_QUALITY_ID_DESC.TXT"

/* INSTRUMENT AND DETECTOR DESCRIPTIVE DATA ELEMENTS    */
CHANNEL_ID                     = "IR"


/* SPICAM IR COMMAND PARAMETERS - DEFINITIONS AND VALUES */
/* COMMAND_MODE = (EXIT,SOURCE,DETS,TIME)                                   */
/*    EXIT - A bit specifying a lab mode (bit set to 0) or a flight mode    */
/*          (bit set to 1)                                                  */
/*    SOURCE - A bit specifying a host command (bit set to 0)or a ROM       */
```

```
/*              command (bit set to 1). A host command is received from the  */
/*              memory of host computer, a ROM command is a command stored in*/
/*              program controller and invoked by host command.              */
/*    DETS - Detectors used for spectrum measurement : 0- detector 0 only,   */
/*           1- detector 1 only, 2- both detector 0 and detector 1,          */
/*           3- detector 0 and AOTF RF power.                                */
/*    TIME - AOTF chopping period : 0- 1.4 ms, 1- 2.8 ms, 2- 5.6 ms,         */
/*           3- 11.2 ms                                                      */
/*    GAIN - Amplifiers gain factor : 0- 1, 1- 3, 2- 8.25, 3- 26             */
/*                                                                           */
/* COMMAND_DAC - AOTF power control : 0...255.                               */
/*                DAC value = 16*RF power control                            */
/*                                                                           */
/* COMMAND_WINDOW0 = (FREQUENCY,POINTS,STEP)                                 */
/* Three windows are specified in a command and are characterized by 3       */
/* values FREQUENCY, POINTS and STEP.                                        */
/*    FREQUENCY - determines starting frequency point of measured spectral   */
/*              interval in the first window: 0...255. The real frequency    */
/*              value in AOTF operating range from 80 MHz to 140 MHz is      */
/*              specified by 83.2 MHz + FREQUENCY*256*1.0e-3 in MHz.         */
/*    POINTS - Number of measured spectrum points in the window: 0..4095     */
/*           Zero points number means that the window has not been processed */
/*    STEP - Determines frequency step between points. Frequency increment   */
/*         is STEP*1.0e-3 in MHz, with STEP:0..15. Zero step means that all  */
/*         the spectrum points have been measured at the same frequency      */
/*         (time evolution of the spectrum)                                  */
/*                                                                           */
/* COMMAND_CONFIG = (COMMAND_DESCRIPTOR,DOTS_DESCRIPTOR)                     */
/*    COMMAND_DESCRIPTOR - A set of 32 predefined commands is stored in      */
/*    program memory (ROM commands). COMMAND_DESCRIPTOR field is a number    */
/*    (adress) of the command in this set. The adressed command can be       */
/*    activated by setting COMMAND_MODE_SOURCE bit of host command.          */
/*    DOTS_DESCRIPTOR -Along with spectrum measurement in three frequency    */
/*    frequency windows a set of specturm dots can be obtained during        */
/*    measurement cycle. Each dot represents a few adjacent spectrum points */
/*    and can be viewed as a small window with predefined starting          */
/*    frequency, points number and frequency step. Height various sets of    */
/*    spectrum dots are predefined and each set has a unique number :        */
/*    DOTS_DESCRIPTOR. A zero value is reserved for 'no dots' measurement    */
/*    configuration.                                                         */

MEX:SPICAM_IR_COMMAND_MODE    = (1,0,2,0,2)
MEX:SPICAM_IR_COMMAND_DAC     = (1744,0,2)
MEX:SPICAM_IR_COMMAND_WINDOW0 = (0.000,1.000,277,3.000)
MEX:SPICAM_IR_COMMAND_WINDOW1 = (0.000,1.000,500,1.000)
MEX:SPICAM_IR_COMMAND_WINDOW2 = (0.000,1.000,164,1.000)
MEX:SPICAM_IR_COMMAND_CONFIG  = (0,3)

/* ACTIVE_CHANNELS - Number of channels activated                            */
/* EXPECTED_POINTS - Number of expected points by spectrum                   */
/* NUMBER_SPECTRA - Number of spectra in the sequence of measurement         */
/* NUMBER_SESSIONS - Number of sessions by spectrum                          */

MEX:SPICAM_IR_ACTIVE_CHANNELS = 2
MEX:SPICAM_IR_EXPECTED_POINTS = 996
MEX:SPICAM_IR_NUMBER_SPECTRA  = 87
MEX:SPICAM_IR_NUMBER_SESSIONS = 3

/* DATA OBJECT POINTERS IDENTIFICATION DATA ELEMENTS    */

^FREQUENCY_ARRAY          = ("SPIM_0BR_2385A01_N_04.DAT",101<BYTES>)
^RECORD_ARRAY             = ("SPIM_0BR_2385A01_N_04.DAT",4085<BYTES>)


/* DATA OBJECTS DEFINITION */

OBJECT                  = FREQUENCY_ARRAY
   NAME                     = "FREQUENCY ARRAY"
   INTERCHANGE_FORMAT       = BINARY
   DESCRIPTION              = "Frequency array associated to each spectrum."
   AXES                     = 1
   AXIS_ITEMS               = 996
```

```
   OBJECT             = ELEMENT
     BYTES               = 4
     DATA_TYPE           = PC_REAL
     NAME                = "frequency value"
   END_OBJECT         = ELEMENT

END_OBJECT             = FREQUENCY_ARRAY


OBJECT                         = RECORD_ARRAY
  NAME                         = "SPICAM IR RECORD ARRAY"
  INTERCHANGE_FORMAT           = BINARY
  AXES                         = 1
  AXIS_ITEMS                   = 87
  DESCRIPTION                  = "This array contains all records of a IR SPICAM
                                 observation."

  OBJECT                       = COLLECTION
    NAME                       = "ONE_SPICAM_IR_RECORD"
    BYTES                      = 8026
    DESCRIPTION                = "A record is described by a COLLECTION object
                                  containing 18 elements, providing time and system
                                  monitor's values information at the beginning of
                                  each communication cycle, and one data array
                                  containing the spectrum points recorded by the
                                  detectors."


      OBJECT                 = ELEMENT
        NAME                 = YEAR
        DATA_TYPE            = LSB_INTEGER
        START_BYTE           = 1
        BYTES                = 2
        DESCRIPTION          = "year of time at the beginning of each measurement
                                cycle"
      END_OBJECT             = ELEMENT

      OBJECT                 = ELEMENT
        NAME                 = MONTH
        DATA_TYPE            = LSB_INTEGER
        START_BYTE           = 3
        BYTES                = 2
        DESCRIPTION          = "month of time at the beginning of each measurement
                                cycle"
      END_OBJECT             = ELEMENT

      OBJECT                 = ELEMENT
        NAME                 = DAY
        DATA_TYPE            = LSB_INTEGER
        START_BYTE           = 5
        BYTES                = 2
        DESCRIPTION          = "day of time at the beginning of each measurement
                                cycle"
      END_OBJECT             = ELEMENT

      OBJECT                 = ELEMENT
        NAME                 = HOUR
        DATA_TYPE            = LSB_INTEGER
        START_BYTE           = 7
        BYTES                = 2
        DESCRIPTION          = "hour of time at the beginning of each measurement
                                cycle"
      END_OBJECT             = ELEMENT

      OBJECT                 = ELEMENT
        NAME                 = MINUTE
        DATA_TYPE            = LSB_INTEGER
        START_BYTE           = 9
        BYTES                = 2
        DESCRIPTION          = "minute of time at the beginning of each measurement
                                cycle"
```

```
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = SECOND
      DATA_TYPE         = LSB_INTEGER
      START_BYTE        = 11
      BYTES             = 2
      DESCRIPTION       = "second of time at the beginning of each measurement
                           cycle"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = CENTISECOND
      DATA_TYPE         = PC_REAL
      START_BYTE        = 13
      BYTES             = 4
      DESCRIPTION       = "centisecond of time at the beginning of each
                           measurement cycle"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = SUTRP1_TEMP
      DATA_TYPE         = LSB_INTEGER
      START_BYTE        = 17
      BYTES             = 4
      DESCRIPTION       = "Temperature (ADU) of SU TRP1. Temperature of
                           Reference Point number 1 (near SPICAM foot on
                           corner +Z; -Y)"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = SUTRP2_TEMP
      DATA_TYPE         = LSB_INTEGER
      START_BYTE        = 21
      BYTES             = 4
      DESCRIPTION       = "Temperature (ADU) of SU TRP2 . Temperature of
                           Reference Point number 2 (on SOIR strap)"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = SOLARSHUTTER_TEMP
      DATA_TYPE         = LSB_INTEGER
      START_BYTE        = 25
      BYTES             = 4
      DESCRIPTION       = "Temperature (ADU) of SOLAR SHUTTER . Temperature on
                           Baseplate near solar shutter"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = STRUCTURE_TEMP
      DATA_TYPE         = LSB_INTEGER
      START_BYTE        = 29
      BYTES             = 4
      DESCRIPTION       = "Temperature (ADU) of STRUCTURE . Temperature of
                           Baseplate (near HVPS, in corner -Z; +Y)"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = DET0_TEMP
      DATA_TYPE         = PC_REAL
      START_BYTE        = 33
      BYTES             = 4
      UNIT              = "Volt"
      DESCRIPTION       = "Detector 0 temperature measured at the beginning of
                           each measurement cycle"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = DET1_TEMP
      DATA_TYPE         = PC_REAL
      START_BYTE        = 37
      BYTES             = 4
```

```
      UNIT              = "Volt"
      DESCRIPTION       = "Detector 1 temperature measured at the beginning of
                           each measurement cycle"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = AOTF_TEMP
      DATA_TYPE         = PC_REAL
      START_BYTE        = 41
      BYTES             = 4
      UNIT              = "Kelvin"
      DESCRIPTION       = "AOTF temperature measured at the beginning of
                           each measurement cycle"
    END_OBJECT          = ELEMENT


    OBJECT              = ELEMENT
      NAME              = BASE_TEMP
      DATA_TYPE         = PC_REAL
      START_BYTE        = 45
      BYTES             = 4
      UNIT              = "Kelvin"
      DESCRIPTION       = "Base plate temperature measured at the beginning of
                           each measurement cycle"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = RF_POWER
      DATA_TYPE         = PC_REAL
      START_BYTE        = 49
      BYTES             = 4
      UNIT              = "Volt"
      DESCRIPTION       = "RF power array at 110 MHz (the middle of AOTF
                           frequency range measured at the beginning of each
                           measurement cycle"
    END_OBJECT          = ELEMENT

    OBJECT              = ELEMENT
      NAME              = SUPP_VOLT
      DATA_TYPE         = PC_REAL
      START_BYTE        = 53
      BYTES             = 4
      UNIT              = "Volt"
      DESCRIPTION       = "Supply voltage control measured at the beginning of
                           each measurement cycle"
    END_OBJECT          = ELEMENT

  OBJECT                  = ARRAY
    NAME                  = "DATA_ARRAY"
    AXES                  = 2
    AXIS_ITEMS            = (996,2)
    AXIS_NAME             = (SAMPLE,DETECTOR)
    START_BYTE            = 57
    DESCRIPTION           = "Spectrum points recorded by the 2 detectors for
                             one measurement cycle, in the following order :
                             spectrum points of window 0, spectrum points of
                             window 1, spectrum points of window 2 and
                             spectrum points of dots set defined by the
                             command."

    OBJECT                = ELEMENT
      NAME                = "intensity value"
      UNIT                = "Analog Digital Unit"
      DATA_TYPE           = PC_REAL
      BYTES               = 4
    END_OBJECT            = ELEMENT

  END_OBJECT              = ARRAY


END_OBJECT                = COLLECTION
```

```
END_OBJECT                    = RECORD_ARRAY

END
```

SPIM_0BR_2385A01_N_04.LBL file (nadir observation in orbit 2385)

4.1.3 Label keywords descriptions

4.1.3.1 File and Data Characteristics Data Elements

PDS_VERSION_ID Version number of the PDS standards document that is valid when a data product label is created. For labels adhering to the PDS Standards Reference, Version 3.6, the appropriate value is [PDS3].

RECORD_TYPE Record format of a file. For binary data the RECORD_TYPE is [FIXED_LENGTH].

RECORD_BYTES Number of bytes in a record.
For example, a SPICAM UV record consists in a header table (256 bytes) followed by a data table (4096 bytes). The RECORD_BYTES value is then 4352 bytes ([4352] for 0AUV, 1AUV…tbc).

FILE_RECORDS Number of records in a file.

FILE_NAME Name of the data file.

DATA_SET_ID Unique alphanumeric identifier of this dataset.
["MEX-Y/M-SPI-2-UVEDR-RAWXCRU/MARS-V1.0",
"MEX-Y/M-SPI-2-IREDR-RAWXCRU/MARS-V1.0"]
The data_set_id is an abbreviation of the data_set_name.

DATA_SET_NAME Full name given to a data set or a data product. The data_set_name typically identifies the instrument that acquired the data, the target of that instrument, and the processing level of the data.
["MEX SPICAM CRUISE/MARS UV EDR-RAW V1.0",
"MEX SPICAM CRUISE/MARS IR EDR-RAW V1.0"]

PRODUCT_ID Unique identifier assigned to a data product. Data file name is used.

PRODUCT_CREATION_TIME Time of creation of this data file on the ground (in UTC).

MISSION_NAME Name of the mission including the SPICAM instrument. ["MARS EXPRESS"]

INSTRUMENT_HOST_NAME Name of the host spacecraft for the SPICAM instrument. ["MARS EXPRESS"]

INSTRUMENT_HOST_ID Abbreviated name of the host spacecraft. [“MEX”]

MISSION_PHASE_NAME Mission subphases during which the data were collected. [“EV”,“IC,…] following the table below :

"2003-06-09"	" "	"EV"
"2003-07-01"	" "	"IC"
"2003-12-30"	" 0"	"MC Phase 0"
"2004-01-13"	" 17"	"MC Phase 1"
"2004-01-28"	" 59"	"MC Phase 2"
"2004-02-12"	" 106"	"MC Phase 3"
"2004-03-16"	" 209"	"MC Phase 4"
"2004-04-07"	" 279"	"MC Phase 5"
"2004-04-20"	" 321"	"MC Phase 6"
"2004-06-05"	" 476"	"MR Phase 1"
"2004-08-16"	" 734"	"MR Phase 2"
"2004-10-16"	" 952"	"MR Phase 3"
"2005-01-08"	" 1251"	"MR Phase 4"
"2005-03-05"	" 1455"	"MR Phase 5"
"2005-03-25"	" 1523"	"MR Phase 6"
"2005-07-13"	" 1916"	"MR Phase 7"
"2005-10-04"	" 2216"	"MR Phase 8"
"2005-12-01"	" 2419"	"ME Phase 1"

Full definition of this table can be found in the Mars Express Master Science Plan (MSP). The data used to fill in this table are from the MSP MEX-EST-PL-11912 from 10 June 2004."

TARGET_NAME The name of the target observed in the data. [“SKY”,”STAR”,“MARS”,”PHOBOS”,”DEIMOS”,“COMET”,”CALIBRATION”]

TARGET_TYPE The target-type element identifies the type of a named target.

PRODUCT_TYPE Type or category of a data product within a data set.[EDR, RDR]

STANDARD_DATA_PRODUCT_ID Used to link a data product (file) to a standard data product (collection of similar files). [RAWX, CORX, SPEC, RDRX].

START_TIME The time of data acquisition of the first record (in UTC)

STOP_TIME The time of data acquisition of the last record (in UTC)

SPACECRAFT_CLOCK_START_COUNT The value of the spacecraft clock at the beginning of data acquisition of the first record

SPACECRAFT_CLOCK_STOP_COUNT The time on the spacecraft clock at the end of data acquisition of the last record

ORBIT_NUMBER Spacecraft orbit during which this data was collected. Valid values are [“N/A”] during the CRUISE phase or the value of the orbit on 4 digits (e.g “0103”) during the MARS phase.

PRODUCER_ID Identity of the producer of this dataset. [MEX_SPI_TEAM]

PRODUCER_FULL_NAME Full_name of the individual mainly responsible for the production of a data. [“FRANCK MONTMESSIN”].

PRODUCER_INSTITUTION_NAME Institution associated with the production of a data set ["LATMOS, IPSL/CNRS,FRANCE"]

DATA_QUALITY_ID This keyword provides a numerickey which identifies the quality of data available.

DATA_QUALITY_DESC This describes the data quality which is associated with a particular data_quality_id value.

4.1.3.2 Data Object Pointers Identification Data Elements

^RECORD_ARRAY Pointer to the file containing the SPICAM data and described in the label file.

4.1.3.3 Instrument and Detector Descriptive Data Elements

INSTRUMENT_ID Acronym which identifies the instrument. [“SPICAM”]

INSTRUMENT_NAME name of the instrument. [“SPICAM”]

INSTRUMENT_TYPE Type of the instrument. [“SPECTROMETER”]

INSTRUMENT_MODE_ID Instrument-dependent designation of operating mode. The standard values for SPICAM are [“ALIGN”, “BINNING”, ”BINNINGP” without the slit and “ALIGN_S”, “BINNING_S”, ”BINNINGP_S” with the slit]. For more details, see the SPICAM_UVMODE_DESC.TXT file in the DOCUMENT directory.

CHANNEL_ID Instrument channel through which data were obtained [“UV” or “IR”]

4.1.3.4 Data Object and Data Element Definition

TABLE The TABLE object is a uniform collection of rows containing ASCII and/or binary values stored in columns. Required elements are COLUMNS, ROW_BYTES, INTERCHANGE_FORMAT, and ROWS.

COLUMN The COLUMN object identifies a single column in a data object. Required elements are BYTES, DATA_TYPE, START_BYTE and NAME.

ARRAY The ARRAY object is provided to describe dimensioned arrays of homogeneous objects. Note that an ARRAY can contain only a single object, which can itself be another ARRAY or COLLECTION if required.
Elements required in a ARRAY are the AXES, AXIS_ITEMS and NAME elements. Other elements are optional.

COLLECTION The COLLECTION object allows the ordered grouping of heterogeneous objects into a named collection. The COLLECTION object may contain a mixture of different object types including other COLLECTIONS. The optional START_BYTE data element provides the starting location relative to an enclosing object. If a START_BYTE is not specified, a value of 1 is assumed. Elements required in a COLLECTION are the NAME and BYTES elements.

ELEMENT	The ELEMENT object provides a means of defining a lowest level component of a data object that is stored in an integral multiple of 8-bit bytes. The optional START_BYTE element identifies a location relative to the enclosing object. If not explicitly included, a START_BYTE = 1 is assumed for the ELEMENT.
NAME	Literal value representing the common term used to identify an element or object
INTERCHANGE_FORMAT	Represents the manner in which data items are stored. [BINARY,ASCII].
AXES	Number of axes or dimensions of an array data object.
AXIS_ITEMS	Dimension(s) of the axes of an array data object. For arrays with more than 1 dimension, this element provides a sequence of values corresponding to the number of axes specified.
AXIS_NAME	Sequence of axis names of a array data object, and identifies the order in which the axes are stored in the object.
BYTES	Number of bytes allocated for a particular data representation.
DATA_TYPE	Internal representation of a value.
START_BYTE	Location of the first byte of the object, counting from 1. For nested objects, the start_byte value is relative to the start of the enclosing object.
ROW_BYTES	Maximum number of bytes in each data object row.
ROWS	Number of rows in a data object.
COLUMNS	Number of columns in each row of a data object.
COLUMN_NUMBER	Location of a specific column within a larger data object, such as a table
FORMAT	A specified arrangement of data within a file or on a storage medium. It is equivalent to the FORTRAN language format specification

4.1.3.5 Parameters Index File Definition

The index PDS label files describe the content and structure of the fields (name, format, brief definition) in the index table.
Each field in the INDEX.TAB file is described in the index label file by a COLUMN object, containing the following keywords:

NAME	Name of the field
COLUMN_NUMBER	Column number of the field in the index table
DATA_TYPE	Internal representation of a value.
START_BYTE	Location of the first byte of the object, counting from 1. The values for START_BYTE include commas between fields or quotation

marks surrounding character fields (All fields are separated by commas and character fields are enclosed in double quotation marks ("), therefore the start_byte of the first field is equal to 2).

BYTES Number of bytes allocated for the particular data representation.

FORMAT Format of the value

DESCRIPTION brief definition of the field

Figure 11 gives an example of PDS label file describing the content of the data index table within an archive volume.

```
PDS_VERSION_ID = PDS3

RECORD_TYPE   = FIXED_LENGTH
RECORD_BYTES  = 227
FILE_RECORDS  = 2335
^INDEX_TABLE  =  "INDEX.TAB"

DATA_SET_ID   = MEX-Y/M-SPI-2-UVEDR-RAWXCRU/MARS-V1.1
PRODUCT_NAME  = "SPICAM DATA INDEX TABLE"
PRODUCT_ID    = INDEX
RELEASE_ID    = 0001
REVISION_ID   = 0000

INSTRUMENT_HOST_NAME  = "MARS EXPRESS"
INSTRUMENT_NAME       = "SPICAM"
TARGET_NAME           = "MARS"
START_TIME            = 2003-07-03T19:36:09.000
STOP_TIME             = 2005-12-19T06:58:25.000
PRODUCT_CREATION_TIME = 2007-07-26T19:01:29.000
MISSION_PHASE_NAME    = {"EV","IC","MC Phase 0","MC Phase 1",
                         "MC Phase 2","MC Phase 3","MC Phase 4","MC Phase 5",
                         "MC Phase 6","MR Phase 1","MR Phase 2","MR Phase 3",
                         "MR Phase 4","MR Phase 5","MR Phase 6","MR Phase 7",
                         "MR Phase 8","ME Phase 1"}

DESCRIPTION  = "This table contains the PDS-required index for all data files
                in the /MEXSPI_0AUV/DATA directory on the SPICAM level 0A UV
                Archive Volume. It includes file location, and PDS
                identification information."

OBJECT     = INDEX_TABLE
  NAME               = "MEX SPICAM level 0A UV main Index"
  INTERCHANGE_FORMAT = ASCII
  ROWS               = 2335
  COLUMNS            = 9
  ROW_BYTES          = 227
  INDEX_TYPE         = SINGLE
  INDEXED_FILE_NAME  = {"DATA/*.LBL"}
  DESCRIPTION        = "INDEX.TAB lists all label files in this volume."

  OBJECT     = COLUMN
    NAME          = FILE_SPECIFICATION_NAME
    COLUMN_NUMBER = 1
    DATA_TYPE     = CHARACTER
    START_BYTE    =  2
    BYTES         = 52
    DESCRIPTION   = "Pathname to the detached label which identifies this data
```

```
                         file.  Or path name to text file"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = PRODUCT_ID
    COLUMN_NUMBER = 2
    DATA_TYPE      = CHARACTER
    START_BYTE     = 57
    BYTES          = 25
    DESCRIPTION    = "The name of the data file, which is unique within this
                         data set."
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = PRODUCT_CREATION_TIME
    COLUMN_NUMBER = 3
    DATA_TYPE      = CHARACTER
    START_BYTE     = 85
    BYTES          = 24
    DESCRIPTION    = "Time at which the data file was created."
  END_OBJECT = COLUMN


  OBJECT      = COLUMN
    NAME           = DATA_SET_ID
    COLUMN_NUMBER = 4
    DATA_TYPE      = CHARACTER
    START_BYTE     = 112
    BYTES          = 37
    DESCRIPTION    = "An identifier unique for this dataset"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = RELEASE_ID
    COLUMN_NUMBER = 5
    DATA_TYPE      = CHARACTER
    START_BYTE     = 152
    BYTES          = 4
    DESCRIPTION    = "Release id"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = REVISION_ID
    COLUMN_NUMBER = 6
    DATA_TYPE      = CHARACTER
    START_BYTE     = 159
    BYTES          = 4
    DESCRIPTION    = "Revision id"
  END_OBJECT = COLUMN

OBJECT      = COLUMN
    NAME         = START_TIME
    COLUMN_NUMBER = 7
    DATA_TYPE    = TIME
    START_BYTE     = 166
    BYTES        = 24
    DESCRIPTION = "Start date and time of product observation or event"
  END_OBJECT = COLUMN

OBJECT      = COLUMN
    NAME         = STOP_TIME
    COLUMN_NUMBER = 8
    DATA_TYPE    = TIME
    START_BYTE     = 193
    BYTES        = 24
    DESCRIPTION = "Stop date and time of product observation or event"
  END_OBJECT = COLUMN

  OBJECT      = COLUMN
    NAME           = NB_RECORDS
    COLUMN_NUMBER = 9
    DATA_TYPE      = INTEGER
```

```
    START_BYTE     = 220
    BYTES          = 4
    DESCRIPTION    = "Number of records in the data file"
  END_OBJECT = COLUMN

END_OBJECT = INDEX_TABLE



END
```

Figure 11. Data index label file example

4.1.3.6 Mission Specific Keywords

SPACECRAFT_POINTING_MODE Pointing mode of the spacecraft. The definition of the modes and the standard values are given via the spacecraft_pointing_mode_desc element ["NADIR", "INERT"]

SPACECRAFT_POINTING_MODE_DESC Definition of the different pointing modes of the spacecraft .

^MEX_ORIENTATION_DESC Pointer to a file containing Information about the spacecraft orientation.

5 Appendix: Example of Directory Listing of MEXSPI_1001 (0AUV) archive volume

```
ROOT
 |
 |- AAREADME.TXT     The file you are reading
 |
 |- ERRATA.TXT       Description of known anomalies and errors present
 |                   on the volume.
 |- AAREADME.LBL     PDS detached label describing AAREADME.TXT
 |
 |- VOLDESC.CAT      Description of the contents of the volume in a PDS
 |                   format for the PDS Catalog
 |
 |
 |- [DATA]       A directory containing the data + associated label files
 |      |
 |      |- DATAINFO.TXT     Description of files in this directory
 |      |
 |      |-[CRUISE]  A directory containing MEX SPI level 0A UV data
 |      |     |     collected during the cruise phase
 |      |     |
 |      |     |-- {file(s) *DAT, *.LBL}
 |      |     |
 |      |     |-- HEADER_ARRAY.FMT Include file containing a description of the header
|      |                          of a UV record.
 |      |
 |      |
 |      |-[MARS]    A directory containing MEX SPI level 0A UV data
 |      |     |     collected during the MARS nominal phase
 |      |     |
 |      |     |-[MOCP_00001_00482]
 |      |     |     |
 |      |     |     |-- {file(s) *DAT, *.LBL}
 |      |     |     |
```

```
|      |    |    |-- HEADER_ARRAY.FMT Include file containing a description of the
|      |    |                         header of a UV record.
|      |    |
|      |    |-[MTP001_00483_00583]
|      |    |    |
|      |    |    |-- {file(s) *DAT, *.LBL}
|      |    |    |
|      |    |    |-- HEADER_ARRAY.FMT Include file containing a description of the
|      |    |                         header of a UV record.
|      |    |
|      |     ...
|
|
|- [CATALOG] A directory containing information about the data set
|      |
|      |- CATINFO.TXT         Description of files in this directory
|      |
|      |- DATASET.CAT         Description of the MEXSPI_1001 data set
|      |                      during the cruise phase
|      |
|      |- RELEASE.CAT         Release object of the MEXSPI_1001 data set
|      |
|      |- MISSION.CAT         Description of the Mars Express mission
|      |
|      |- INSTHOST.CAT        Description of the Mars Express spacecraft
|      |
|      |- INST.CAT            Description of the MEX SPICAM instrument
|      |
|      |- PERS.CAT            Listing of the people involved in the
|      |                      production of this archive volume
|      |- REFS.CAT            List of pertinent references.
|      |
|      |- SWINV.CAT           Description of the software included on the
|      |                      volume.
|
|-[CALIB]                     A directory containing UV calibration files
|      |
|      |- SPICAM_UVSEFF.DAT   SPICAM UV Efficient Surface
|      |- SPICAM_UVSEFF.LBL   PDS detached label file describing SPICAM_UVSEFF.DAT
|
|
|- [INDEX]           A directory containing an index of data files.
|      |
|      |- INDXINFO.TXT     Description of files in this directory.
|      |
|      |
|      |- INDEX.TAB                Index of level 0A UV data files in
|      |                           the DATA directory
|      |- INDEX.LBL                PDS detached label describing the
|      |                           the corresponding *.TAB file
|      |
|      |- BROWSE_INDEX.TAB        Index of level 0A UV browse files in
|      |                          the BROWSE directory
|      |- BROWSE_INDEX.LBL        PDS detached label describing the
|      |                            the corresponding *.TAB file
|      |
|      |
|      |- GEOMETRY_INDEX.TAB      Index of geometry files in the
|      |                          GEOMETRY directory
|      |- GEOMETRY_INDEX.LBL      PDS detached label describing
|      |                          the corresponding *.TAB file
|      |- GEO_MARS.TAB        Geometry index file providing geometry and position
|      |                information to locate the data within the data set
|      |- GEO_MARS.LBL       PDS detached label describing corresponding
```

```
                              *.TAB file

    |
    |- [BROWSE]  A directory containing reduced-size, easily viewed versions
    |     |      of data products.
    |     |
    |     |- BROWINFO.TXT   Description of files in this directory.
    |     |
    |     |-[CRUISE]  A directory containing browse images of MEX SPI level
    |     |    |      0A UV data collected during the cruise phase
    |     |    |
    |     |    |-- {file(s) *PNG, *.LBL}
    |     |
    |     |
    |     |-[MARS]    A directory containing browse images of MEX SPI level
    |     |    |     0A UV data collected during the MARS Mars nominal phase
    |     |    |
    |     |    |-[MOCP_00001_00482]
    |     |    |    |
    |     |    |    |-- {file(s) *PNG, *.LBL}
    |     |    |
    |     |    |-[MTP001_00483_00583]
    |     |    |    |
    |     |    |    |-- {file(s) *PNG, *.LBL}
    |     |    |
    |     |    ...
    |
    |- [GEOMETRY]  A directory containing geometry files associated to the
    |     |        data products.
    |     |
    |     |- GEOMINFO.TXT   Description of files in this directory.
    |     |
    |     |-[MARS]    A directory containing geometry of MEX SPI level
    |     |    |     0A UV data collected during the MARS Mars nominal phase
    |     |    |
    |     |    |-[MOCP_00001_00482]
    |     |    |    |
    |     |    |    |-- {file(s) *TXT, *.LBL}
    |     |    |
    |     |    |-[MTP001_00483_00583]
    |     |    |    |
    |     |    |    |-- {file(s) *TXT, *.LBL}
    |     |    |
    |     |    ...
    |     |
    |
    |- [DOCUMENT]   A directory containing information documents.
    |     |
    |     |- DOCINFO.TXT          Description of files in this directory.
    |     |
    |     |- SA_MEX_ARCH_003_xx.PDF The SPICAM EAICD in PDF format
    |     |
    |     |- SA_MEX_ARCH_003_xx.ASC The SPICAM EAICD in ASCII format
    |     |
    |     |- SA_MEX_ARCH_003_xx.LBL PDS detached label that describes
    |     |                      SA_MEX_ARCH_001_xx.PDF and SA_MEX_ARCH_001_xx.ASC
    |     |
    |     |- SPICAM_UVDATAFILE_DESC.TXT ASCII file describing the contents of the data
    |     |                    files which are delivered in the Spicam data product.
|         |
    |     |- SPICAM_UVDATAFILE_DESC.LBL PDS detached label that describes
    |     |                    SPICAM_UVDATAFILE_DESC.TXT
    |     |
    |     |- SPICAM_UVCALIB_DESC.TXT ASCII file describing the calibration of the
```

```
        |      |                      Spicam UV data which are delivered in the Spicam UV
|       |                       dataset.
        |      |- SPICAM_UVCALIB_DESC.LBL PDS detached label that describes
        |      |                         SPICAM_UVCALIB_DESC.TXT
        |      |
        |      |- SPICAM_GEOMETRY_DESC.TXT ASCII file describing the contents of the
        |      |                           geometry files which are delivered in the Spicam
        |      |                           data set.
        |      |- SPICAM_GEOMETRY_DESC.LBL PDS detached label that describes
        |      |                         SPICAM_GEOMETRY_DESC.TXT.
|       |
        |      |-SPICAM_UVMODE_DESC.TXT- ASCII file describing the different operating modes
        |      |                         of the UV SPICAM spectrometer.
        |      |
        |      |-MEX_ORIENTATION_DESC.TXT - ASCII file informing on the usage of
        |      |                         the spacecraft orientation on Mars Express.
        |      |
        |      |-MEX_ORIENTATION_DESC.LBL - PDS detached label that describes
        |      |                                   MEX_ORIENTATION_DESC.TXT.
|       |
        |
        |-[LABEL] A directory containing include (*.FMT) files for data products
        |      |
        |      |-HEADER_ARRAY.FMT - Include file containing a description of
        |      |                    the header of a UV record.
|-[SOFTWARE] A directory containing IDL routines to read UV data
        |      |
        |      |-SOFTINFO.TXT           - Description of files in this directory.
        |      |
        |      |-SPICAM_READPDS.ZIP     - A ZIP file containing the IDL routines
        |      |                         needed to read the SPICAM UV data files
        |      |
        |      |-SPICAM_READPDS.LBL     - PDS detached label that describes
        |      |                          SPICAM_READPDS.ZIP
```