Service d'Aéronomie du CNRS

[Venus Express]-[SPICAV]

To Planetary Science Archive Interface Control Document

SA_VEX_ARCH_001

Issue 05

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Change Log

Date	Sections Changed	Reasons for Change
14/02/2006		Update document from MEX SPICAM
13/12/2006	All	Document updated before first delivery: EAICD01.doc
25/05/2007	3.1.1.1 and 3.1.3 3.1.3	MTP01 = 14 May instead of 15 May MTPnnn… from Orbit 023 on 14 May instead of April VOCP… 13 May instead of 15
05/07/2007		Several updates: - New keywords - Example of Geometry header's file - New examples of Label files - Correction of multiple small errors

03/04/208		Several updates due to the RID of The PEER REVIEW: - Table 2.3.2.2: Update under processing to Available - Table 2.3.2.3: Update under processing to Available - Section 3.4.3.9 Label directory
06/10/2008		Update the Annex section: - 6.1 Annex .1 : Software - removed

Table Of Contents

1 Introduction

1.1 Purpose and Scope

The purpose of this EAICD (Experimenter to (Science) Archive Interface Control Document) is:

- First it provides users of the SPICAV 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 SPICAV 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 SPICAV instrument on VENUS EXPRESS from the s/c until the insertion into the PSA for ESA. It includes informations 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 SPICAV data, and the staff of the archiving authority (Planetary Science Archive, ESA, RSSD, design team).

TBD

1.5 Applicable Documents

[1] Planetary Data System Preparation Workbook, February 17, 1995, Version 3., JPL, D-7669, Part1.
[2] Planetary Data System Standards Reference, August 1, 2003, Version 3.6, JPL, D7669, Part2.
[3]
[4] Planetary Science Archive. Experiment Data Release Concept. Technical proposal. SOP-RSSD-TN015.
[5] VEX Archive Conventions VEX-EST-TN-036 Draft d 20 November 2006
[6] SOIR EAICD

1.6 Relationships to Other Interfaces

Changes in the standard SPICAV 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 (Space Research Institute)
IR	Infra Red
MPS	Mission Planning System
N/A	Not Applicable
PDS	Planetary Data System
PSA	Planetary Science Archive
SA	Service d'Aéronomie, CNRS
SPICAV	Spectoscopy for the Investigation of Characteristics of the Atmosphere of VENUS
SIR	SPICAV Sensor IR
SU	Sensor Unit
SUV	SPICAV Sensor UV
SOIR	Solar Occultation IR sensor
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 SPICAV staff at Service d'Aéronomie (SA), France.

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

2.1 Instrument Design

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

The SPICAV instrument is made of 2 boxes as depicted in Figure 1. 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), one (named SIR) in the near infrared wavelength range 0.7-1.7 µm and a third one (SOIR) in the Infrared wavelength range 2.2-4.4 µm.

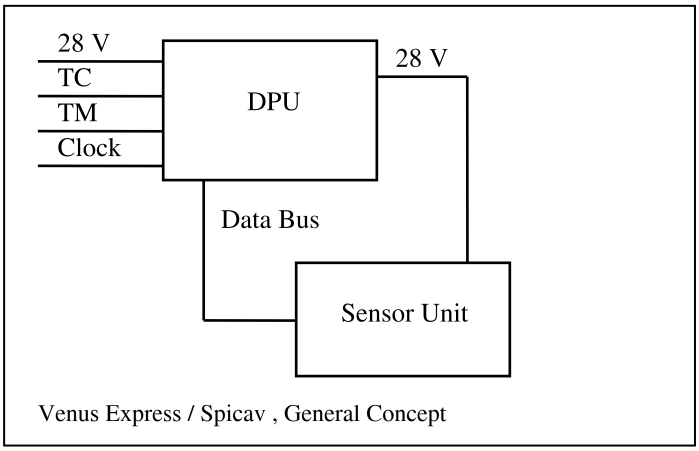

Figure 1 SPICAV instrument

Shutter Operations :

Due to geometry and specific attitudes during the mission, it is possible that the SUN is directed to the UV and IR Nadir apertures (SC +Z axis). It mainly happens during Earth communication phase at specific time during the mission.

Then, the UV and IR apertures have been equipped with a shutter. This one is operated directly by the S/C, and has no electrical interfaces with Spicav DPU or Spicav Sensor Unit. It is totally independant. The shutter is needed to be closed ONLY when the Sun direction is close to the S/C +Z axis.

See the INST.CAT catalog file in the CATALOG directory of each dataset for more details about all the technical details concerning the SPICAV instrument. The mechanical and electrical characteristics are listed. The optical interfaces with spacecraft and the fields of view are explicited. The Table 1 gives a summary of the main characteristics of the instrument.

Spectral bands	118 - 320 nm (UV) 0.7 - 1.7 µm (IR) 2.2 - 4.4 µm (SOIR)
Spectral sampling	UV: 0.55 nm/pix IR: 0.8 nm/pix at 1.5 µm SOIR: 0.11 cm^{-1} at 2.325 µm 0.08 cm^{-1} at 3.170 µm 0.06 cm^{-1} at 4.25 µm
Mass	DPU+harness 0.865 kg SU 13.05 kg Total 13.915 kg Sunshields 0.47 kg
Power	DPU+SU 17.6 W, 26.4 W, 51.4 W
Volume	DPU: 161 x 142 x 70 mm^3 SU: 504 x 400 x 350 mm^3
Data rate	9, 34, 66 kbit/s (1)
Data Volume	Typ. 100 Mbits / day TBC
Observations	One On-Board Time TC, One Spicav TC Duration: 5 to 30 mn typ.
Pointing (orientation)	Inertial Star (2) Inertial Sun (2) Nadir

(1) averaged over several seconds
(2) if atmospheric effects (refraction, …) assumed negligeable.

Table 1 Summary of SPICAV light main characteristics

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 (Hamamatsu) 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 approximatively 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) allowing to have at the same time, in Star mode, the Star spectrum surrounded by the background spectra. 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 2). 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 or OFF.

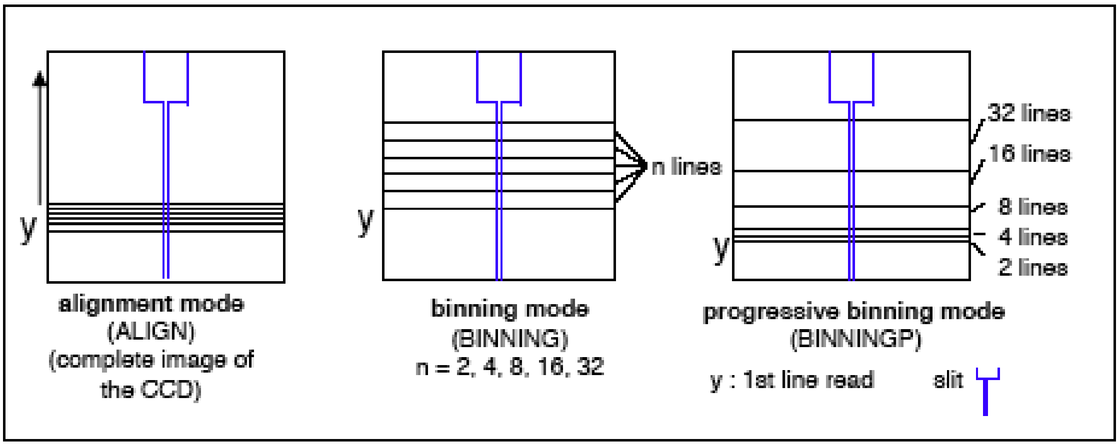

Figure 2. UV detector operating modes

2.1.2 IR channel unit

The SPICAV infrared channel is made of an entrance lens, a scanning acousto-optical tuneable filter (AOTF), two (Hamamatsu) double pixels detectors (two polarisations, two wavelength ranges) with their own Peltier cooler, and an electronic board. When the AOTF is powered (at a certain frequency), it selects a wavelength which goes up to the detectors. A full spectrum is then obtained by scanning the frequencies. The measurement is obtained by the difference between the AOTF on and off.

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.

2.1.3 SOIR channel unit

The SOIR Channel is made of an entrance optics ('periscope') which leads the Sunlight to the AOTF entrance optic (in plane X, Y). When the AOTF is powered (at a certain frequency), it selects a bandwidth to be analysed by the spectrometer including a parabolic mirror and an echelle grating (selection of right order). Associating AOTF and echelle grating (4 grooves/mm) permits to have a high reolution spectrometer. Spectra is collected, via optic lenses, by an IR detector. It is a Sofradir detector coupled with a cooler.

2.2 Scientific Objectives

The suite of measurements of SPICAV in the various available observation modes is addressing key questions of the atmosphere of VENUS, including its present state, the global circulation pattern and the atmospheric evolution of the planet.
The experiment is looking through the atmosphere of Venus either at :

A star :	vertical profiles by stellar occultation technique (CO_2, Temperature, ...).
The Nadir:	integrated profiles (SO_2, UV absorber, aerosols).
The Limb :	vertical profiles of high atmosphere emissions (H, C, O, CO_2^+ , CO, aerosols).
The Sun :	vertical profiles by solar occultation technique (H_2O, aerosols, SO_2 , O_2?).

The Sensor SOIR is only used in the Sun looking mode, to measure CO_2 , aerosols, HCl, HDO, H_2O, HF and possible new constituents.

Chemistry: Simultaneous measurements of SO_2 and H_2O will allow validating and/or modifying chemistry models of the atmosphere at cloud top level (~ 65 km).

Structure/Dynamics/Meteorology: Vertical profiles of density / temperature (80-160 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 general circulation systems (Super-rotation and Solar Anti-Solar (SSAS) system).

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	Concentration vertical profile
UV+IR+SOIR	Solar occultation	Concentration vertical profile
UV+IR	Nadir	Total column abundance
UV+IR	Limb emissions	Vertical profiling of aeronomic emissions

Table 2 Summary of sensor configurations

UV,IR targets:

Species	**Measurements**			**Accuracy**	**Altitude range**
	Scientific objective	**Mode (occultation, nadir, limb)**	**Spectral range**		
CO_2	Atmospheric density and temperature vertical profile	Solar / Stellar occultation	110 - 200 nm	2 – 10 % 5 K	80 – 160 km
Aerosols	Vertical profile of characteristics	Solar / stellar occultation	UV	10^{-2} (optical thickness)	80 – 120 km
O_2	Concentration vertical profile	Stellar occultation	200 nm	20 %	80 – 100 km (never done before)
H, C, O, CO_2^+, CO	Vertical profiling of aeronomic emissions	Limb emission	118– 310 nm	20 %	80 – 400 km
SO_2	Total abundance	Nadir	200 - 300 nm		> 65 km
H_2O	Total abundance	Nadir	1.38 µm	0.2. ppmv	> 60 km
Aerosols	Mapping of properties	Spectro polarimetry in nadir	0.7 to 1.7 µm	10^{-3} (photometric)	Exploratory
UV absorber	Mapping	Nadir	200 – 310 nm	10^{-3} (photometric)	> 65 km

Table 3. Observation modes, spectral range, altitude range for the key atmospheric constituents measurable by SPICAV, UV+IR sensors.

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

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SOIR targets :

Species	Spectral range (mm)	Altitude, precision/threshold
CO_2	2.7 , 4.3	60-200 km
CO_2 isotopes		
H_2O	2.56	60-105 km
HDO	2.56, 3.7	60-90 km
$H_2{}^{18}O$	2.56	Similar to HDO
CO	2.35	60-150 km, 600 ppb
OCS	3.44	130
H_2S	2.63, 3.7	150
HCl	3.6	30
HF	2	1
SO_2	4.0	60-70 km, 1.7 ppb
C_2H_6	3.4	50 ppb

Table 4 Spectral range and altitude for atmospheric key constituents measurable by SOIR. All minor at ~ 60-100 km.

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

2.3.1 SPICAV data processing, retrieval algorithms.

The SPICAV data collected between each switch ON and switch OFF of SPICAV will be transferred to ESOC and stored at ESOC on the Data Disposition System (DDS) in Darmstadt (Germany). It will be then transferred via ftp from the DDS to Service d'Aéronomie.

All new data files concerning UV and IR channels will be collected at Service d'Aéronomie.
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.

SOIR data will be transferred to IASB and all new data files concerning SOIR channel will be collected at IASB. SOIR data archiving will be processed by IASB team

2.3.2 *Definitions of data levels*

2.3.2.1 Level 0 data

This is the SPICAV data collected by ESOC and stored on the DDS. One ESOC file contains both UV, IR and SOIR data. SA 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 splitted per observation, disassembled and reformatted to build level 0A UV data files and level 0B IR data files. Level 0A/B assembles one single file per SPICAV observation and per sensor (UV, IR, SOIR). In the following, the different SPICAV data levels will be described by sensor, the data processing being different for UV, IR and SOIR 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 SPICAV archive.

Level / Mode	0A*	1A	1B	2
Star	Available	TBD	TBD	TBD
Sun	Available	TBD	TBD	TBD
Nadir	Available	TBD	TBD	TBD
Limb	Available	TBD	TBD	TBD

Table 5 UV data products available in the archive.
* : data files + associated browse and geometry files

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

2.3.2.2.1 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. UV Source data are extracted from ESA packets specific to UV
- a header is added to each record to comply to our requirement. A description of the header is given in the SPICAV_UVDATAFILE_DESC.TXT file in the DOCUMENT directory.
- a UTC time is added in the header. The time of observation is defined in the SPICAV_UVCALIB_DESC.TXT file in the DOCUMENT directory.

A level 0A UV data file contains then all records of a UV SPICAV observation, each record consisting of the SPICAV header followed by the data table (Source data), in binary format. Data are in ADU units (Analog to Digital Units). A description of the UV data files is given in the SPICAV_UVDATAFILE_DESC.TXT file in the DOCUMENT directory. 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 modes are used for the observations on the Venus Express spacecraft. The different SPICAV UV operating modes are described in the SPICAV_UVMODE_DESC.TXT file in the DOCUMENT directory.

The SPICAV 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 SPICAV team will provide quicklook images (browse files) and geometry files. A description of the geometry files is given in the SPICAV_GEOMETRY_DESC.TXT file in the DOCUMENT directory,
Geometry files: NA for the CRUISE.

2.3.2.2.2 Level 1A UV data

The SPICAV level 1A should correspond with the PDS CODMAC level 2 (edited data or Experimental Data Record (EDR)).

TBD.

2.3.2.2.3 Level 1B UV data

The SPICAV level 1B should correspond with the PDS CODMAC level 3 (calibrated data).
TBD.

2.3.2.2.4 Level 2 UV data

Level 2 data will consist in derived science data products (see Table 3).

The SPICAV level 2 will correspond with the PDS CODMAC level 5 (derived data).

TBD.

2.3.2.3 <u>IR data</u>

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

Level \ Mode	0A	0B*	1A	1B	2
Star	-	Available	TBD	TBD	TBD
Sun	-	Available	TBD	TBD	TBD
Nadir	-	Available	TBD	TBD	TBD
Limb	-	Available	TBD	TBD	TBD

Table 6 IR data products available in the archive.

- : not archived

* : data files + associated files

The different SPICAV IR data products are described in the following sections.

2.3.2.3.1 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 (dedicated to IR) are disassembled and reformatted to build level 0A data files.
- a header is added to each record.
- a UTC time is added in the header.

An infrared measurement requires several communication sessions to collect and transmit measurement data (one 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 4 parameters: FREQUENCY_OFFSET, FREQUENCY_RANGE, POINTS and STEP. Along with spectrum measurements 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 SPICAV 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.

2.3.2.3.2 Level 0B IR data

A level 0B IR data file contains all reconstructed spectra of an IR SPICAV observation collected by the two detectors of the infrared channel. All other relevant information (parameters of the command, frequency array, system monitor's values…) are also included in the file.

A description of the IR data files is given in the the SPICAV_IRDATAFILE_DESC.TXT file in the DOCUMENT directory.

The SPICAV 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 SPICAV team will provide quicklook images (browse files) and geometry files. A description of the geometry files is given in the SPICAV_GEOMETRY_DESC.TXT file in the DOCUMENT directory
Geometry files: NA for the CRUISE.

2.3.2.3.3 Level 1A IR data

The SPICAV level 1A should correspond with the PDS CODMAC level 2.

TBD.

2.3.2.3.4 Level 1B IR data

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

TBD.

2.3.2.3.5 Level 2 IR data

The SPICAV level 2 will correspond with the PDS CODMAC level 5 (derived data).

TBD.

2.3.2.4 SOIR data

See dedicated SOIR EAICD(ref: [6]) written by IASB team.

2.4 Overview of Data Products

2.4.1 In-Flight Data Products

During the active mission UV, IR and SOIR data from the CRUISE, VOCP and VENUS NOMINAL phases will be collected. A data set will be defined for each sensor (UV, IR and SOIR) and for each data product level.

2.4.2 Instrument Calibrations

All information about calibration is related to flight model. Information needed to calibrate the UV and IR data will be given in the SPICAV_UVCALIB_DESC.TXT and SPICAV_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 sensors.

2.4.3 Software

The ESA packets (level 0) are processed at Service d'Aeronomie by the SPICAV team for technological verification and SPICAV level 0A/0B data files and associated geometry files are produced:

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

The SPICAV team will provide a software package to read the SPICAV UV data files. Please read section 3.4.3.7 for more information.

2.4.4 Documentation

This document (EAICD) will be provided in the DOCUMENT directory of each archive volume (UV and IR) in PDF and ASCII (.ASC) formats.

The SPICAV Flight User Manual (FUM) and other SPICAV technical document or scientific papers published which could be helpful to use data will be provided in the DOCUMENT directory of each archive volume (UV and IR).

The following SPICAV documents will be present in the DOCUMENT directory of the VEXSPI_1001 (UV) archive volume :

- SPICAV_UVDATAFILE_DESC.TXT:
  This document describes the contents of the UV data files which are delivered in the VEXSPI_1001 archive volume.

- SPICAV_GEOMETRY_DESC.TXT:
  This document describes the contents of the geometry files which are delivered in the the VEXSPI_1001 archive volume.

- SPICAV_UVMODE_DESC.TXT:
  This document describes the different operating mode of the SPICAV UV spectrometer.

The following SPICAV documents will be present in the DOCUMENT directory of the VEXSPI_1002 (IR) archive volume :

- SPICAV_IRDATAFILE_DESC.TXT:
This document describes the contents of the IR data files which are delivered in the VEXSPI_1002 archive volume.

- SPICAV_GEOMETRY_DESC.TXT:
This document describes the contents of the geometry files which are delivered in the the VEXSPI_1002 archive volume.

The following ESA documents will be also present in the DOCUMENT directory of each archive volume:

- DATA_QUALITY_ID_DESC.TXT : This file describes the data quality which is associated with a particular DATA_QUALITY_ID value
- OBSERVATION_TYPE_DESC.TXT: This description file gives the definition for the OBSERVATION_TYPE keyword values.
- SPICAV_POINTING_001.TXT: This document describes the geometry computation. It gives some useful definitions for computations
- VEX_ARCHIVE_CONVENTIONS.PDF: This document defines the conventions that apply to the VEX Science Data Archive. The conventions are agreements and rules in addition to the PDS Standards (AD1, AD2).
- VEX_MISSION_CALENDAR.PDF: This document aims at providing information about the mission, its phases and some of the environmental conditions.
- VEX_ORIENTATION_DESC.TXT: This description file describes the convention used to describe the Venus Express spacecraft orientation, especially in nadir pointing mode.
- VEX_POINTING_MODE_DESC.TXT: This document describes the values for the SPACECRAFT_POINTING_MODE keyword.
- VEX_RSSD_LI_009.TAB: This is a Venus Express Mission phase's table. More information can be found in the Express Science Activity Plan, VEX-RSSD-PL-002 for the nominal mission and in VEX-RSSD-PO-005 for the extended mission.
- VEX_SCIENCE_CASE_ID_DESC.TXT: This file describes 10 typical Venus Express modes of observations (called science cases).

2.4.5 Derived and other Data Products

SPICAV team do not intend, for now, to provide any other derived data or data products that result from co-operation with other instrument teams. However, SPICAV team is aware of the importance of this issue and how this can clearly increase its scientific return. The team will reconsider this point in future deliveries.

2.4.6 *Ancillary Data Usage*

SPICE files produced by VSOC/ESTEC in collaboration with NAIF/JPL from the VENUS 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://gorilla.estec.esa.int/pub/projects/VenusExpress/data/spice/

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

Available SPICE files are:
1. SPK spacecraft/planet/satellites/asteroids ephemeris data kernel files
2. EK event kernel – no EK available for VENUS 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 VEX 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 SPICAV Archive Volumes. Data in 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 SPICAV Delivery Schedule

After a final check, the processed data will be delivered to the co-Is and after the priority phase to PSA at ESAC. The Service d'Aéronomie 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 SPICAV archive team. Data should be delivered in the long term by mission phases scheduled by MPS. Target date for delivery of SPICAV raw data (level 0A) to PSA is 4 months after the last data of a specific VENUS mission phase.

Upper levels data will be delivered as soon as the data products are ready and validated by the SPICAV team. date: TBD

The original archive volume delivery schedule, based on the nominal science mission timeline and defined by archive team, is shown below.

Data Collection Period	**Required Delivery To PSA 0A and 0B**	**Delivery to PSA 0A UV**	**Delivery to PSA 0B IR**	**Public Distribution**
11/2005 Interference/Pointing 05-06/2006 Venus Commissioning	Nov 2006	End of Oct 2008	Nov 2008	UNK
June/July/August 2006	Dec 2006	End of Oct 2008	Nov 2008	UNK
Sep/Oct/Nov – 2006	Mar2007	Mid Nov 2008	Nov 2008	UNK
Dec06/Jan/Feb-2007	Jun2007	Mid Nov 2008	Nov 2008	UNK
Mar/Apr/May-2007	Sep 2007	End of Nov 2008	Nov 2008	UNK
Jun/Jul/Aug-2007	Dec 2007	End of Nov 2008	Nov 2008	UNK
Sep/Oct/Nov-2007	Mar 2008	Dec 2008	Dec 2008	UNK
Dec/Jan/Feb-2008	Jun 2008	Dec 2008	Dec 2008	UNK
Mar/Apr/May-2008	+ 4 months	Jan 2009	Jan 2009	UNK

Table 7 Archive delivery schedule.

No ground based observation is provided.

Cruise data consist of data from Interference and Pointing (1 and 2) tests. It is not intended to provide data from Check-out tests (1 and 2) which are only functional tests (compliance of the sequences with spacecraft): No pointing, no target, no scientific interest.

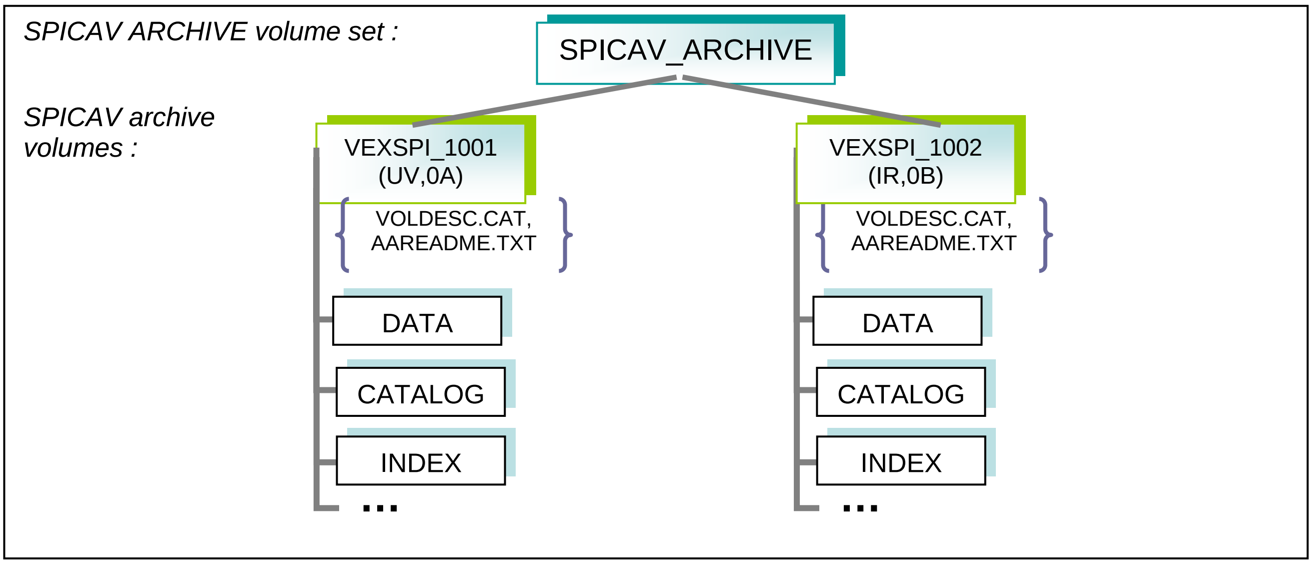
Venus Commissioning: Spicav will deliver data from insertion (14 april 2006) until Orbit 22 (14 May 2006).

Data for extended commissioning are considered to be in MTP001 and will be deliver with the first set of routine data.

3.1.1.2 *Archive Volume Format and Concept of Deliveries*

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

Figure 3 SPICAV volume set organization



Each SPICAV 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 (for quick – look)

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.

DOCUMENT Documentation, supplementary and ancillary information to assist in understanding and using the data products.

CALIB Calibration files to process the data. More information needed to process the data will be delivered in the DOCUMENT directory

Currently, no plans exist for including a SOFTWARE directory in UV, IR dataset. This may be updated 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).
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,… 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

For more details , see [5]

The VOLDESC.CAT file gives a description of the archive volume in a PDS format. See an example of an initial VOLDESC.CAT file of the VEXSPI_1001 archive volume in annex 1.

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

- The mission identifier (VEX), followed by the instrument identifier (SPI),
- A 4-digit sequence identifier for the volumes corresponding to different data level and sensor :
-

1001	**UV**
1002	**IR**
1003	**SOIR**

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.

3.1.1.3.1 VOLUME_SET_ID

Each SPICAV 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,
- The government branch,
- The discipline within the branch that is producing the archive, *SA (Service d'Aéronomie)*
- The VOLUME_ID

For example, the VOLUME_SET_ID of the data level 0A/0B SPICAV archive volume is :

FR-IPSLCNRS-SA-VEXSPI_1000

3.1.1.3.2 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.

3.1.1.3.3 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.

An example of the RELEASE.CAT catalog file in the SPICAV UV level 0A (VEXSPI_1001) Archive Volume is given in Annex 2.

A release will concern a well-defined period of time, based on the nominal science mission timeline, as shown in the SPICAV archive volume delivery schedule (section 1.1.1.1). 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. Annex 3 gives an example of a revision of an initial release.

3.1.1.5 Index files

The PDS standard defines index files 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).

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	VEX (VENUS Express)
Target	V (VENUS) or Y (Sky/CRUISE)
Instrument	SPI (SPICAV)
Data processing level number	see below
Data set type (optional)	see below
Description (optional)	see below
Version number	V1.0

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 associatedwith the data sets, and enough documentation to allow secondary user to extract information from the data.
N N Not Applicable

SPICAV data set	Data processing level number
0A**/0B**	2
1A**	2
1B**	3
2X**	5

*Table 8 CODMAC level number and correspondance with SPICAV dataset(** : UV, IR).*

<u>Data set type</u>

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

SPICAV data set	PRODUCT_TYPE value	Data set type
0A**/0B**	EDR	**EDR
1A**	TBD	TBD
1B**	TBD	TBD
2X**	TBD	TBD

*Table 9 Dataset type and correspondance with SPICAV dataset (**: UV, 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 SPICAV 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: XXXXCRU/VENUS, where XXXX is the value of the STANDARD_DATA_PRODUCT_ID keyword.

SPICAV DATA level	STANDARD_DATA_PRODUCT_ID value
0A	RAWX
1A	CORX
1B	SPEC
2	RDRX

Table 10 Standard_data_product_id value.

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

DATA_SET_NAME = "VEX SPICAV CRUISE/VENUS UV EDR-RAW V1.0"

DATA_SET_ID = "VEX-Y/V-SPI-2-UVEDR-RAWXCRU/VENUS-V1.0"

3.1.3 Data Directory Naming Convention

In the DATA directory, data are stored by mission phase (CRUISE, VENUS).
The CRUISE phase corresponds to data collected before the VENUS Orbit Injection (VOI) phase , including the Near Earth Verification (NEV) and Interplanetary Cruise (IC) phases. This phase contains the corresponding data classified by Day Of Year (DOY), one directory per DOY.

The VENUS phase starts with the VOCP (Venus Orbit Commissioning Phase), followed by Medium Term Planning (MTP) nominal phases, corresponding to the ones defined by the VENUS EXPRESS mission planning. The VENUS directory contains one subdirectory for the VOCP and one subdirectory per MTP.
In the VOCP directory, data are stored by DOY, like the CRUISE phase (DOYxxxx subdirectories).
In the different MTPs directories, covering a unique orbit range, data are stored by orbit (ORBITxxxx subdirectories).
The filenaming convention of the different directories is the following:

XXXX_nnnn_pppp - data collected during a VENUS mission phase from orbit nnnn to pppp
XXXX - the abbreviated name of the VENUS mission phase. XXXX can have the following values:
VOCP-VENUS Orbit Commissioning Phase (from insertion on 14 April 2006 to Orbit 022 on 13 May 2006)
MTPyyy - Medium Term Planning , yyy three digit for MTP number (001,002,003, …) from Orbit 023 on 14 April 2006

See example in paragraph 3.4.3.4

3.1.4 Filenaming Convention

<u>Data and browse files</u>

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

SPIV_YYT_nnnnApp_M_vv.DAT

Where:

YY 2 letters describing the SPICAV data level (eg. 0A, 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 type of observation
vv version number of the file

<u>NOTE:</u>
For the **CRUISE** and **VOCP** phases:

- The orbit number is not applicable. The 4 digits will contain the day of the year (**doy** of 2005/2006) of the observation, preceeded by the letter **C** (for the **IC** phase) or by the letter **P** (for the VOCP phase).
- **M** is the Type of Observation . It may represent:

E: Star (occultation)
S: Sun (occultation)

L: Limb
N: Nadir
A: Alignment (in Nadir direction)
W: Mercury observation
M: Mars observation
H: Earth observation
Y: Sky (Sky observation or observation with spicav no master)
T: Techno (calibration)

During the Cruise, Star and Sun observations are technological (T) observations with no occultation. However, during the CRUISE , E and S (observations types) are used in the data file name.

Examples :

SPIV_0AU_C016A02_E_04.DAT Star UV observation during the CRUISE phase.
SPIV_0AU_P104A01_Y_04.DAT Sky UV observation during the VOCP phase.
SPIV_0AU_nnnnA01_E_04.DAT Stellar UV occultation on orbit nnnn

Associated detached label files and browse files follow the same filenaming convention with the .LBL and _QL.PNG extension respectively.

Geometry files
N/A for CRUISE phase

Geometry files provided by the SPICAV team will have the following name:
(N/A for the cruise)

SPIV_YYT_nnnnApp_M_vv_GOXww.TXT

where:

X	1 letter describing the content of the file. The value of this letter can be L for a light version of the geometry file (only some main parameters) and F for a full version (see section 3.4.3.6 for more details).
ww	version number of the software generating the geometry file

3.2 Standards Used in Data Product Generation
Issued from MEX

3.2.1 PDS Standards

The PDS standards used to describe data products in the SPICAV 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 SPICAV 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 is .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 labels adhering to the standards version 3.6 the appropriate value is "PDS3":

PDS_VERSION_ID = PDS3

PDS data product labels contain data element informations that describe 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

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,

^SPICAV_FILE_ARRAY = "SPIV_0AU_0017A01_E_04.DAT"

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 SPICAV data products are not projected into any coordinate system, however some basic geometric parameters are provided in a associated geometry file.

3.3 Data Validation

The concept of validation is useful in the case of Earth Observation instrument,where measurements can be compared to other means of measurements, for instance lidars.In the case of the exploration of Venus, the same concept is not applicable.
In addition, since we provide for the archive Level 0 only, the algorithm used are quite simple, and have been checked thoroughly.
The scientific products are not yet archived.For our own purpose, we are comparing our results to other measurements of the same quantity, if they exist.They are rare, and when they disagree with our results, we check our assumptions and algorithms.This is as much as can be done for validation in the frame of the exploration of the solar system

3.4 Content

3.4.1 Volume Set

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

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

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

VOLUME_SET_NAME = "VEX SPICAV UV DATA PRODUCTS"

A data set is defined for each sensor (UV,IR,) and for each data product level (level 0A or 0B). Therefore, the SPICAV volume set will consist of at least 2 data volumes containing a single data set.
For SOIR Channel, see SOIR EAICD

3.4.2 Data Set

Each data set will contain the accumulation of data products of one sensor (UV, IR, SOIR) and of one data level (0A or 0B), 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 SPICAV archive volume (VEXSPI_1001 (0AUV), VEXSPI_1002 (0BIR), VEXSPI_1003 (0BSO TBC)) 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.

All TXT and LBL files can be the usual maximum of 80 characters.
All CAT files should have a maximum of 70 characters in each line, *plus* the <CR><LF>, so 72 characters in total, including the line terminators. Not all lines have to be 72 characters.
The 72 character maximum only applies to *.CAT files. It means also the VOLDESC.CAT

3.4.3.1 <u>Root Directory</u>

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 SPICAV 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 VEXSPI_1001 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 VEXSPI_1001 data set
|    |                   during the cruise phase
|    |
|    |- RELEASE.CAT      Release object of the VEXSPI_1001 data set
|    |
|    |- MISSION.CAT      Description of the VENUS Express mission
|    |
|    |- INSTHOST.CAT     Description of the VENUS Express spacecraft
|    |
|    |- INST.CAT         Description of the VEX SPICAV 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.
|    |
|    |- TARGET.CAT       Description of VENUS target objects with SUN, STARS and
|    |                   SKY parameters
```

The 72 character maximum only applies to *.CAT files. It means also the VOLDESC.CAT

3.4.3.3 Index Directory

Files in the INDEX directory are provided by the SPICAV 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.

3.4.3.3.1 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_VENUS.TAB       Geometry index file providing geometry and position
|    |                       information to locate the data within the data set
|    |- GEO_VENUS.LBL       PDS detached label describing corresponding *.TAB file
```

3.4.3.3.2 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

The geometry index file (GEO_VENUS.TAB) provides geometry and position information. 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 the Planetary Science Data Archive Technical Note Geometry and Postion Information SOP-RSSD-TN-010.PDF.

3.4.3.4 Data Directory

The DATA directory contains data subdirectories in which the VENUS Express SPICAV standard data products are stored by mission phases (CRUISE, VENUS). The VENUS directory is divided in several directories, containing data from the VENUS Orbit Commissioning Phase (VOCP) 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 VEXSPI_1001 (UV, 0A) 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 VEX SPICAV level 0A UV data
|    |    |      collected during the cruise phase
|    |    |-[DOYxxxx]
|    |         |-- {file(s) *DAT, *.LBL}
|    |
|    |
|    |-[VENUS]    A directory containing VEX SPICAV level 0A UV data
|    |    |      collected during the VENUS nominal phase
|    |    |
|    |    |-[VOCP_0001_0022]
|    |    |      |
|    |    |      | - [DOYxxxx]
|    |    |             |-- {file(s) *DAT, *.LBL}
|    |    |
|    |    |-[MTP001_0023_0044]
|    |    |    |
|    |    |    |-[ORBITxxxx]
|    |    |    |
|    |    |    |-- {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 PNG. Browse images, provided by the SPICAV team, have the same name of the data product with a _QL.PNG. The browse subdirectories contain the browse image products and corresponding PDS detached label describing the browse image.

3.4.3.6 Geometry Directory

3.4.3.6.1 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.
For example, The GEOMETRY directory of the VEXSPI_1001 volume archive follows the structure outlined below:

```
|- [GEOMETRY] A directory containing the geometry + associated label files
|   |
|   |- GEOMINFO.TXT     Description of files in this directory
|   |
|   |-[VENUS]    A directory containing VEX SPICAV level 0A UV geometry
|   |   |      files associated to data collected during the VENUS nominal phase
|   |   |
|   |   |-[VOCP_0001_0022]
|   |   |   |
|   |   |   |-[DOYxxxx]
|   |   |          |-- {file(s) *TXT, *.LBL}
|   |   |
|   |   |-[MTP001_0023-0044]
|   |   |
|   |   |   |-[ORBITxxxx]
|   |   |
|   |   |   |-- {file(s) *TXT, *.LBL}
|   |   ...
```

Currently no plans exist for providing geometry files associated to observations obtained during the cruise phase.

3.4.3.6.2 Content of the geometry files

Geometric parameters are generated with a SPICAV software using SPICE routines and SPICE kernels. Each geometry file contains two blocks: a header (comments) and a data table.
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 nadir,limb,sun observations.
- Parameters definition. The SPICAV 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.
An example of a geometry file header is provided in Annex 4.

3.4.3.6.3 Content of the geometry label files

The geometry PDS label file describes 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.

3.4.3.7 Software Directory

The SOFTWARE directory contains IDL routines to read the SPICAV UV data files,
as a ZIP file SPICAV_READPSD43.ZIP and its corresponding label file,
SPICAV_READPSD43.LBL
This zip file contains IDL software routines able to read the Venus Express
SPICAV-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/SPICAV_READPDS43
directory. Instructions for running the routines are located in the file
SPICAV_READPDS43_README.TXT, located in the same directory.
The main routine readSBN_UV.pro has been developed by the SPICAV team and
calls the readPDS 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 example SPICAV data file and associated label
file. The LABEL directory contains the FMT included file describing the
structure of the HEADER_ARRAY object in the SPICAV level 0AUV data products.

Version 01 of readSBN_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 SPICAV UV dataset while it has not been updated by the SBN
team. Please not that we do not guarantee that the readSBN_UV SPICAV 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

All PDS detached label files describing data or document files in a volume are stored in the same directory as the data or document files. Thus, they are not stored in the Label directory.
This directory only includes files (*.FMT (FORMAT)), containing additional description of data object and referenced by a pointer in a PDS label.

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).
- A SPICAV UV/IR data file description(eg. SPICAV_UVDATAFILE_DESC.TXT)
- A SPICAV geometry documentation (eg. SPICAV_GEOMETRY_DESC.TXT)
- A SPICAV UV/IR calibration documentation (eg. SPICAV_UVCALIB_DESC.TXT)
- A SPICAV UV operating mode description (SPICAV_UVMODE_DESC.TXT)
- A Flight User Manual (SPVFUM25.PDF)

The SPICAV EAICD document will be provided in both ASCII and PDF (Adobe Portable Document Format).
Data file, geometry and calibration documentation will be provided in ASCII format, and the SPICAV flight user manual (FUM) in PDF.
Helpful technical SPICAV documentation or SPICAV scientific papers will be provided in the DOCUMENT directory in addition to other ESA documentation.

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).

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

Data product design

A SPICAV 0AUV data product file contains one or several records of an observation. One SPICAV 0AUV record contains all the header and data information from one SPICAV 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 an 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 **SPICAV_UVDATAFILE_DESC.TXT** in the DOCUMENT directory.

In the label, a SPICAV 0AUV data product is considered as an ARRAY object of one dimension, containing n records. 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:

VEX:SPICAV_UV_EXPOSURE_TIME = HEADER_ARRAY[42]
VEX:SPICAV_UV_FIRST_BAND = HEADER_ARRAY[44]
VEX:SPICAV_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)
VEX:SPICAV_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.

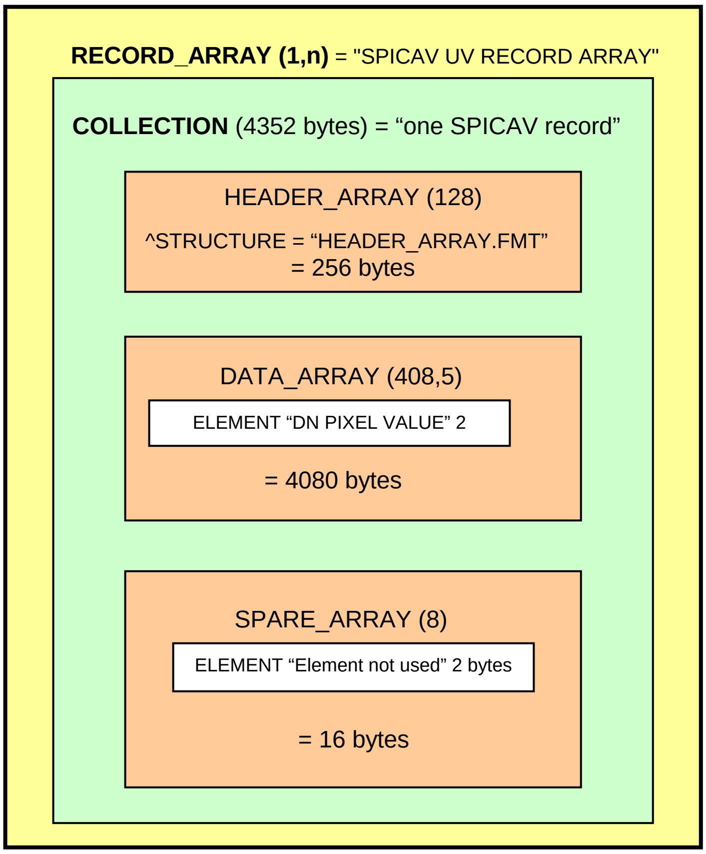


Figure 4. SPICAV 0AUV data representation in the label file.

Example label of level 0A UV data product

See in annex 5.

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

Data product design

A SPICAV 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 SPICAV IR general header contains all the general information from one SPICAV IR sequence of measurement. The general header length is 50*2 bytes. They are command parameters and

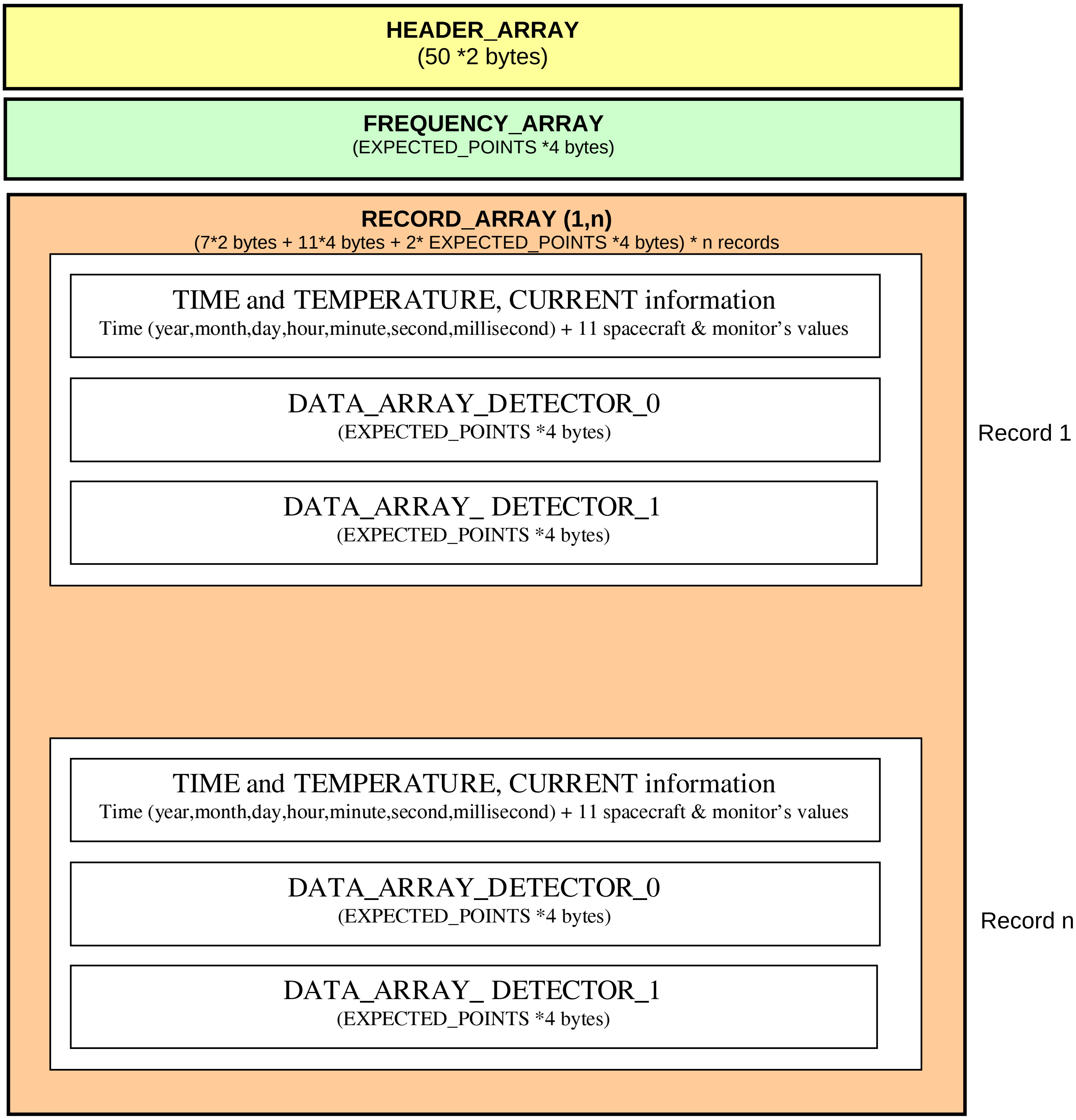
informations about the number of channels used, the expected points per spectrum, the number of spectra and the number of sessions per spectrum.
The frequency array informations are the frequency array associated to the spectra (expected points *4 bytes).

Each record contains: a header table (58 bytes), giving time, system monitor's values and some sattelite's parameters (temperature, 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 4 parameters: FREQUENCY_OFFSET, FREQUENCY_RANGE, 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 SPICAV 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 SPICAV 0BIR record is then described by a COLLECTION object, containing 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).


HEADER_ARRAY
(50 *2 bytes)
FREQUENCY_ARRAY
(EXPECTED_POINTS *4 bytes)
RECORD_ARRAY (1,n)
(7*2 bytes + 11*4 bytes + 2* EXPECTED_POINTS *4 bytes) * n records
TIME and TEMPERATURE, CURRENT information
Time (year,month,day,hour,minute,second,millisecond) + 11 spacecraft & monitor's values
DATA_ARRAY_DETECTOR_0
(EXPECTED_POINTS *4 bytes)
DATA_ARRAY_ DETECTOR_1
(EXPECTED_POINTS *4 bytes)
Record 1
TIME and TEMPERATURE, CURRENT information
Time (year,month,day,hour,minute,second,millisecond) + 11 spacecraft & monitor's values
DATA_ARRAY_DETECTOR_0
(EXPECTED_POINTS *4 bytes)
DATA_ARRAY_ DETECTOR_1
(EXPECTED_POINTS *4 bytes)
Record n

Example label of level 0B IR data product

See in Annex 6 .

4.1.3 Data product design and example label of a SOIR data product

See SOIR EAICD

4.1.4 Label keywords descriptions

4.1.4.1 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 SPICAV 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.
["VEX-Y/V-SPI-2-UVEDR-RAWXCRU/VENUS-V1.0",
"VEX-Y/V-SPI-2-IREDR-RAWXCRU/VENUS-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.
["VEX SPICAV CRUISE/VENUS UV EDR-RAW V1.0",
"VEX SPICAV CRUISE/VENUS 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 SPICAV instrument. ["VENUS EXPRESS"]

INSTRUMENT_HOST_NAME Name of the host spacecraft for the SPICAV instrument. ["VENUS EXPRESS"]

INSTRUMENT_HOST_ID Abbreviated name of the host spacecraft. ["VEX"]

MISSION_PHASE_NAME Mission subphases during which the data were collected. See [5]

TARGET_NAME The name of the target observed in the data.
[« SKY », « VENUS », « STAR », « SUN », « 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, 0 during the VOCP phase and the value of the orbit on 4 digits (e.g "0103") during the VENUS phase.

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

PRODUCER_FULL_NAME Full_name of the individual mainly responsible for the production of a data. ["JEAN-LOUP BERTAUX"].

PRODUCER_INSTITUTION_NAME Institution associated with the production of a data set ["SERVICE D'AERONOMIE, IPSL/CNRS,FRANCE"]

DATA_QUALITY_ID This keyword includes a quality flag string of eight characters. It identifies the quality of data available. The eight characters are describes in the DATA_QUALITY_DESC.

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

4.1.4.2 Data Object Pointers Identification Data Elements

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

4.1.4.3 Instrument and Detector Descriptive Data Elements

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

INSTRUMENT_NAME name of the instrument. [“SPICAV”]

INSTRUMENT_TYPE Type of the instrument. [“SPECTROMETER”]

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

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

DISTRIBUTION TYPE: to distinguish data files from geometry files

VEX:SPICAV_UV_EXPOSURE_TIME
[integer, text, scalar]
The keyword provides a value of the time for which the SPICAV CCD was exposed for a given measurement. The value provided is in units of *10 msec. For example VEX:SPICAV_UV_EXPOSURE_TIME = 56 would mean an exposure time of 560 msec.

VEX:SPICAV_UV_FIRST_BAND
[Integer, formation, scalar]
The SPICAV CCD has 288 lines, from which 5 bands can be chosen. This keyword identifies the line number on the CCD at which the first band begins.

VEX:SPICAV_UV_CCD_ROW_BINNED
[Integer, formation, scalar]
The keyword value indicates the number of physical CCD rows that are binned and contained in one band. This keyword will be set to 0 when SPICAV is in BINNINGP mode.

VEX:SPICAV_UV_HT
[Real, formation,scalar]
The value assigned to this keyword indicates the high voltage put on the intensifier of the CCD.

4.1.4.4 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

4.1.4.5 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

An example of PDS label file describing the content of the data index table within an archive volume in Annex 7.

4.1.4.6 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 .

VEX:SCIENCE_CASE_ID: This element, used within the VENUS EXPRESS mission, is an integer defining the science case. Allowed values are : [1,2,3,4,5,6,7,8,9,10,ALL]

VEX:SCIENCE_CASE_ID_DESC: It provides the definition of the SCIENCE_CASE_ID value.

OBSERVATION_TYPE: The observation_type element identifies the general type of an observation.

^ OBSERVATION_TYPE_DESC: It is used to give a full description of the values and meanings of the element OBSERVATION_TYPE.

5 Appendix: Example of Directory Listing of VEXSPI_1001 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 VEX SPI level 0A UV data
 |     |    |      collected during the cruise phase
 |     |    | -[DOYxxxx]
 |     |    |        |-- {file(s) *DAT, *.LBL}
 |     |    |
 |     |    |-- HEADER_ARRAY.FMT Include file containing a description of the header
 |     |                    of a UV record.
 |     |
 |     |
 |     |-[VENUS]    A directory containing VEX SPI level 0A UV data
 |     |    |      collected during the VENUS nominal phase
 |     |    |
 |     |    |-[VOCP_0001_0022]
 |     |    |    | -[DOYxxxx]
 |     |    |    |       |-- {file(s) *DAT, *.LBL}
 |     |    |    |
 |     |    |    |-- HEADER_ARRAY.FMT Include file containing a description of the
 |     |    |                    header of a UV record.
 |     |    |
 |     |    |-[MTP001_0023-0044]
 |     |    |    |
 |     |    |    |-[ORBITxxxx]
 |     |    |    |   |
 |     |    |    |   |
 |     |    |    |   |--file(s) *DAT, *.LBL}
 |     |    |    |
```

```
|    |   |
|    |   |
|    |   |
|    |   ...
|
|
|- [CATALOG] A directory containing information about the data set
|    |
|    |- CATINFO.TXT      Description of files in this directory
|    |
|    |- DATASET.CAT      Description of the VEXSPI_0AUV data set  during the cruise phase
|    |
|    |
|    |- RELEASE.CAT      Release object of the VEXSPI_0AUV data set
|    |
|    |- MISSION.CAT      Description of the VENUS Express mission
|    |
|    |- INSTHOST.CAT     Description of the VENUS Express spacecraft
|    |
|    |- INST.CAT         Description of the VEX SPICAV 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.
|    |-
|    |- TARGET.CAT       Description of VENUS target objects with SUN, STARS and
|    |                   SKY parameters
|
|
|
|- [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 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 corresponding *.TAB file
|     |
|     |
|     |- GEOMETRY_INDEX.TAB       Index of geometry files in the GEOMETRY directory
|     |                                              ( N/A for Cuise)
|     |- GEOMETRY_INDEX.LBL   PDS detached label describing the corresponding *.TAB file
|     |                                          ( N/A for Cuise
|     |- GEO_VENUS.TAB       Geometry index file providing geometry and position
|     |                              information to locate the data within the data set ( N/A for Cuise)
|     |- GEO_VENUS.LBL       PDS detached label describing corresponding *.TAB file
|                                    (N/A for Cuise)
|
|
|- [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 VEX SPI level
|     |    |     0A UV data collected during the cruise phase
|     |    | - [DOYxxxx]
|     |            |-- {file(s) *PNG, *.LBL}
|     |
|     |
|     |-[VENUS]    A directory containing browse images of VEX SPI level
|     |    |     0A UV data collected during the VENUS VENUS nominal phase
|     |    |
|     |    |-[VOCP_0001_0022]
|     |    |    |-[DOYxxxx]
|     |    |            |-- {file(s) *PNG, *.LBL}
|     |    |
|     |    |-[MTP001_0023-044]
|     |    |    |
|     |    |    |-[ORBITxxxx]
|     |    |    |    |
|     |    |         | --{file(s) *PNG, *.LBL}
|     |    |
|     |    ...
|
|- [GEOMETRY]  A directory containing geometry files associated to the
|     |     data products.   ( N/A for the Cruise )
|     |
|     |- GEOMINFO.TXT   Description of files in this directory.
|     |
|     |-[VENUS]    A directory containing geometry of VEX SPI level
|     |    |     0A UV data collected during the VENUS nominal phase
|     |    |
```

```
|    |    |-[VOCP_0001_0022]
|    |    |    |
|    |    |    |-- {file(s) *TXT, *.LBL}
|    |    |
|    |    |-[MTP001_0023-0044]
|    |    |
|    |    |    |-[ORBITxxxx]
|    |    |    |    |
|    |    |    |    |
|    |    |    |    | --{file(s) *TXT, *.LBL}
|    |    |
|    |    ...
|    |
|
|- [DOCUMENT]   A directory containing information documents.
|    |
|    |- DOCINFO.TXT          Description of files in this directory.
|    |
|    |- SA_VEX_ARCH_001_xx.PDF The SPICAV EAICD in PDF format
|    |
|    |- SA_VEX_ARCH_001_xx.ASC The SPICAV EAICD in ASCII format
|    |
|    |- SA_VEX_ARCH_001_xx.LBL PDS detached label that describes
|    |                   SA_VEX_ARCH_001_xx.PDF and SA_VEX_ARCH_001_xx.ASC
|    |
|    |- SPVFUM25.PDF         - SPICAV Flight User Manual in PDF Format
|    |
|    |-SPVFUM25.LBL         - PDS detached label that describes SPFUM25.PDF
|    |
|    |- SPICAV_UVDATAFILE_DESC.TXT ASCII file describing the contents of the data
|    |                 files which are delivered in the SPICAV data product
|    |- SPICAV_UVDATAFILE_DESC.LBL PDS detached label that describes
|    |                 SPICAV_UVDATAFILE_DESC.TXT
|    |
|    |- SPICAV_UVCALIB_DESC.TXT ASCII file describing the calibration of the
|    |                 SPICAV UV data which are delivered in the SPICAV UV
|    |                 dataset.
|    |- SPICAV_UVCALIB_DESC.LBL PDS detached label that describes
|    |                   SPICAV_UVCALIB_DESC.TXT
|    |
|    |- SPICAV_GEOMETRY_DESC.TXT ASCII file describing the contents of the
|    |                     geometry files which are delivered in the SPICAV
|    |                     data set.  ( N/A for the Cruise )
|    |- SPICAV_GEOMETRY_DESC.LBL PDS detached label that describes
|    |                     SPICAV_GEOMETRY_DESC.TXT.  ( N/A for the Cruise )
|    |
|    |-SPICAV_UVMODE_DESC.TXT- ASCII file describing the different operating modes
```

```
|    |                              of the UV SPICAV spectrometer.
|    |
|    | - SPICAV_UVMODE_DESC.LBL    PDS detached label that describes
|    |                              SPICAV_UVMODE_DESC.TXT
|    |
|    | - DATA_QUALITY_ID_DESC.TXT    file describing the data quality
|    |            which is associated with a particular DATA_QUALITY_ID value
|    |
|    | - DATA_QUALITY_ID_DESC.LBL     PDS detached label that describes
|    |                          DATA_QUALITY_ID_DESC.TXT
|    |
|    | - VEX_SCIENCE_CASE_ID_DESC.TXT file describing 10 Typical Venus
|    |                        Express modes of observations
|    |
|    |- VEX_SCIENCE_CASE_ID_DESC.LBL  PDS detached label that describes
|    |               VEX_SCIENCE_CASE_ID_DESC.TXT
|    |
|    |- VEX_RSSD_LI_009.TAB     A Venus Express Mission phase's table.
|    |        This file summarizes the Mission nominal phases and the extended
|    |        one, in terms of orbit number and date.
|    |
|    |
|    |- VEX_RSSD_LI_009.LBL    PDS detached label that describes
|    |           VEX_RSSD_LI_009.TAB
|    |
|    |- VEX_POINTING_MODE_DESC.TXT document describes the values for
|    |             the SPACECRAFT_POINTING_MODE keyword.
|    |
|    |- VEX_POINTING_MODE_DESC.LBL    PDS detached label that describes
|    |               VEX_POINTING_MODE_DESC.TXT
|    |
|    |- VEX_ORIENTATION_DESC.TXT    file describing the convention used
|    |           to describe the Venus Express spacecraft orientation, especially
|    |           in nadir pointing mode.
|    |
|    |- VEX_ORIENTATION_DESC.LBL    PDS detached label that describes
|    |             VEX_ORIENTATION_DESC.TXT
|    |
|    |- VEX_MISSION_CALENDAR.PDF  This document aims at providing
|    |             information about the mission. It is a constantly updated document.
|    |
|    |
|    |- VEX_MISSION_CALENDAR.LBL   PDS detached label that describes
|    |              VEX_MISSION_CALENDAR.PDF
|    |
|    |- VEX_ARCHIVE_CONVENTIONS.PDF document defining the conventions
|    |              that apply to the VEX Science Data
```

```
|    |                      Archive
|    |- VEX_ARCHIVE_CONVENTIONS.LBL  PDS detached label that describes
|    |                      VEX_ARCHIVE_CONVENTIONS.PDF
|    |
|    |- UV_OPERATION_MODES.PNG     SPICAV UV detector operation modes
|    |                 (figure 2 of EAICD)
|    |
|    |- UV_OPERATION_MODES.LBL     PDS detached label that describes
|    |                      UV_OPERATION_MODES.PNG
|    |
|    |- SPICAV_POINTING_001.TXT   document describing the geometry
|    |                    computation
|    |
|    |- SPICAV_POINTING_001.LBL   PDS detached label that describes
|    |                     SPICAV_POINTING_001.TXT
|    |
|    |- OBSERVATION_TYPE_DESC.TXT  file giving the definition for
|    |                     the OBSERVATION_TYPE keyword values.
|    |
|    |- OBSERVATION_TYPE_DESC.LBL  PDS detached label that describes
|    |                     OBSERVATION_TYPE_DESC.TXT
|    |
|    |
|    |- PSS_2007_SPICAV_SOIR.PDF   Paper describing SPICAV, in
|    |                     Planetary and Space Science.
|    |
|    |- PSS_2007_SPICAV_SOIR.LBL    PDS detached label that describes
|    |                      PSS_2007_SPICAV_SOIR.PDF
|    |
|    |- NATURE_2007_SPICAV_SOIR.PDF   First paper in Nature 2007,
|    |                       describing first results obtained
|    |                      with SPICAV/SOIR instrument data
|    |
|    |- NATURE_2007_SPICAV_SOIR.LBL  PDS detached label that describes
|    |                      NATURE_2007_SPICAV_SOIR.PDF
|    |
|    |- JQSRT_2008_12C16O18O.PDF    Detailed spectroscopy of the new
|    |                      band of CO2 isotopologue from SOIR
|    |                      observations in the  atmosphere of
|    |                      Venus.
|    |
|    |- JQSRT_2008_12C16O18O.LBL    PDS detached label that describes
|    |                      JQSRT_2008_12C16O18O.PDF
|    |
|    |- JGR_2006_SPICAM_UV.PDF      Description of SPICAM UV, almost
|    |                      identical to  SPICAV UV.
|    |
```

```
|    |
|    |- JGR_2006_SPICAM_UV.LBL      PDS detached label that describes
|    |                        JGR_2006_SPICAM_UV.PDF
|    |
|    |- ICARUS_2008_12C16O18O.PDF   Discovery of a new band of  absorption of isotope
|    |                       CO16018 in the atmosphere of Venus at 2982 cm-1:
|    |
|    |- ICARUS_2008_12C16O18O.LBL   PDS detached label that describes
|    |                       ICARUS_2008_12C16O18O.PDF
|    |
|    |
|    |- ESA_SP_VEX_SPICAV_P1.PDF   This paper contains a description of SPICAV
|    |                          scientific objectives
|    |
|    |- ESA_SP_VEX_SPICAV_P1.LBL    PDS detached label that describes
|    |                         ESA_SP_VEX_SPICAV_P1.PDF
|    |
|    |- ERRATA.TXT         The aim of this file is to notify the users about small inconsistencies
|    |                 that might be  present in the SPICAV UV/IR dataset
|    |                 .
|-[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.
```

6 Annexes.

6.1 Annex 1: example of an initial VOLDESC.CAT file of the VEXSPI_1001 archive volume

```
PDS_VERSION_ID              = PDS3
LABEL_REVI                                          RECORD_TYPE              = FIXED_LENGTH

RECORD_BYTES                = 70
RELEASE_ID                = 0001
REVISION_ID               = 0000

OBJECT                   = VOLUME
 VOLUME_SERIES_NAME         = "MISSION TO VENUS"
 VOLUME_SET_NAME           = "VEX SPICAV UV DATA PRODUCTS"
 VOLUME_SET_ID             = FR_IPSLCNRS_SA_VEXSPI_1000
 VOLUME_NAME                  = "Volume 1: VEX SPICAV LEVEL 0 UV  DATA"   VOLUME_ID
    = VEXSPI_1001
 VOLUME_VERSION_ID          = "VERSION 1"
 PUBLICATION_DATE          = 2007-01-09
 VOLUMES                 = 1
 MEDIUM_TYPE               = "ONLINE"
 VOLUME_FORMAT              = "ISO-9660"
 DATA_SET_ID          = "VEX-Y/V-SPI-2-UVEDR-RAWXCRU/VENUS-V1.0"
 DESCRIPTION                  = "This volume release contains Venus Express SPICAV 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
```

6.2 Annex 2: example of RELEASE.CAT for the initial release (RELEASE_ID=0001, REVISION_ID=0000)

```
PDS_VERSION_ID          = PDS3
LABEL_REVISION_NOTE     = "A. REBERAC, 2005-01-21 (original)
                      C.NEHME, 2007-01-07 (revision)"
RECORD_TYPE             = STREAM
RELEASE_ID              = 0001
REVISION_ID             = 0000

OBJECT                  = DATA_SET_RELEASE
 DATA_SET_ID            = "VEX-Y/V-SPI-2-UVEDR-RAWXCRU/VENUS-V1.0"
 RELEASE_ID             = 0001


 DESCRIPTION            = "
This release contains the digital numbers (DN) contained in the telemetry (TM) packages of the UV
SPICAV instrument on board of  spacecraft Venus Express. Data have not been further converted or
calibrated. This release contains data from the cruise phase of  the s/c, all data from  Interplanetary Cruise
(IC) phase from November 2006 until April 2006 and  data for MTP001 to MTP004 from May 2006 till
August 2006.
   Revision 0000 contains the original delivery. "

 OBJECT                 = REVISION
   REVISION_ID          = 0000
   REVISION_DATE        = NULL
   REVISION_MEDIA       = "ONLINE"
   DESCRIPTION          = "FIRST DELIVERY: RELEASE 0001, REVISION: 0000"
 END_OBJECT             = REVISION

END_OBJECT              = DATA_SET_RELEASE

END
```

6.3 Annex 3: RELEASE.CAT example for RELEASE_ID=0001, REVISION_ID=0001

```
PDS_VERSION_ID          = PDS3
LABEL_REVISION_NOTE     = "A. REBERAC, 2005-01-21 (original)
                    C. NEHME, 2007-01-07 (revision)"
RECORD_TYPE             = STREAM
RELEASE_ID              = 0001
REVISION_ID             = 0000

OBJECT                  = DATA_SET_RELEASE
 DATA_SET_ID            = "VEX-Y/V-SPI-2-UVEDR-RAWXCRU/VENUS-V1.0"
 RELEASE_ID             = 0001


 DESCRIPTION            = "
This release contains the digital numbers (DN) contained in the telemetry (TM) packages of the UV SPICAV instrument on board of  spacecraft Venus Express. Data have not been further converted or calibrated. This release contains data from the cruise phase of  the s/c, all data from  Interplanetary Cruise (IC) phase    from November 2006 until April 2006 and  data for MTP001 to MTP004 from May 2006 till August 2006.

   Revision 0000 contains the original delivery. "

 OBJECT                 = REVISION
   REVISION_ID          = 0000
   REVISION_DATE        = NULL
   REVISION_MEDIA       = "ONLINE"
   DESCRIPTION          = "FIRST DELIVERY: RELEASE 0001, REVISION: 0000"         END_OBJECT
      = REVISION

 OBJECT                 = REVISION
   REVISION_ID          = 0001
   REVISION_DATE        = NULL
   REVISION_MEDIA       = "ONLINE"
   DESCRIPTION                  = "Update of geometry files content: RELEASE 0001, REVISION:
                  0001"
 END_OBJECT             = REVISION
  END_OBJECT            = DATA_SET_RELEASE

END
```

6.4 Annex 4: Geometry file header example

```
UV GeocalcveUV Geocalcvex, version= 03 Mon Sep 15 09:15:44 2008
```

```
Geo File = SPIV_0AU_0104A07_E_04_GOL03.TXT

Contents of metakernel file

SPICE Meta-Kernel for Venus Express
===========================================================================

\begindata

  PATH_VALUES     = ( '/home/spicav/orbito/spice/kernels' )

  PATH_SYMBOLS    = ( 'KER_PATH' )


 KERNELS_TO_LOAD = ('$KER_PATH/lsk/NAIF0009.TLS',
                 '$KER_PATH/sclk/VEX_080630_STEP.TSC',
                 '$KER_PATH/spk/DE405.BSP',
                 '$KER_PATH/pck/PCK00008.TPC',
                 '$KER_PATH/fk/VEX_V08.TF',
                 '$KER_PATH/fk/RSSD0001.TF',
                 '$KER_PATH/pck/DE403-MASSES.TPC',
                 '$KER_PATH/spk/ORHV________________00030.BSP',
                 '$KER_PATH/spk/ORVV__060409211524_00039.BSP',
                 '$KER_PATH/spk/ORVV__060501000000_00048.BSP',
                 '$KER_PATH/spk/ORVV__060601000000_00054.BSP',
                  ………………………
                  ………………………
\begintext
```

SUN...
1 AU (from Near Earth Objects Program) = 149 597 870.691 km
SUN Long, Lat, Dist, Ls, at first Time, 2006-08-03T01:41:24.342 56.181 -0.797 107794107. 350.322
SUN ra, dec, at 1st Time 254.133 -22.561

TARGET... HR 472
In J2000, and in SC axes, CENTER of slit 24.430 -57.240 -1.000 -1.000

UV, y0 (first CCD line), binning values...
103 16 16 16 16 16

Parameters definition...
LOS is Line of VIEW
If Star it is Star direction, If Nadir it is center of slit (== center of CCD)
1stB, 2ndB, 3rdB, 4thB, and 5thB are center of UV Bands (binning included), Because UV 3rd = IR, IT IS ALSO IR geo parameters !!!
Planproj is the projection plane (u,v,w frame) defined as the plane
at the nearest point on Venus and perpendicular to vdir (view direction from VEX);
with w = -vdir , v = North pole, u = right handed
Time UTC (A23) + (I5, F9.1, 2F7.2, F6.1, 2F7.2, F6.1, 2F10.1, F8.2, 5F7.2, F6.1, F7.2, 2F10.1,F7.2, 2F7.2, F10.1,2F7.2, 2F7.2, F10.1,2F7.2, 2F7.2, F10.1,2F7.2, 2F7.2, F10.1,2F7.2, 9F10.6, F8.2,F8.2, 10F10.2, 6F7.2, 2F7.2, F6.1, 2F10.1, F8.2, 5F7.2, F6.1, F7.2, 2F10.1,F7.2)

Number of parameters (without Time): 84
Reference number, Order number, Label
0 1 Record number
19 2 SC altitude, (km), above Venus ellipsoid
17 3 SC longitude, (deg) , 0 360
18 4 SC latitude, (deg)
20 5 Sza, (deg), Solar zenith angle at sub-SC point
141 6 3rdB longitude (deg) at Venus Nearest Point
142 7 3rdB latitude (deg) at Venus Nearest Point
145 8 3rdB sza, (deg) Solar zenith angle at VNP point

144 9 3rdB Distance (km) between Vex and VNP, < 0 IF behind SC
143 10 3rdB altitude (km) above ellipsoid, < 0 IF intersection
146 11 3rdB Pixel (0.01 deg) size (km) at VNP point
147 12 3rdB ra, (deg) right ascension of LOS (EMEJ2000)
148 13 3rdB dec, (deg) declination of LOS (EMEJ2000)
149 14 3rdB Angl (deg) between LOS and SUN
150 15 3rdB Phase (deg) between LOS at VNP and SUN
151 16 3rdB Solar incidence (deg) between normal at VNP and SUN
152 17 3rdB Solar local time at VNP
153 18 3rdB Emiss (deg) angle between Normal and Observer
155 19 3rdB Distance (km) between LOS and Center of Venus
154 20 3rdB Distance (km) between Vex and Center of Venus
156 21 3rdB Alfa (deg) azimut of SUN in Vex axes (relative to X)
101 22 1stB longitude (deg) at Venus Nearest Point
102 23 1stB latitude (deg) at Venus Nearest Point
103 24 1stB altitude (km) above ellipsoid, < 0 IF intersection
107 25 1stB ra, (deg) right ascension of LOS (EMEJ2000)
108 26 1stB dec, (deg) declination of LOS (EMEJ2000)
121 27 2ndB longitude (deg) at Venus Nearest Point
122 28 2ndB latitude (deg) at Venus Nearest Point
123 29 2ndB altitude (km) above ellipsoid, < 0 IF intersection
127 30 2ndB ra, (deg) right ascension of LOS (EMEJ2000)
128 31 2ndB dec, (deg) declination of LOS (EMEJ2000)
161 32 4thB longitude (deg) at Venus Nearest Point
162 33 4thB latitude (deg) at Venus Nearest Point
163 34 4thB altitude (km) above ellipsoid, < 0 IF intersection
167 35 4thB ra, (deg) right ascension of LOS (EMEJ2000)
168 36 4thB dec, (deg) declination of LOS (EMEJ2000)
181 37 5thB longitude (deg) at Venus Nearest Point
182 38 5thB latitude (deg) at Venus Nearest Point
183 39 5thB altitude (km) above ellipsoid, < 0 IF intersection
187 40 5thB ra, (deg) right ascension of LOS (EMEJ2000)
188 41 5thB dec, (deg) declination of LOS (EMEJ2000)
87 42 Xsc X in body-fixed rotating IAU_VENUS
88 43 Xsc Y in body-fixed rotating IAU_VENUS
89 44 Xsc Z in body-fixed rotating IAU_VENUS
90 45 Ysc X in body-fixed rotating IAU_VENUS
91 46 Ysc Y in body-fixed rotating IAU_VENUS
92 47 Ysc Z in body-fixed rotating IAU_VENUS
93 48 Zsc X in body-fixed rotating IAU_VENUS
94 49 Zsc Y in body-fixed rotating IAU_VENUS
95 50 Zsc Z in body-fixed rotating IAU_VENUS
312 51 Angle (deg) between Xsc and the local verticale at VNP
301 52 Angle (deg) between Xsc and the projplan u axis
302 53 P1 u horizon point component in projplan
303 54 P1 v horizon point component in projplan
304 55 P2 u horizon point component in projplan
305 56 P2 v horizon point component in projplan
306 57 P3 u horizon point component in projplan
307 58 P3 v horizon point component in projplan
308 59 P4 u horizon point component in projplan
309 60 P4 v horizon point component in projplan
310 61 P5 u horizon point component in projplan
311 62 P5 v horizon point component in projplan
320 63 X ra, Transformation matrix from IAU_VENUS to EMEJ2000
321 64 X dec, Transformation matrix from IAU_VENUS to EMEJ2000
322 65 Y ra, Transformation matrix from IAU_VENUS to EMEJ2000
323 66 Y dec, Transformation matrix from IAU_VENUS to EMEJ2000
324 67 Z ra, Transformation matrix from IAU_VENUS to EMEJ2000
325 68 Z dec, Transformation matrix from IAU_VENUS to EMEJ2000
31 69 LOS longitude (deg) at Venus Nearest Point
32 70 LOS latitude (deg) at Venus Nearest Point
35 71 LOS sza, (deg) Solar zenith angle at VNP point

```
 34 72 LOS   Distance  (km)  between Vex and VNP,  < 0 IF behind SC
 33 73 LOS   altitude  (km)  above ellipsoid,      < 0 IF intersection
 36 74 LOS   Pixel (0.01 deg) size (km) at VNP point
 37 75 LOS   ra,   (deg) right ascension of LOS (EMEJ2000)
 38 76 LOS   dec,  (deg) declination     of LOS (EMEJ2000)
 39 77 LOS   Angl  (deg) between LOS and SUN
 40 78 LOS   Phase (deg) between LOS at VNP and SUN
 41 79 LOS   Solar incidence (deg) between normal at VNP and SUN
 42 80 LOS   Solar local time at VNP
 43 81 LOS   Emiss (deg) angle between Normal and Observer
 45 82 LOS   Distance    (km)  between LOS and Center of Venus
 44 83 LOS   Distance    (km)  between Vex and Center of Venus
 46 84 LOS   Alfa  (deg) azimut    of SUN in Vex axes (relative to X)

     Time (UTC)        1      2    3     4     5    6     7     8       9       10     11    12    13    14    15    16    17   18       19
20   21    22    23       24   25    26    27    28       29   30    31    32    33       34   35    36    37    38       39   40    41
 42      43      44      45      46      47      48      49      50      51     52      53      54      55      56      57      58      59
  60      61      62    63    64    65    66    67    68    69    70    71      72      73    74    75    76    77    78    79    80    81
     82      83    84
-- End Comments
```

6.5 Annex 5: Example 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                 = 374


/* DATA OBJECT POINTERS IDENTIFICATION DATA ELEMENTS     */
^RECORD_ARRAY                = "SPIV_0AU_P104A01_Y_04.DAT"


FILE_NAME                    = "SPIV_0AU_P104A01_Y_04.DAT"
DATA_SET_ID                  = "VEX-Y/V-SPI-2-UVEDR-RAWXCRU/VENUS-V1.0"
DATA_SET_NAME                = "VEX SPICAV CRUISE/VENUS UV EDR-RAW V1.0"
RELEASE_ID                   = 0001
REVISION_ID                  = 0000
DISTRIBUTION_TYPE            = DATA

PRODUCT_ID                   = "SPIV_0AU_P104A01_Y_04.DAT"
PRODUCT_CREATION_TIME        = 2007-07-05T11:42:14.000
MISSION_NAME                 = "VENUS EXPRESS"
MISSION_ID                   = VEX
INSTRUMENT_HOST_NAME         = "VENUS EXPRESS"
INSTRUMENT_HOST_ID           =  VEX
MISSION_PHASE_NAME           = "VOI"

TARGET_NAME                  = "SKY"
TARGET_TYPE                  = "N/A"
SPACECRAFT_POINTING_MODE     = "INERT"
SPACECRAFT_POINTING_MODE_DESC  = "This pointing mode is used to point the
                        instrument platform towards a fixed
                        direction in right ascension and declination."
RIGHT_ASCENSION              =  306.17
DECLINATION                  =   61.63

VEX:SCIENCE_CASE_ID          = N/A
VEX:SCIENCE_CASE_ID_DESC     = "Please refer to VEX_SCIENCE_CASE_ID_DESC.TXT
                         in the DOCUMENT directory"
OBSERVATION_TYPE             = "N/A"
PRODUCT_TYPE                 = EDR
PROCESSING_LEVEL_ID          = 2
STANDARD_DATA_PRODUCT_ID     = RAWX
START_TIME                   = 2006-04-14T17:50:19.000
STOP_TIME                    = 2006-04-14T17:56:32.000
SPACECRAFT_CLOCK_START_COUNT   = 1/0035401819.27502
SPACECRAFT_CLOCK_STOP_COUNT    = 1/0035402192.27497
ORBIT_NUMBER                 = 0
ORBITAL_ECCENTRICITY         = "N/A"
ORBITAL_INCLINATION          = "N/A"
ORBITAL_SEMIMAJOR_AXIS       = "N/A"
PERIAPSIS_ALTITUDE           = "N/A"
PERIAPSIS_ARGUMENT_ANGLE     = "N/A"
```

```
PERIAPSIS_TIME                    = "N/A"

PRODUCER_ID                   = VEX_SPI_TEAM
PRODUCER_FULL_NAME            = "JEAN-LOUP BERTAUX"
PRODUCER_INSTITUTION_NAME     = "SERVICE D'AERONOMIE, IPSL/CNRS,FRANCE"
INSTRUMENT_ID                 = SPICAV
INSTRUMENT_NAME               = "SPICAV"
INSTRUMENT_TYPE               = "SPECTROMETER"

DESCRIPTION            = "This file contains all records of a UV
                     SPICAV observation; for completness, each
                     record consists of a SPICAV header array,
                     followed by the SPICAV spectra."
DATA_QUALITY_ID               = 0
^DATA_QUALITY_DESC            = "DATA_QUALITY_DESC.TXT"
/* INSTRUMENT AND DETECTOR DESCRIPTIVE DATA ELEMENTS    */
CHANNEL_ID                    = "UV"
INSTRUMENT_MODE_ID            = BINNING_S
^SPICAV_MODE_DESC             = "SPICAV_UVMODE_DESC.TXT"


VEX:SPICAV_UV_EXPOSURE_TIME      = 64  /* (*10 msec)                  */
VEX:SPICAV_UV_FIRST_BAND          = 113 /*First band position           */
VEX:SPICAV_UV_CCD_ROWS_BINNED  = 32  /*Number of physical CCD row binned   */
      /* and contained in one band. (=0 in the case of BINNINGP mode)  */
VEX:SPICAV_UV_HT                  = 150 /*High Voltage put on the intensifier */
                                      /*of the CCD                   */



/* DATA OBJECT DEFINITION  */

OBJECT               = RECORD_ARRAY
 NAME                = "SPICAV UV RECORD ARRAY"
 INTERCHANGE_FORMAT     = BINARY
 AXES               = 1
 AXIS_ITEMS            = 374
 DESCRIPTION           = "This file contains all records of a UV SPICAV
                  observation. A record is described by a COLLECTION
                  object."

 OBJECT              = COLLECTION
  NAME               = "ONE SPICAV UV RECORD"
  BYTES              = 4352
  DESCRIPTION          = "One spicav UV record contains all the header and
                  data information from one spicav 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 SPICAV 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
```

6.6 Annex 6 : Example 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            = 47866
FILE_RECORDS            = 17
FILE_NAME               = "SPIV_0BR_0052A04_E_04.DAT"
DATA_SET_ID             = "VEX-Y/V-SPI-2-IREDR-RAWXCRU/VENUS-V1.0"
DATA_SET_NAME           = "VEX SPICAV CRUISE/VENUS IR EDR-RAW V1.0"
RELEASE_ID              = 0002
REVISION_ID             = 0000
DISTRIBUTION_TYPE       = DATA

PRODUCT_ID              = "SPIV_0BR_0052A04_E_04.DAT"
PRODUCT_CREATION_TIME   = 2007-07-05T15:18:18.000
MISSION_NAME            = "VENUS EXPRESS"
MISSION_ID              = VEX
INSTRUMENT_HOST_NAME    = "VENUS EXPRESS"
INSTRUMENT_HOST_ID      =  VEX
MISSION_PHASE_NAME      = "PHASE 1"

TARGET_NAME             = "STAR"
TARGET_TYPE             = "STAR"
```

```
SPACECRAFT_POINTING_MODE       = "INERT"
SPACECRAFT_POINTING_MODE_DESC  = "This pointing mode is used to point the
                          instrument platform towards a fixed
                          direction in right ascension and declination."
RIGHT_ASCENSION           =   81.57
DECLINATION               =   28.61

VEX:SCIENCE_CASE_ID          = 5
VEX:SCIENCE_CASE_ID_DESC     = "Please refer to VEX_SCIENCE_CASE_ID_DESC.TXT
                          in the DOCUMENT directory"
OBSERVATION_TYPE             = {AD001B, AS001B, AC001B, AC004B, AC006B,
                          CL004B}
PRODUCT_TYPE                 = EDR
PROCESSING_LEVEL_ID          = 2
STANDARD_DATA_PRODUCT_ID     = RAWX
START_TIME                   = 2006-06-12T02:12:17.710
STOP_TIME                    = 2006-06-12T02:21:53.710
SPACECRAFT_CLOCK_START_COUNT   = 1/0040443137.20518
SPACECRAFT_CLOCK_STOP_COUNT    = 1/0040443713.20513
ORBIT_NUMBER                 = 0052
ORBITAL_ECCENTRICITY         = 0.83908938
ORBITAL_INCLINATION          = 83.196331
ORBITAL_SEMIMAJOR_AXIS       = 72856.722
PERIAPSIS_ALTITUDE           = 6350.8217
PERIAPSIS_ARGUMENT_ANGLE     = 122.91984
PERIAPSIS_TIME               = 2006-06-12T01:45:25.000
PRODUCER_ID                  = VEX_SPI_TEAM
PRODUCER_FULL_NAME           = "JEAN-LOUP BERTAUX"
PRODUCER_INSTITUTION_NAME    = "SERVICE D'AERONOMIE, IPSL/CNRS,FRANCE"
INSTRUMENT_ID                = SPICAV
INSTRUMENT_NAME              = "SPICAV"
INSTRUMENT_TYPE              = "SPECTROMETER"
DESCRIPTION                  = "This file contains a general header and a
                          frequency array followed by all records of a
                          IR SPICAV 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, sattellite parameters
                     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        = -1
DATA_QUALITY_DESC      = "defined in DATA_QUALITY_DESC.TXT"
/* INSTRUMENT AND DETECTOR DESCRIPTIVE DATA ELEMENTS    */
CHANNEL_ID             = "IR"


/* SPICAV IR COMMAND PARAMETERS - DEFINITIONS AND VALUES */
/* COMMAND_MODE = (EXIT,SOURCE,DETS,SWAP_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.                                    */
/*    SWAP_DETS - This bit specifies ADC Channels  (0 and 1 ) that are used */
/*             to measure output signals of detectors 0 and 1.Detectors        */
/*             swapping is implemented for a higher reliability                */
/*    TIME - AOTF chopping period : 0- 1.4 ms, 1- 2.8 ms, 2- 5.6 ms,        */
/*         3- 11.2 ms                                                          */
/*    COMMAND_DAC = (DAC, GAINBOOST, GAIN)                                 */
/*    DAC -    AOTF power control : 0...255.                                  */
/*          DAC value = 16*RF  power control                                 */
/*    GAINBOOST - defines the gain of amplification stage: 0-1 , 1-4          */
/*    GAIN - Amplifiers gain factor : 0- 1, 1- 3, 2- 8.25, 3- 26               */
/*                                                                           */
/* COMMAND_WINDOW0 = (FREQUENCY_OFFSET,FREQUENCY_RANGE,POINTS,STEP)     */
/* Three windows are specified in a command and are characterized by 4      */
/* values FREQUENCY_OFFSET,FREQUENCY_RANGE,POINTS,STEP      */
/*     FREQUENCY_OFFSET = difference between the start frequency of a     */
/*                    window and a reference frequency                        */
```

```
/*                    (4375 frequency step = 4375 * 16 kHZ   )                    */
/*                    (                  = 70 MHZ        )                        */
/*    FREQUENCY_RANGE = range of wave frequencies = 1: LW (Long Wave)      */
/*                                          70 to 140 MHZ                         */
/*                                          2: SW (Short Wave)                    */
/*                                          140 to 280 MHZ                        */
/* The start frequency of a window (i= 0, 1 or 2) is defined as:                  */
/* start_freqi = (ref_freq + freq_offi*16) * freq_step*freq_rangei)               */
/* With:     start_freqi     start frequency of window i                          */
/*           ref_freq        reference frequency                                  */
/*                      ( 4375 or 70 MHz for SPICAV)                              */
/*                      ( 5200 or 83.2 MHz for SPICAM)                            */
/*           freq_step       minimum frequency step = 16 MHz                      */
/*           freq_offi       frequency offset (in frequency step)                 */
/*           freq_rangei    frequency range = 1 for LW range                      */
/*                                  (70 to 140 MHZ SPICAV)                        */
/*                                  (80 to 140 MHz SPICAM)                        */
/*                                  2 for SW range (140 to 280 MHz                */
/*                                  only for SPICAV)                              */
/*    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.                                          */
```

```
VEX:SPICAV_IR_COMMAND_MODE    = (1,1,2,0,2)
VEX:SPICAV_IR_COMMAND_DAC     = (3840,1,1)
VEX:SPICAV_IR_COMMAND_WINDOW0 = (35.000,1.000,3320,1.000)
VEX:SPICAV_IR_COMMAND_WINDOW1 = (0.000,2.000,2656,1.000)
VEX:SPICAV_IR_COMMAND_WINDOW2 = (68.000,1.000,0,0.000)
VEX:SPICAV_IR_COMMAND_CONFIG  = (6,0)

/* 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                         */

VEX:SPICAV_IR_ACTIVE_CHANNELS = 2
VEX:SPICAV_IR_EXPECTED_POINTS = 5976
VEX:SPICAV_IR_NUMBER_SPECTRA  = 17
VEX:SPICAV_IR_NUMBER_SESSIONS = 18

/* DATA OBJECT POINTERS IDENTIFICATION DATA ELEMENTS                  */

^FREQUENCY_ARRAY      = ("SPIV_0BR_0052A04_E_04.DAT",101<BYTES>)
^RECORD_ARRAY         = ("SPIV_0BR_0052A04_E_04.DAT",24005<BYTES>)


/* DATA OBJECTS DEFINITION */

OBJECT               = FREQUENCY_ARRAY
  NAME               = "FREQUENCY ARRAY"
  INTERCHANGE_FORMAT   = BINARY
  DESCRIPTION        = "Frequency array associated to each spectrum."
  AXES               = 1
  AXIS_ITEMS         = 5976

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

```
OBJECT                  = RECORD_ARRAY
 NAME                   = "SPICAV IR RECORD ARRAY"
 INTERCHANGE_FORMAT     = BINARY
 AXES                   = 1
 AXIS_ITEMS             = 17
 DESCRIPTION            = "This array contains all records of a IR SPICAV
                          observation."

 OBJECT                 = COLLECTION
  NAME                  = "ONE_SPICAV_IR_RECORD"
  BYTES                 = 47866
  DESCRIPTION           = "A record is described by a COLLECTION object
                          containing 18 elements, providing time,
                          satellites parameters 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      = LSB_INTEGER
  START_BYTE     = 13
  BYTES          = 2
  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    = 15
  BYTES         = 4
  DESCRIPTION   = "Temperature (ADU) of SU TRP1. Temperature of
                Reference Point number 1 (near SPICAV foot on
                corner +Z; -Y)"
END_OBJECT      = ELEMENT

OBJECT          = ELEMENT
  NAME          = SUTRP2_TEMP
  DATA_TYPE     = LSB_INTEGER
  START_BYTE    = 19
  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    = 23
  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    = 27
  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     = 31
    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     = 34
    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     = 38
    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     = 42
    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     = 46
    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     = 50
    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       = (5976,2)
  AXIS_NAME        = (SAMPLE,DETECTOR)
  START_BYTE       = 54
  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
```

6.7 Annex 7: 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  = 239
FILE_RECORDS  = 836
^INDEX_TABLE  =  "INDEX.TAB"

DATA_SET_ID   = "VEX-Y/V-SPI-2-UVEDR-RAWXCRU/VENUS-V1.0"
PRODUCT_NAME  = "SPICAV DATA INDEX TABLE"
PRODUCT_ID    = INDEX
RELEASE_ID    = 0001
REVISION_ID   = 0000

INSTRUMENT_HOST_NAME  = "VENUS EXPRESS"
INSTRUMENT_NAME       = "SPICAV"
TARGET_NAME           = "VENUS"
START_TIME            = 2005-11-27T01:20:06.000
STOP_TIME             = 2006-08-24T03:05:17.000
PRODUCT_CREATION_TIME = 2008-10-06T15:16:11.000
MISSION_PHASE_NAME    = {"CRUISE","VOI","PHASE 0","PHASE 1",
                 "PHASE 2"}

DESCRIPTION  = "This table contains the PDS-required index for all data files
          in the /VEXSPI_0AUV/DATA directory on the SPICAV level 0A UV
          Archive Volume. It includes file location, and PDS
          identification information."

OBJECT     = INDEX_TABLE
 NAME              = "VEX SPICAV level 0A UV main Index"
 INTERCHANGE_FORMAT = ASCII
 ROWS              = 836
 COLUMNS           = 9
 ROW_BYTES         = 239
 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         = 64
  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    = 69
  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    = 97
   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    = 124
   BYTES         = 38
   DESCRIPTION   = "An identifier unique for this dataset"
  END_OBJECT = COLUMN

  OBJECT     = COLUMN
   NAME         = RELEASE_ID
   COLUMN_NUMBER = 5
   DATA_TYPE     = CHARACTER
   START_BYTE    = 165
   BYTES         = 4
   DESCRIPTION   = "Release id"
  END_OBJECT = COLUMN

  OBJECT     = COLUMN
   NAME         = REVISION_ID
   COLUMN_NUMBER = 6
   DATA_TYPE     = CHARACTER
   START_BYTE    = 172
   BYTES         = 4
   DESCRIPTION   = "Revision id"
  END_OBJECT = COLUMN

 OBJECT     = COLUMN
   NAME       = START_TIME
   COLUMN_NUMBER = 7
   DATA_TYPE   = TIME
   START_BYTE    = 179
   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    = 206
   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    = 233
   BYTES         = 4
   DESCRIPTION   = "Number of records in the data file"
```

```
  END_OBJECT = COLUMN

END_OBJECT = INDEX_TABLE

END
```

6.8 Annex 8: Links

the website where the PDS standards can be found is
http://pds.nasa.gov/documents/sr/index.html

Livelink to descriptive files from PSA files is :
http://www.rssd.esa.int/open/?Ynxmxp9Qkx