Using SPICAM and SPICAV 1A level data

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1	31/05/2012	First release
1.1	07/06/2012	Add part 3 FORTRAN
2	07/02/2013	Update sections 2 and 4
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1 Brief description of the data

SPICAM and SPICAV 1A data files are built from the 0C level files. The 1A level provides data corrected from the dark charge and the electronic noise. It is also cleaned from erroneous data (only SPICAM), cosmic rays damage and saturation.

Since the 1A level is based on the 0C level, the files follow the same FITS structure with modules update and addition.

The 1A level files are under FITS (Flexible Image Transport System) format and conform to the requirements of the FITS standard. For a general introduction of FITS format please follow the link: http://fits.gsfc.nasa.gov/fits_documentation.html

The 1A level FITS files contain the following modules:

- *Primary:* data 3d image. It corresponds to the 1A level data.
- *Flag:* 3D image extension. A flag is associated to each pixel of the Primary data 3d image. Flag code values are:
  - 0: nominal
  - 1: missing data
  - 2: SPICAM erroneous data
  - 3: saturated data
  - 4: data damaged by cosmic rays
  - 5: data corrected from electronic noise
- *ErrData:* 3D image extension. It corresponds to the error from the Dark Charge and Electronic Noise removal process on each pixel.
- *Functional_Parameters:* binary table extension. This extension contains functional parameters (telecommand) information and temperatures.
- *Geo_* binary: table extensions (from 6 to 10 depending on the observation type and mode, example: *Geo_Spacecraft*). Each of these extensions contains the geometrical parameters record associated.

A reading software is provided by the development team. It is available in IDL, C and FORTRAN programming languages. It can be found in the following directories:
/net/nfs/spicam/data/ARCHIVE/MEXSPI_1AUV/SOFTWARE/read/
/net/nfs/spicav/data/ARCHIVE/VEXSPI_1AUV/SOFTWARE/read/
The software returns a structure with the content described in the next section.

NB: the reading program is able to read both SPICAM and SPICAV 1A files as they share the same format. The FITS file can be read by other languages. In this case check the detailed description of the 1A files contents given in Annex 1 to access required information.

2 Returned structure variable detailed description

The variable returned by *SPICA_Read_1A* is a structure with 9 sub structures. The detailed architecture is given below, with a short description of each field. Note that some sub-structures may vary depending on the observation type and mode.

2.1 CLEANDATA:

This field is a 3 dimensions float array containing the corrected data. For a general case 5-band observation, the dimensions of the array are (Nb_Pixel=408,Nb_Spectrum,Nb_Band=5). For an Alignment mode observation the dimensions are (Nb_PixelX=408,Nb_PixelY=289, Nb_Image). Window mode dimensions are (XWidth,YWidth,Nb_Record).
The data is corrected from Dark Charge and Electronic Noise.

Mode	NAxis1	NAxis2	NAxis3
5 bands	408	Number of records	5
Alignment	408	289	Number of reconstituted images
Window	Window width	Window length	Number of records

2.2 FLAG:

This field is a 3 dimensions integer array with the same dimension as the CLEANDATA field.
A flag is associated to each pixel of the data 3d image. Flag code is:

- 0: nominal (flagged by pixel)
- 1: missing data (flagged by spectrum (record) line)
- 2: erroneous data (flagged by spectrum (record) line)
- 3: saturated data (flagged by pixel)
- 4: data damaged by cosmic rays (flagged by pixel)
- 5: data corrected from electronic noise (flagged by pixel)

This array is a mask that the user should apply on the CLEANDATA array. If applied, the missing records, the erroneous data, the saturated pixels and the pixels damaged by the cosmic ray are set to NaN[1] value.

2.3 ERRDATA:

Matrix with the same dimensions as CLEANDATA, and type float. Contains error on Dark Charge and Electronic Noise corrections.

2.4 INFO:

This field contains information about the input files and general observation characteristics (tag names in parenthesis are specific to alignment observations):

- NAxis1[Int]: Number of pixels of the X-axis of the CCD, i.e. number of points of each spectrum = 408 except for window mode.
- NAxis2[Int]: Number of 5-band spectra recorded throughout observation. For alignment observation this field corresponds to the number of pixels of the Y-axis of the CCD = 289. For Window modes, it is the vertical width.

[1] NaN: Not a Numer, data type representing an undefined value, IEEE 754 standard

- NAxis3[Int]: Number of bands of the CCD = 5. For alignment observations this is equal to the number of complete mapping of the CCD. For Window mode this is equal to the number of records.
- Instrument[String]: Instrument name.
- Orbit[Int]: Orbit index of the mission.
- Sequence[Int]: Sequence index of the orbit.
- ObsType[Char]: Type of observation as defined by SPICAM/V conventions
- BeginTime[String]: Observation first recording time, format=YYYY-MMDDTHH:MM:SS.mmm
- EndTime[String]: Observation last recording time, format=YYYY-MM-DDTHH:MM:SS.mmm
- Data_status[String]: Status of the Data (F "Final" or "P" Preliminary)
- Geo_status[String]: Status of the Geometry (F "Final" or "P" Preliminary)
- Flag_status[String]: Status of the Flag (F "Final" or "P" Preliminary)
- DC_status[String]: Status of the Dark Charge correction (F "Final" or "P" Preliminary)
- OrbDCNU[Int]: Number of the DCNU model orbit
- DCProc[Int]: Dark Charge removal process (0: process not done - 1: process done)
- ENProc[Int]: Electronic Noise removal process (0: process not done - 1: process done)
- COSProc[Int]: Cosmic rays damaged data removal process (0: process not done - 1: process done)
- SATProc[Int]: Saturated data removal process (0: process not done - 1: process done)

2.5 PARAMETERS:

This field contains the functional parameters of the instrument. For 5-bands observations the "All_Ti" and "T_..." fields are 1d of length the number of spectra. For alignment modes they are 2d with size [nb_PixelY=289,nb_Image]:

- CodeOp[Int]: SPICAM/V operation code
- Binning[Int]: Number of lines binned together to form a band. In case of progressive binning, the field is set to string 'VARIABLE'
- HT[Int]: Digital scale of the High Voltage used to amplify signal. Ranging from 0 to 255
- Ti[Int]: Exposure Time of the CCD, in second/100. Usually constant throughout observation. If not the field is set to string 'VARIABLE'
- X0[Int]: X-axis first pixel index. o Y0[Int]: Y-axis first pixel index. Field is set to 'VARIABLE' for alignment observations
- Slit[boolean]: 1 if slit is on, 0 else.
- Peltier[boolean]: 1 if Peltier cooler is on, 0 else.
- UVSampling[Int]: Sample rate of the spectrometer.
- IROn[boolean]: 1 if IR channel is on, 0 else.
- SoirOn[boolean]: 1 if SPICAV SOIR channel is on, 0 else. 255 for SPICAM
- All_Ti[Int]: vector of all the time exposure throughout observation
- T_Peltier[Int]: Temperature vector of Peltier's hot side (all temperatures are given in °C)
- T_CCD[Int]: Temperature vector of the CCD
- T_NumBoard[Int]: Temperature vector of the digital board
- T_BTBoard[Int]: Temperature vector of the low tension board
- T_Shutter[Int]: Temperature vector of the solar shutter
- T_ServBoard[Int]: Temperature vector of the servitudes board
- T_HVPS[Int]: Temperature vector of the High Voltage Power Supply
- T_Structure[Int]: Temperature vector of the structure

2.6 GEOINFO:

This field contains geometrical parameters of the instrument which do not vary during observation:

- Target[String]: Pointing target of the instrument (for stars, see SPICAM/V star catalog)
- SunLat[Float]: Sub-solar point latitude in planet body-fixed frame, at first record (deg)
- SunLong[Float]: Sub-solar point longitude in planet body-fixed frame, at first record (deg)
- SunDist[ULong]: Distance between planet and sun, at first record (ua)
- SunLS[Float]: Planet position seen from the Sun in Ecliptic J2000 frame (deg)
- SunRa[Float]: Sun Right Ascension in J2000 frame, at first record (deg)
- SunDec[Float]: Sun Declination in J2000 frame, at first record (deg)
- SlitCenter[Float]: Position vector of the slit center in SC axes (=offset, deg)
- ShadowCone[Char]: Trajectory of the spacecraft relatively to the planet shadow cone

2.7 GEO:

- RECORD: structure array containing the time and number of each record
- SPACECRAFT: structure array containing geometrical information relative to the SC
- BAND3: structure array containing geometrical information relative to the central band Coordinates: structure array containing the SC coordinates in different referential
- COORDINATES: structure array containing the SC coordinates in different referential
- TRANSMATRIX: structure array of the transformation matrix coordinates from the local referential to EMEJ2000

Fields specific to the 5 bands mode:

- BAND1: structure array containing geometrical information relative to the 1st band
- BAND2: structure array containing geometrical information relative to the 2nd band
- BAND4: structure array containing geometrical information relative to the 4th band
- BAND5: structure array containing geometrical information relative to the 5th band
- LOSE: structure array containing geometrical information relative to the specific star pointing line of sight (if present in the 0A level geometry file), see Annex1.

Field specific to the Alignment mode:

- CCDLINE: structure array containing geometrical information relative to each particular CCD line

Notes:

1.

Mode	Structure array dimensions
5 bands	Vector of length NAxis2
Alignment	Matrix of size [NAxis2, NAxis3]
Window	Vector of length Naxis3

2. The details of the geo sub-structures geo are given in annex 2.

3. Under IDL, geo sub-structures are structure arrays and therefore if a precise element of the array needs to be subscripted, it is necessary to type the subscript before the final field as follows: Output.Geo.GeoSubstructure[subscript].Field (See in section 3)

3 Reading 1A using IDL

3.1 Installation and execution

Download and uncompress the *SPICA_Read_1A.zip* package in your working directory.
The IDL spica_read_1A.zip package is located in the directories:
/net/nfs/spicam/data/ARCHIVE/MEXSPI_1AUV/SOFTWARE/read/IDL/
/net/nfs/spicav/data/ARCHIVE/VEXSPI_1AUV/SOFTWARE/read/IDL/

Compile the procedures.
The function SPICA_Read_1A takes for argument the filename of the 1A file to read and returns a structure variable. SILENT keyword can be added to avoid printing the reading confirmation.

IMPORTANT: The FLAG mask is applied by default. It means that the data with a flag value equal to 1, 2, 3 or 4 are removed and set to NaN. The keyword /NO_MASK can be used to keep the data flagged in the CLEANDATA array.

3.2 3.2 Examples of use

Read a SPICAM 1C file located in *1Apath* into *obs* variable:

```
IDL>obs=SPICA_Read_1A('/1Apath/SPIM_1AU_02697A01_E_01.FITS')
The file SPIM_1AU_02697A01_E_01.FITS was read successfully!
```

Create a window with the size of the data and plot the clean data central band:

```
IDL> Window,0,XSIZE=obs.Info.NAxis1,YSIZE=obs.Info.NAxis2
IDL> LoadCT,39
IDL> TVIMAGE, obs.CleanData[*,*,2]
```

Plot the error data on central band:

```
IDL> Window,1,XSIZE=obs.Info.NAxis1,YSIZE=obs.Info.NAxis2
IDL> TVIMAGE, obs.ErrData[*,*,2]
```

4 Reading 1A data using C and FORTRAN

4.1 Building the library

The 1A reading function provided uses the ***cfitsio*** library of C routines for reading and writing FITS format data files. The cfitsio library package can be found at:
http://heasarc.gsfc.nasa.gov/docs/software/fitsio/fitsio.html

- Download and uncompress the cfitsio package for your system.
- Build your own *cfitsio* library ***libcfitsio.a*** by launching the *makefile* (see README file in the cfitsio directory for building information).

For Unix-like systems, the simple launch of the *makefile* permits to build easily the library. For Windows systems, a unix-like emulator system such as *Cygwin* can be used to launch this *makefile*.

4.2 4.2 Execution using C

The C language spica_read_1A.zip package is located in the directories:
/net/nfs/spicam/data/ARCHIVE/MEXSPI_1AUV/SOFTWARE/read/C/
/net/nfs/spicav/data/ARCHIVE/VEXSPI_1AUV/SOFTWARE/read/C/

The "*src*" directory contains the sources and header files needed to read SPICAM or SPICAV FITS data file. The structure "*spica_struct_1A*" is the structure variable as described in section 2. It is defined by the source file "*spica_struct_1A.c*" and header file "*spica_struct_1A.h*". The files "*spica_read_1A.c*" and "*spica_read_1A.h*" permit to build an executable file.
To build the project and the spica_read_1A executable program on UNIX system, the user should type first the command *./configure* in the console and then the command *make*. Those 2 commands create the executable file in the "*src*" directory.

This executable file reads any 1A files, and permits to display some data sample, parameters and information. This is a usage example of the *spica_struct_1A.c* module.
The call line is:
spica_read_1A [full_1A_file_path] [options] [sample]

- [full_1A_file_path]:
  The full path and filename of the 1A file to read
- [options]:
  - ***-c [sample], --cleandata=[sample]***: print Band number, Spectrum number (or records), Pixel number, Flag value (from FLAG sub-structure of the main spica_struct_1A structure) and intensity value (from CLEANDATA sub-structure of the main spica_struct_1A structure)
  - ***-i, --info***: print content of INFO sub-structure of the main spica_struct_1A structure
  - ***-g, --geoinfo***: print content of GEOINFO sub-structure of the main spica_struct_1A structure
  - ***--georec=[sample]***: print content of GEO.RECORD sub-structure of the main spica_struct_1A structure
  - ***--geosc=[sample]***: print content of GEO.SPACECRAFT sub-structure of the main spica_struct_1A structure
  - ***--geoband1=[sample]***: print content of GEO.BAND1 sub-structure of the main spica_struct_1A structure
  - ***--geoband2=[sample]***: print content of GEO.BAND2 sub-structure of the main spica_struct_1A structure
  - ***--geoband3=[sample]***: print content of GEO.BAND3 sub-structure of the main spica_struct_1A structure

- ***--geoband4=[sample]***: print content of GEO.BAND4 sub-structure of the main spica_struct_1A structure
- ***--geoband5=[sample]***: print content of GEO.BAND5 sub-structure of the main spica_struct_1A structure
- ***--geocoord=[sample]***: print content of GEO.COORDINATES sub-structure of the main spica_struct_1A structure
- ***--geotransm=[sample]***: print content of GEO.TRANSMATRIX sub-structure of the main spica_struct_1A structure
- ***--geolose=[sample]***: print content of GEO.LOSE sub-structure of the main spica_struct_1A structure
- ***-m, --minimum***: print the minimum value of the data, -c or -r must be defined with [sample] (minimum on the data sample) or without (minimum on all data)
- ***-M, --maximum***: print the maximum value of the data, -c or -r must be defined with [sample] (maximum on the data sample) or without (maximum on all data)
- ***-p, --parameters***: print content of PARAMETERS, except all temperatures fields sub-structure of the main spica_struct_1A structure
- ***-r [sample], --rawdata=[sample]***: print Band number, Spectrum number (or records), Pixel number, Flag value (from FLAG sub-structure of the main spica_struct_1A structure) and intensity value (from RAWDATA sub-structure of the main spica_struct_1A structure)
- ***-t [sample], --temperatures=[sample]***: print content of PARAMETERS, only for temperatures fields, sub-structure of the main spica_struct_1A structure
- ***-v, --version***: print current version of the program

- [sample]: For -c or -r option, [sample] is a 3 dimension array defined as [Npixels, NRecords(septrum), NBands]

Example:
to display pixel nb. 500, on the spectrum 100, on band 2: [500,100,2]
to display pixel from nb. 500 to 520, on the spectrum 100, on band 2 to 5: [500:520,100,2:3]
to display pixel from nb. 500 to 520, all spectrum 100, on band 2 to 5: [500:520,*,2:3]

For other options, [sample] is a 1 dimension array defined as [NRecords(septrum)]

4.3 Execution using FORTRAN

The FORTRAN language spica_read_1A.zip package is located in the directories:
/net/nfs/spicam/data/ARCHIVE/MEXSPI_1AUV/SOFTWARE/read/FORTRAN/
/net/nfs/spicav/data/ARCHIVE/VEXSPI_1AUV/SOFTWARE/read/FORTRAN/

The spica_read_1A.zip package contains a FORTRAN module file, needed to read SPICAM or SPICAV FITS data file. The 1A-reading module is called *spica_struct_1A* and is included in the "***spica_struct_1A.f***" file. The "***test.f*** " program is an example of the module use. From the spica_read_1A directory, compile the "***spica_struct_1A.f***" and your main program (here test.f as an example (*gfortran* compiler example):
gfortran -ffree-form -c -o "spica_struct_1A.o" "spica_struct_1A.f"
gfortran -ffree-form -c -o "test.o" "test.f"

And link with the cfitsio library **libcfitsio.a** (gfortran compiler example):
gfortran -o "test" spica_struct_1A.o test.o –lcfitsio

4.4 Returned structure variable detailed description

The variable returned by *spica_read_1A* has the same architecture as described in section 2

5 Annex 1: Detailed contents of SPICAM and SPICAV 1A FITS files

5.1 Macro description:

A FITS file is made of several blocks (named as HDU), a primary data block and several extensions blocks, which can be of Image type or Binary table type. SPICAM/V 1A FITS files have 9 mandatory blocks that they all share (plain black lines boxes). Depending on the observation mode, there are either 4 extra binary table extensions called Geo_Band1, 2, 4 and 5 (case of a 5 band or Window mode, plain blue line boxes) or 1 extra binary table called Geo_CCDLine (case of an Alignment mode, plain green line box). There is also on optional binary table extension called Geo_LOSE (dotted blue line box).

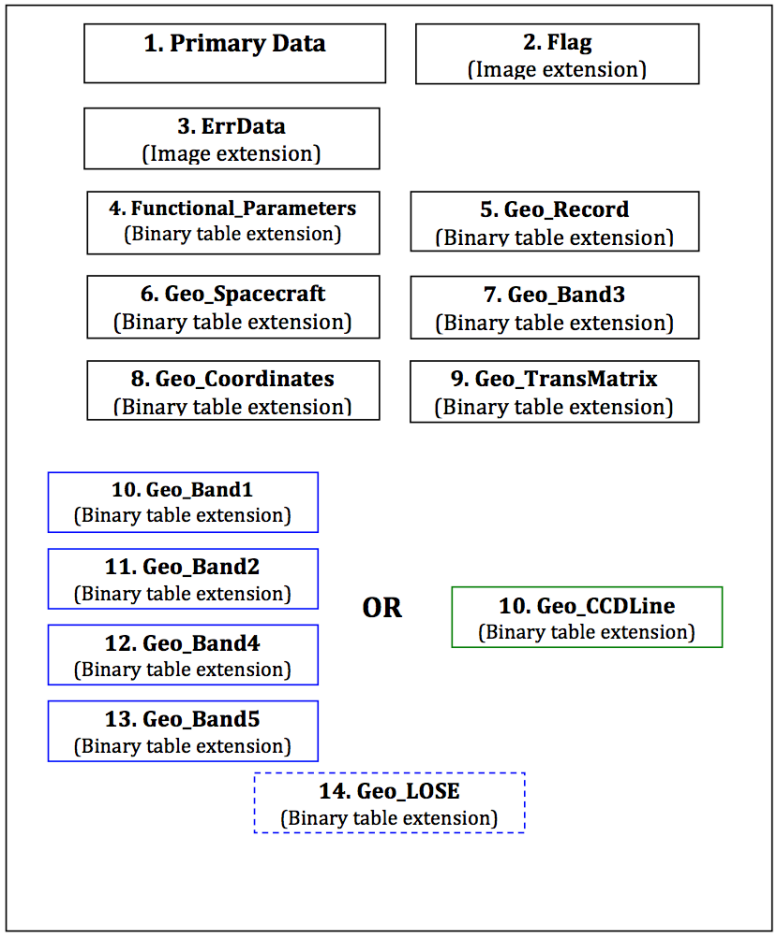

Fig. 1: FITS file blocks

5.2 Block description:

In a FITS file, each block has its own header. The SPICAM/V 1A FITS files respect the standard header keywords (ex: BITPIX, EXTNAME, NAXIS,...). When specific fields are added to store information, those fields are explicitly given under the block layout.

5.2.1 Primary Data (Primary HDU)

The primary data has the following specific header fields:

- INSTRU: name of the instrument
- DATA_0A: name of the 0A data file used to build this file
- DATA_GEO: name of the 0A geo file used to build this file
- DATA_0C: name of the 0C data file used to build this file
- FLAG: name of the FLAG file used to build this file
- DATA_SS: Status of the current 0C data ('F' as Final or 'P' as Preliminary)
- GEO_SS: Status of the used Geometry data ('F' as Final or 'P' as Preliminary)
- FLAG_SS: Status of the used Flag data ('F' as Final or 'P' as Preliminary)
- DC_SS: Status of the Dark Charge correction ('F' as Final or 'P' as Preliminary)
- ORBIT: orbit number of the observation
- SEQ_NB: sequence number of the observation
- OBSTYPE: type of observation in SPICAM/V code
- BEGINS: UTC time of the first record in the file
- ENDS: UTC time of the last record in the file

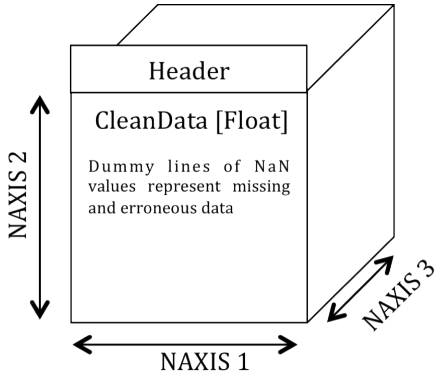

Fig. 2: Primary HDU

5.2.2 Flag extension (Flag HDU)

The Flag extension has the following specific header fields:

- NB_ERR: the number of spectra (complete line) detected as erroneous (flag code 3).
- NB_MISS: the number of dummy lines injected (complete line) because of missing data (flag code 2)
- NB_SAT: the number of detected and cleaned saturated pixels (flag code 3)
- NB_COS: the number of detected and cleaned cosmic rays damaged pixels (flag code 4)

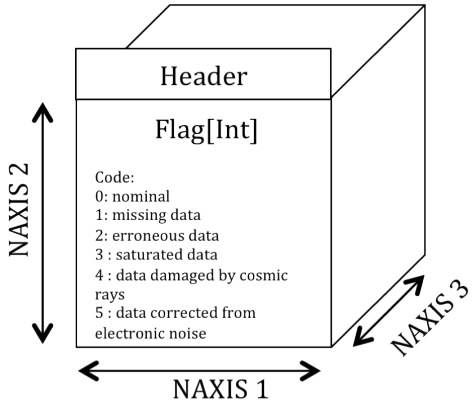

Fig. 3: Flag HDU

5.2.3 Error on correction extension (ErrData HDU)

The image extension contains the error value of the dark charge and the electronic noise correction for each pixel. The header of this extension does not contain any specific fields.

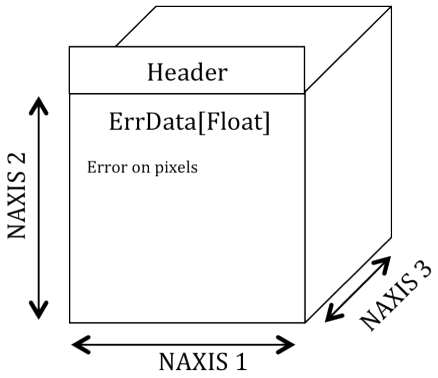

Fig. 4: ErrData HDU

5.2.4 Functional_Parameters extension

This extension stores the exposure time (Ti) and temperatures for each record of the observation. The explicit name of each column is given by the TTYPEn fields.
It has the following specific header fields (see section 2 for details):

- CODEOP
- BINNING
- HT
- TI
- X0
- Y0
- SLIT
- PELTIER
- UVSAMPL
- IR_ON
- SOIR_ON

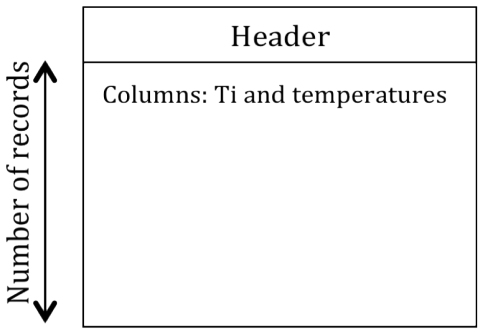

Fig. 5: Functional_Parameters HDU

5.2.5 Geo_Record extension

This extension stores the record number and UTC time for each record of the observation. The explicit name of each column is given by the TTYPEn fields
The Geo_Record extension has the following specific header fields:

- TARGET
- SUNLAT
- SUNLONG
- SUNDIST
- SUNLS
- SUNDEC
- SUNRA
- SLIT_C
- CONE

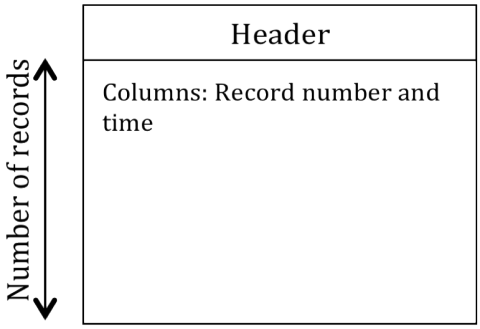

Fig. 6: Geo_Record HDU

For a description, please look at the associated fields in the GEOINFO sub-structure description.

5.2.6 Other Geo_ extensions

All other extensions share the same layout and do not have specific header fields. The explicit name of each column is given by the TTYPEn fields and the associated description can be found in *Annex 2* section.

6 Annex 2: Geo-substructures detailed fields

6.1 Parameters definition

1stB, 2ndB, 3rdB, 4thB, and 5thB are the center of UV Bands (binning included). For all kind of observations, the line of sight (LOS) emanating from the center of a UV band is defined by SC attitude. In the case of star observations, geometry parameters are also computed for a LOS emanating from the UV CCD center, but defined by S/C position and Star direction. (This LOS is called LOSE in the following description of parameters to distinguish from LOS defined by SC attitude).
Planproj is the projection plane (u,v,w frame) defined as the plane at the nearest point on the planet to vdir and perpendicular to vdir (view direction from SC); with w = -vdir , v = North pole, u = right handed.
The view direction is LOS emanating from the center of the CCD and defined by SC attitude.
The body-fixed frame is IAU_MARS for SPICAM observations and IAU_VENUS for SPICAV.

Geo sub-structure	**Fields**	**Description**
Record	Number	Record number, begins at 1
	Time	UTC time of record (YYYY-MM-DDTHH:MM:SS.cScS)
Spacecraft	Lat	Latitude of the sub-spacecraft point (in degrees, body-fixed frame)
	Long	Longitude of the sub-spacecraft point (in degrees, increases toward East from 0 to 360, body-fixed frame)
	Alt	Altitude of the spacecraft above planet ellipsoid (in km, body-fixed frame)
	SZA	Solar Zenith Angle at sub-spacecraft point (in degrees, body-fixed frame)
	ShadowConeRatio	Ratio indicating the SC position relative to the planet's shadow cone. If >1 SC is outside the shadow cone.
Band3, LOSE (In the description, first elements in brackets [] concern Band3 sub-structure, last elements concern LOSE sub-structure.	SZA	Solar zenith angle at nearest point on MARS ellipsoid to [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees, body-fixed frame)
	DistToPlanetNP	Distance from SC to nearest point on the planet ellipsoid to [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in kms, body-fixed frame, < 0 if behind SC)
Fields in italic font are specific to the 5 bands mode)	PixelSize	Pixel (0.01 deg) size at nearest point on the planet ellipsoid to [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in kms, body-fixed frame)
	AngleLOSSun	Angle between S/C-SUN vector and [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees, body-fixed frame)

	PhaseLOSSun	Phase angle between the SUN and the Observer measured at the nearest point on the planet ellipsoid to [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees)
	SolarIncidence	Solar incidence angle between SUN and Normal at nearest point on the planet ellipsoid to [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees)
	SolarLocalTime	Solar local time at nearest point on the planet ellipsoid to [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees)
	AngleNormalObserver	Emission angle between Normal and Observer at nearest point on the planet ellipsoid to [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees)
	SunAzimuth	Azimuth of SUN in SC axes (relative to X, in degrees)
	DistLOSPlanetCenter	Distance between the nearest point on [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees) and center of planet (in kms)
	DistSCPlanetCenter	Distance between SC position and center of planet (in kms)
	Lat	Latitude of nearest point on the planet ellipsoid to [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees, body-fixed frame)
	Long	Longitude of nearest point on the planet ellipsoid to [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees, body-fixed frame)
	Alt	Altitude above the nearest point on the planet ellipsoid of [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in kms, body-fixed frame, < 0 IF intersection)
	Ra	Right ascension of [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees, EMEJ2000)
	Dec	Declination of [LOS,LOSE] emanating from the center of [3rdB band, CCD] (in degrees, EMEJ2000)
Band1, Band2, Band4, Band5, CCDLine	Lat	Latitude of nearest point on MARS ellipsoid to LOS emanating from the center of band/line (in degrees, body-fixed frame)
	Long	Longitude of nearest point on MARS ellipsoid to LOS emanating from the center of band/line (in degrees, body-fixed frame)
	Alt	Altitude above the nearest point on MARS ellipsoid of LOS emanating from the center of band/line (in kms, body-fixed frame, < 0 IF intersection)
	Ra	Right ascension of LOS emanating from the center of band/line (in degrees, EMEJ2000)

	Dec	Declination of LOS emanating from the center of band/line (in degrees, EMEJ2000)
Coordinates	Xsc_X	X component of the unit inertial pointing vector (1,0,0) in SC coordinates relative to MARSIAU (SPICAM) or IAU_VENUS (SPICAV) frame
	Xsc_Y	Y component of the unit inertial pointing vector (1,0,0) in SC coordinates relative to MARSIAU (SPICAM) or IAU_VENUS (SPICAV) frame
	Xsc_Z	Z component of the unit inertial pointing vector (1,0,0) in SC coordinates relative to MARSIAU (SPICAM) or IAU_VENUS (SPICAV) frame
	Ysc_X	X component of the unit inertial pointing vector (0,1,0) in SC coordinates relative to MARSIAU (SPICAM) or IAU_VENUS (SPICAV) frame
	Ysc_Y	Y component of the unit inertial pointing vector (0,1,0) in SC coordinates relative to MARSIAU (SPICAM) or IAU_VENUS (SPICAV) frame
	Ysc_Z	Z component of the unit inertial pointing vector (0,1,0) in SC coordinates relative to MARSIAU (SPICAM) or IAU_VENUS (SPICAV) frame
	Zsc_X	X component of the unit inertial pointing vector (0,0,1) in SC coordinates relative to MARSIAU (SPICAM) or IAU_VENUS (SPICAV) frame
	Zsc_Y	Y component of the unit inertial pointing
		vector (0,0,1) in SC coordinates relative to MARSIAU (SPICAM) or IAU_VENUS (SPICAV) frame
	Zsc_Z	Z component of the unit inertial pointing vector (0,0,1) in SC coordinates relative to MARSIAU (SPICAM) or IAU_VENUS (SPICAV) frame
	Angle_Xsc_LocalVert	Angle between the S/C X axis and the local verticale at the planet Nearest Point (in degrees)
	Angle_Xsc_Proj	Angle between the projection plane U axis and the S/C X axis projected on this plane (in degrees)
	P1_u	P1 u horizon point component in Planproj
	P1_v	P1 v horizon point component in Planproj
	P2_u	P2 u horizon point component in Planproj
	P2_v	P2 v horizon point component in Planproj
	P3_u	P3 u horizon point component in Planproj
	P3_v	P3 v horizon point component in Planproj
	P4_u	P4 u horizon point component in Planproj
	P4_v	P4 v horizon point component in Planproj
	P5_u	P5 u horizon point component in Planproj
	P5_v	P5 v horizon point component in Planproj
TransMatrix	X_Ra	X ra component of transformation matrix from MARSIAU (SPICAM) or IAU_VENUS(SPICAV) to EMEJ2000
	X_Dec	X dec component of transformation matrix from MARSIAU (SPICAM) or IAU_VENUS(SPICAV) to EMEJ2000
	Y_Ra	Y ra component of transformation matrix from MARSIAU (SPICAM) or IAU_VENUS(SPICAV) to EMEJ2000

	Y_Dec	Y dec component of transformation matrix from MARSIAU (SPICAM) or IAU_VENUS(SPICAV) to EMEJ2000
	Z_Ra	Z ra component of transformation matrix from MARSIAU (SPICAM) or IAU_VENUS(SPICAV) to EMEJ2000
	Z_Dec	Z dec component of transformation matrix from MARSIAU (SPICAM) or IAU_VENUS(SPICAV) to EMEJ2000