Product Definition Document

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Product Definition Document

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Part I. Herschel Products Description

Chapter 1. Introduction

The data from the Herschel Space Observatory is provided as standard products. Standard products are generated systematically by the Herschel Science Centre through the Herschel Data Processing system, and are stored in the Herschel Science Archive to be accessed by the astronomical community and for legacy. In addition, the Herschel Interactive Processing Environment (HIPE) package, distributed by the Herschel Science Centre, allows you to reduce the data and generate scientific products through interactive analysis. Highly processed products are expected to be delivered by the observers to the Herschel Science Centre for their inclusion in the Herschel Science Archive. For a further description of the Herschel ground segment context for standard products, please refer to the Herschel Observers' Manual.

This document provides an overview and detailed descriptions of the Herschel standard products. These products encompass different levels of processing of the observational data, and cover also calibration, auxiliary and quality control data required in the processing. For this document purpose, the term *observation* and *AOR* are considered equivalent.

The document is organised as follows. Chapter 2 provides a high level overview of the data products. Chapter 3, Chapter 4 and Chapter 5 describe the HIFI, PACS and SPIRE products, respectively. Chapter 6 provides an overview of the Auxiliary, Catalogue, and Quality Control products. At the end of this manual, you can find Chapter 7 describing the Standalone Browse products. Chapter 1 in *Product Definition Supplement* and the following contain the detailed definition tables of the Herschel products.

1.1. Acronyms

AOR	Astronomical Observation Request
DP	Data Processing
HIFI	Heterodyne Instrument for the Far Infrared
HIPE	Herschel Interactive Processing Environment
HRS	High Resolution Spectrometer
HSA	Herschel Science Archive
PACS	Photodetector Array Camera and Spectrometer
RD	Reference Document
SPIRE	Spectral and Photometric Image REceiver
TAI	Temps Atomique International
TBD	To Be Defined
WBS	Wide Band Spectrometer
WCS	World Coordinate System

Chapter 2. Herschel products

A Herschel Pipeline product consists of metadata keywords, tables or datasets with the actual data, and the history of the processing that generated the product. Metadata keywords have been specified to allow an optimal identification and characterisation of the products, both for information to you, and to provide the required items to the processing software. They have been defined so that compatibility with standard keywords used in Astronomy and commonality across Herschel products are ensured. Whenever possible, product formats have been defined to be consistent with similar scientific products used by the astronomical community (for instance, images and spectra).

2.1. Herschel product types

The following types of Herschel products are defined:

1. Observational products

Observational products contain the scientific data resulting from the Herschel observations. Observational products are classified depending on the level of the processing of the data they contain, ranging from raw data (Level 0) to highly processed scientific data (Level 3). Observational products are generated per observation, although highly processed products may result from the combination of data from several observations. Browse products are also available in the Herschel Science Archive to allow you to quickly look at the contents of the data. The browse products are generated automatically. Therefore the quality of these products may not be good enough for science analysis.

2. Calibration products

These products contain the parameters that characterise the behaviour of the satellite and the instruments. There are uplink and downlink calibration products. Uplink calibration products are used for the specification of the commands that are uplinked to the satellite for the execution of the observations. Downlink calibration products are used in the processing of the raw data to produce astronomically calibrated products in which the instrument artifacts have been removed. In this document, only the downlink calibration products are described.

3. Auxiliary data products

These products contain all Herschel non-science spacecraft data required in the processing and analysis of the scientific data. Auxiliary data products are normally generated per Herschel Operational Day, with the exception of the Uplink product and the Pointing product, which are generated per observation.

4. Quality Control products

Each observation is associated with two Quality Control products, which gather the information required to evaluate the technical quality of the executed observation. The Quality Control Report is automatically created during the Data processing for each observation. The Quality Control Report Summary is generated at the end of the quality control analysis as a result of this process.

5. User Provided Data Products (UPDPs), Highly Processed Data products (HPDPs) and Ancillary products

UPDPs are interactively reduced data provided to the Herschel Science Centre by the observers (initially from the Herschel Key Program consortia only, that commited to do that explicitly, but not excluding other programmes as well, on a voluntary basis). They must follow provided guidelines in terms of format and associated documentation which are available here.

HPDPs are interactively reduced data provided by Instrument Experts. They include data which have been processed beyond the Pipeline and/or using specific algorithms and therefore have been improved to any degree compared to the Pipeline products, as well as any resulting catalogues.

Ancillary Products are data (products, tables, plots, etc..) generated in the course of the different phases of the Herschel mission which are not necessarily linked to a particular observation, but which contain valuable additional information like e.g. the planetary, asteroid and stellar models used by the various instruments for their calibration, PSFs, trend analysis plots, etc...

UPDPs, HPDPs and Ancillary products are also stored in the Herschel Science Archive and made available to the astronomical community. They are out of the scope of this document which is only referring to products created by the Herschel Data processing system.

6. Standalone Browse Products

Standalone Browse Products are data provided through the Herschel Science Archive in an 'standalone' and easy way (using the standard retrieval options or by right clicking on the postcard, both from the Herschel User Interface and from the Postcard Gallery). They are not necessarily 'science ready' products. They are provided for 'quick look' purposes. At this point, Level 2 and Level 2.5 FITS products generated by the standard Herschel data processing pipelines are distributed as 'Standalone Browse Products'. They will evolve in the future with the objective to become simpler and easier-to-use products.

2.2. Observational products levels

Depending on their processing level, the Herschel observational data products are defined as follows:

- **Level 0 data product:** Raw telemetry data as measured by the instrument, minimally manipulated and ingested as Data Frames into the Herschel Science Archive.
- **Level 0.5 data product:** Raw data processed to an intermediate point which is adequate for inspection or to start interactive analysis at a more advanced stage than Level 0.
- **Level 1 data product:** Detector readouts calibrated and converted to physical units, in principle instrument and observatory independent. It is expected that Level 1 data processing can be performed without human intervention.
- **Level 2 data product:** Level 1 data further processed to such a level that scientific analysis can be performed. For optimal results many of the processing steps involved to generate Level 2 data may require human interaction, based both on instrument understanding as well as understanding of the scientific aims of the observation.
- **SPIRE:**
  - The Level 2.5 products are created from combination of single scan direction observations including the following types:
    1. Pairs of scan maps taken in the nominal and orthogonal directions.
    2. Sets of parallel groups of scans (2 or more) at various orientations.
    3. Groups of Large Map mode observations made in overlapping single scan direction.
  - The Level 3 products are mosaics obtained by merging all or a subset of contiguous observations (tracked SSO observations or fixed maps that are known to contain SSOs are excluded). This leads, in some cases, to very large maps which are broken up into reasonable smaller groupings. For instance, the Galactic Plane is cut into chunks of about 15 degrees length with some adjustments around the Galactic Centre.
- **PACS:**
  - Level 2.5 photometric products are maps (SimpleImage) produced with JScanam, Unimap and the high-pass filter pipelines, combining the scan and cross-scan AORs.

- Level 2.5 spectroscopic products combine two observations obtained on-target and on a reference off-position in unchopped range scan observing mode.
- Level 3 photometric products are Level 2.5 JScanam and Unimap overlapping maps on a given field combined with the Mosaic task.
- Level 3 spectroscopic products are provided only for pointed chopNod observations taken in SED mode and they are combined spectrum tables derived from Level 2 products corresponding to several observations of the same target.

- **HIFI:**
  - Level 2.5 single-point data products are stitched (i.e. only one concatenates spectrometer sub-band) spectra for each of the polarisations and backends applicable to the observation.
  - Level 2.5 map data products are regridded cubes for each of the polarisations and backend sub-bands associated to a given observation. The cube dimension is derived from the geometry of the executed map. For moving targets, the maps are provided in the co-moving frame.
  - Level 2.5 spectral scan data products are deconvolved Level 2 spectra (from both WBS-H and WBS-V data) using default parameters.

Tables with the detailed description of these products are available in the following sections:

- **HIFI.** Section 1.3 in *Product Definition Supplement*.
- **PACS.** Section 3.9 in *Product Definition Supplement*.
- **SPIRE.** Section 5.4 in *Product Definition Supplement*.

2.3. Herschel product generic definition

2.3.1. Product basic structure

A product is defined in the Herschel Data Processing system as the highest level of data structure, which contains the following components:

- Metadata
- Zero or more tables or "datasets", which can also have their own metadata
- A processing history of the product

Herschel products have an internal structure representation in the Herschel Data Processing system or HIPE. When the products are exported as FITS files, a proper translation of the metadata keywords and of tables and datasets takes place to ensure consistency with the standard. Products are distributed through the Herschel Science Archive (HSA) as FITS files, or can be loaded from the HSA directly in HIPE.

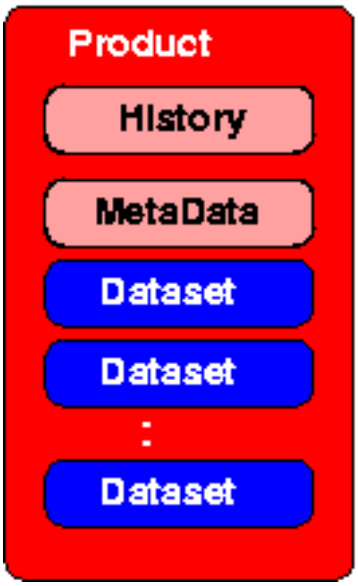

Figure 2.1. Herschel generic Product structure

2.4. Datasets in Herschel products

Dataset structures provide the mean to relate sets of data arrays in a table, and to qualify or annotate their contents with, for example, units and metadata. The Herschel Data Processing system provides three generic datasets:

- **Array Dataset**: A quantifiable dataset containing array data.
- **Table Dataset**: A dataset containing a collection of columns. Each column contains a quantifiable array data (e.g., data vector, array, cube). All columns have the same number of rows.
- **Composite Dataset**: A dataset containing a collection of named datasets. This allows arbitrary complex structures, as a child dataset within a composite dataset may be a composite dataset itself.

2.5. Spectrum specialised datasets

2.5.1. Spectrum1d

Spectrum1d contains a one-dimensional representation of a spectrum. It consists of a Table Dataset with the following columns:

- A flux column (double 1D)
- A wavelength/frequency column (double 1D)
- A weight column (double 1D)
- A segments column (double 1D). The values within this array indicate to which segment the corresponding flux/weight/flag/wave belong. The spectrum can be made of several segments or smallest spectrum component dealt with by the DP system. For example, a spectral segment can be an extracted piece of a spectrum to be used for fitting purposes.
- A flag column (integer 1D).

A Spectrum1d can also have metadata (header information) added. In general the meaning of the flags is stored in the metadata.

2.5.2. Spectrum2d

For multiple spectra taken in an observation, a 2D structure is required. The components of a Spectrum2d dataset are similar to that of a Spectrum1d dataset, except for having a second dimension. An additional component is the ability to contain subbands. Subbands are vertical splits in the Spectrum2d columns equivalent to the segment column in Spectrum1d. A clear example of its usefulness is the storage of the output from the HIFI spectrometers where several CCD or autocorrelator readouts lead to several "chunks" (subbands) of spectra in one data frame.

Spectrum2d consists of a Table Dataset with the following columns:

- A flux column (double 2D), where the first axis runs over the spectral dimension and the second axis runs over e.g. time.
- A wavelength/frequency column (double 2D)
- A weight column (double 2D)
- A flag column (integer 1D). In general the meaning of the flags is stored in the metadata.
- (Optional) a subband start column (integer 1D), which indicates where in the arrays a subband starts.
- (Optional) a subband length column (integer 1d). Indicates the length of the array section that a subband covers.

A Spectrum2d can also have metadata (header information) added.

2.6. Image and cube generic products

2.6.1. SimpleImage product

The SimpleImage product contains a standard two-dimensional image, in particular the following arrays:

- Image in an array 2D (e.g. double, integer)
- (Optional) Error in an array 2D (e.g. double, integer)
- (Optional) Exposure in an array 2D (e.g. double, integer)
- (Optional) Coverage in an array 2D (e.g. double, integer)
- (Optional) Flag in a short integer array 2D

It also contains metadata that provide unit and World Coordinate System information.

For further details see the *User's Reference Manual*: Section 1.384 in *HCSS User's Reference Manual*.

2.6.2. SimpleCube product

The SimpleCube product allows us to store three-dimensional images (or multiple stacked 2D images). In particular it contains the following arrays:

- Image in an array 3D (e.g. double, integer)
- (Optional) Error in an array 3D (e.g. double, integer)
- (Optional) Exposure in an array 3D (e.g. double, integer)
- (Optional) Coverage in an array 3D (e.g. double, integer)

- (Optional) Flag in a short integer 3D array

SimpleCube has the depth as the first (most slowly varying) index. It also contains metadata that provide unit and World Coordinate System information. A single WCS only can be applied to the SimpleCube. For example, it is not possible to provide different WCS sets for each image in an image stack.

For further details see the *User's Reference Manual*: Section 1.381 in *HCSS User's Reference Manual*.

2.6.3. SpectralSimpleCube product

Conceptually, a spectral cube can be seen in three ways:

- As a stack of monochromatic images
- As a cloud of points, when at least one of the axes is not regularly sampled
- As a set of spatially related spectra

SpectralSimpleCube can contain [1D, 2D] and 3D ArrayDatasets. The 3D sets store spectral stacks of images with dimensions [x3,x2,x1], where x3 is the spectral index. 2D sets are of dimension [x2,x1] and are interpreted as images. 1D sets are of dimension [x3] and are interpreted as spectra. SpectralSimpleCube also contains metadata information that provide unit and World Coordinate System information.

SpectralSimpleCube is an extension of the SimpleCube product. As such it includes all its features, such as the error and exposure maps seen before. The main difference is that reading an (x, y) position in a SpectralSimpleCube will return a Spectrum1d, while doing the same with a SimpleCube will return a generic one-dimensional array of flux values.

2.7. Context products

Herschel products can exist as simple products and as context products. Contexts are special types of products that contain references to other products stored. This enables a mean to build complex data structures. Context products also contain the required metadata as applicable to the group of products that contains. There are two "standard" types of context products provided: ListContext (for grouping products into sequences or lists) and MapContexts (for grouping products into containers with access to each one by key).

2.8. Product metadata keywords

The following metadata keywords are required to be present in all Herschel products. In the Data Processing system these keywords are referred to as "attributes":

Table 2.1. Herschel products attributes

Herschel DP keyword name	Type	Description	FITS keyword
type	String	Product type identification	TYPE
creator	String	The name and version of the software that created the product	CREATOR
creationDate	Fine time	Date of product creation	DATE
description	String	Full name of product	DESC
instrument	String	Instrument name	INSTRUME
modelName	String	Instrument Model Name	MODELNAM

Herschel DP keyword name	Type	Description	FITS keyword
startDate	Fine time	Start date of observation	DATE-OBS
endDate	Fine time	End date of observation	DATE-END

Fine Time is the internal DP representation that holds the value of time. Fine time is defined as the atomic time (SI seconds) elapsed since the TAI epoch of 1 January 1958 UT2. In the DP system the resolution provided is microseconds. When the value of a Fine Time keyword is displayed on a GUI or exported to FITS, the parameter is transformed to a String value, formatted according to the rules as defined by the TIMESYS keyword. Per default, TIMESYS='UTC', so the format will then be YYYY-MM-DDTHH:MM:SS.ssssss.

In addition to the product attributes, observational products contain those metadata keywords that identify the product and the observation that is associated with. In particular, the main metadata keywords common to all instruments are:

Table 2.2. Main metadata keywords in observational products

Herschel DP keyword name	Type	Description	FITS keyword
obsid	Long	Observation identifier	OBS_ID
bbid	Long	Building block identifier	BBID
observer	String	Name of observer	OBSERVER
proposal	String	Proposal name	PROPOSAL
aot	String	AOT identifier	AOT
obsMode	String	Observation mode name	OBS_MODE
cusMode	String	CUS observation mode	CUSMODE
aorLabel	String	AOR label as entered in HSpot	AOR
odNumber	Long	Mission operational day number	ODNUMBER

The "obsid" uniquely identifies an observation for all mission phases. The "obsid" relates all observational products associated with an AOR.

The "bbid" identifies uniquely each building block in an observation. A Building Block is a unit of observation or key component of the observation from the instrument commanding point of view (e.g., a single filter, a single node). An observation execution is always defined as a flat sequence of Building Blocks. The bbid is particularly important in the Herschel product definitions because large products (e.g., Level 0, Level 0.5) are sliced per building block. That is, a product or context product is provided for each building block in the observation.

Both the "obsid" and the "bbid" are essential to link the uplink commanding and the downlink telemetry.

"observer", "proposal", "aot", "obsMode" and "aorLabel" are derived from the proposal information and AORs as entered in HSpot.

"cusMode" is an internal uplink keyword that associates the observation requested with the corresponding pipeline processing. CUS stands for Common Uplink System.

"odNumber" is the number that identifies the Operational Day in the mission since launch. An Operation Day is defined as the interval between the start of two contiguous satellite ground contact periods. The duration of an Operational Day is in average around 24 hours, but it can also be shorter or longer, depending on operational constraints. The "odNumber" is an important key for the identification of those Auxiliary products that are generated per OD.

A complete list of the compulsory metadata keywords in the Herschel observational products can be found in the PDS in *Product Definition Supplement*.

A complete list of metadata per instrument mode in the Observation Context Product can be found in Chapter 3 (HIFI), Chapter 4 (PACS) and Chapter 5 (SPIRE).

2.9. The Herschel Observation Context

The Observation Context is the fist data product that you are likely to start with. It essentially contains your observation. It provides associations between products which are specific to a single observation (e.g. Level 0 products) as well as associations between products that are applicable to multiple observations (such as the calibration or auxiliary products). An Observation Context may have a state of completeness, which is defined by the processing of the data for that Observation, for example "scheduled", "Auxiliary data attached", "Calibration data attached", "Level0 data generated", "Level1 data generated". Thus the Observation Context changes its nature along the way of processing.

An Observation Context is generated per AOR, except for the SPIRE PACS parallel mode for which two Observation Contexts are produced, containing the SPIRE and PACS data respectively.

The Observation Context consists of the following contexts and products, which have been defined following the product types described in Section 2.1.

- Telemetry Context: This context is not distributed by default. Telemetry products will only be provided when the Herschel Science Centre deems it to be necessary because of a serious problem in the processing to Level 0 data.
- Level 0, Level 0.5, Level 1, Level 2, Level 2.5 and Level 3 (optional) contexts
- Calibration Context
- Auxiliary Context
- Quality Context
- Browse product
- Observation Log Context

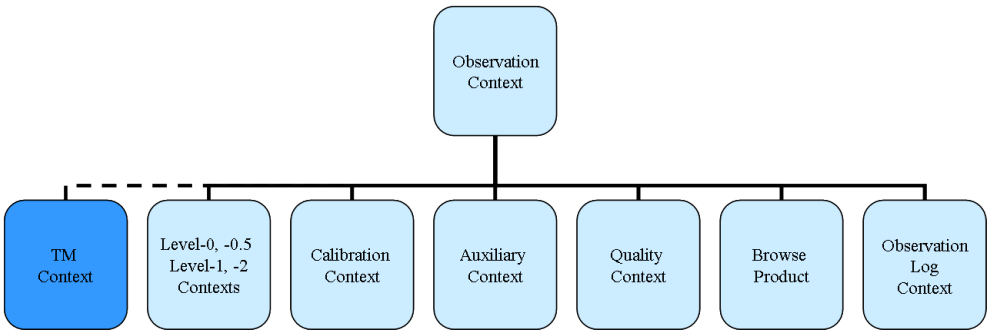

Figure 2.2. Observation Context structure

2.10. Product naming convention for exported FITS files

The Herschel products naming convention for exported FITS files takes the following format which depends on the type of product. The generic format is as follows although not all of the items are present in all filenames. See following subsections for the specific formats for the different groups of products.

`h<product/instrument><subinst><obsid/od>_<bbid>_<level><type>_<slice>_<timestamp>`

where

- `h` stands for Herschel
- `<product/instrument>`: is the product type such as *aux* for auxiliary products or the instrument name either *hifi, pacs or spire* (note that all letters in the filename are lowercase).
- `<subinst>`: This is only relevant for instrument data. Depending on the instrument and on the type of product it stands for the subinstrument used, the detector, polarisation mode etc...
- `<obsid/od>`: The observation ID given in decimal format.
- `<bbid>`: Some observational products are split up into logic parts of the observation such as building blocks. When this occurs the bbid is given in hexadecimal format.
- `<level>`: The level of the product is presented here. Level 0 products are represented by 00, Level 0.5 by 05, Level 1 by 10, Level 2 by 20, Level 2.5 by 25 and Level 3 by 30.
- `<type>`: This indicates the type of product as given in the meta keyword (attribute) TYPE.
- `<slice>`: When data from an observation need to be split up further than by building block or in a way unrelated to building block, the number of the slice is given here. If 100 or less products result from the split then two digits (yy) represent the slices (in time order). For more than 100 slices then three digits (yyy) are used.

The ordering of the parameters is designed to give a logic ordering of the filenames when listed in a directory.

All product names also contain at the end a 13 digits number which is a `<timestamp>` that the system generates when the FITS product is created.

The specific formats per product are given in the following sections.

2.10.1. Observation products

The filenames of observation products take the generic form of (products split into building blocks and slices):

`h<instrument><subinst><obsid>_<bbid>_<level><type>_<slice>_<timestamp>.fits`

For products that contain data from the whole observation (i.e., not split up at all) the generic form is:

`h<instrument><subinst><obsid>_<level><type>_<timestamp>.fits`

For example, hpacs1342188700_20hps3dbs_01_1422300741810.fits is Level 2 Herschel PACS Spectroscopy (3D) cubes Blue slice 01 for observation 1342188700.

For Level 2.5 and Level 3 products which involve more than one observation, the central coordinates of the generated map are used instead of the <obsid>.

For example, hpacs_30HPPJSMAPR_1451_p7409_00_v1.0 is PACS Photometer Scanamorphos Level 3 Red map with central coordinates RA=14h51m DEC=+74d09m.

2.10.2. Calibration products

The majority of the Calibration products have the addition of cal/calibration in the filename, although the names depend very much on the instrument, the subintrument (photometry or espectroscopy) and

whether they are calibration files created by the pipeline or about how the observation was carried out (Uplink).

More details on the name of calibration products can be found in Section 3.2, Section 4.2 and Section 5.2.

2.10.3. Auxiliary products

The filenames of auxiliary products take the generic form:

`haux<obsid/od><type>_<timestamp>.fits`

For products associated with one obsid the form is

`haux<obsid><type>_<timestamp>.fits`

Those with data for one operational day take the form

`haux<OD><type>_<timestamp>.fits`

Some auxiliary products which are valid for a given period like the SIAM product do not follow this naming convention.

A table describing the different types of auxiliary products is in 6.1.

2.10.4. Quality Control products

The filename for the quality control report is:

`h<instrument><obsid>_quality_v<NN>`

For the quality control report summary:

`h<instrument><obsid>_quality_summary_v<NN>`

For the quality logs:

`h<instrument><obsid>_quality_log_v<NN>`

where `v<NN>` stands for the version of the product although it has not changed across the mission and remains as v1.0 for all quality products.

Chapter 3. HIFI Products Description

3.1. HIFI observational products

3.1.1. HIFI Observation Context metadata

The HIFI Observation Context Product contains a list of metadata keywords which give the majority of the parameters that identify the observation. These are examples for the three HIFI modes:

3.1.1.1. ObservationContext for HIFI Single Point

Table 3.1. Example of the metadata keywords contained in a HIFI Single Point observation.

String-Parameter	type (description="Product Type Identification")
String-Parameter	creator (description="Generator of this product")
DateParameter	creationDate (description="Creation date of this product")
String-Parameter	description (description="Name of this product")
String-Parameter	instrument (description="Instrument attached to this product")
String-Parameter	modelName (description="Model name attached to this product")
DateParameter	startDate (description="Start date of the observation")
DateParameter	endDate (description="End date of the observation")
String-Parameter	formatVersion (description="Version of product format")
String-Parameter	obsState (description="One of CREATED, LEVEL0_PROCESSED, LEVEL0_5_PROCESSED, LEVEL1_PROCESSED, LEVEL2_PROCESSED, LEVEL2_5_PROCESSED, LEVEL3_PROCESSED")
Long-Parameter	obsid (description="Observation identifier")
Long-Parameter	odNumber (description="Operational day number")
String-Parameter	cusMode (description="CUS observation mode")

String-Parameter	instMode (description="Instrument Mode")
String-Parameter	obsMode (description="Observation mode name")
String-Parameter	processingMode (description="Processing mode selected to execute the pipeline")
String-Parameter	observer (description="Observer name")
String-Parameter	proposal (description="Proposal name")
String-Parameter	pointingMode (description="Pointing mode")
DateParameter	slewTime (description="Predicted start time for slew before the observation")
String-Parameter	origin (description="Site that created the product")
String-Parameter	aorLabel (description="AOR Label as entered in HSpot")
String-Parameter	aot (description="AOT Identifier")
DoubleParameter	equinox (description="Equinox of celestial coordinate system")
String-Parameter	missionConfig (description="Mission configuration")
String-Parameter	object (description="Target name")
String-Parameter	raDeSys (description="Coordinate reference frame for the RA and DEC")
DoubleParameter	pmRA (description="Target's proper motion RA (arcsec/yr) as given by the observer", quantity="arcsec a-1")
DoubleParameter	pmDEC (description="Target's proper motion Dec (arcsec/yr) as given by the observer", quantity="arcsec a-1")
DoubleParameter	raNominal (description="Requested Right Ascension of pointing", quantity="deg")

DoubleParameter	decNominal (description="Requested Declination of pointing", quantity="deg")
DoubleParameter	ra (description="Average of ra in level 2 datasets", quantity="deg")
DoubleParameter	dec (description="Average of dec in level 2 datasets", quantity="deg")
DoubleParameter	posAngle (description="Spacecraft pointing Position angle", quantity="deg")
StringParameter	telescope (description="Name of telescope")
StringParameter	velocityDefinition (description="The velocity definition and frame")
DoubleParameter	radialVelocity (description="Spacecraft velocity along the l-of-s of the telescope wrt the LSR", quantity="km s-1")
StringParameter	calVersion (description="HIFI calibration version")
StringParameter	Band (description="Active band")
StringParameter	attitudeQuaternion (description="Pointing product quaternion applied")
DoubleParameter	tmbReference (description="Temperature (main beam) at noise reference frequency", quantity="K")
DoubleParameter	noiseRefFrequency (description="Noise reference frequency", quantity="GHz")
DoubleParameter	totNoiseEfficiency (description="Total noise efficiency", quantity="%")
DoubleParameter	driftNoiseContrib (description="Drift noise contribution", quantity="%")
StringParameter	orbitEphemerisSourceFile (description="Name of the file from where data was extracted")
DoubleParameter	solarAspectAngleMean (description="Mean Solar Aspect Angle", quantity="degrees")
DoubleParameter	solarAspectAngleRms (description="RMS Solar Aspect Angle", quantity="degrees")

BooleanParameter	hrsHscience (description="Science data are obtained with HRS-H")
BooleanParameter	hrsVscience (description="Science data are obtained with HRS-V")
BooleanParameter	wbsHscience (description="Science data are obtained with WBS-H")
BooleanParameter	wbsVscience (description="Science data are obtained with WBS-V")
DoubleParameter	loFrequencyRequest (description="User requested local oscillator frequency", quantity="GHz")
BooleanParameter	gyroAttSuspicious (description="Suspicious quality of the attitude reconstruction.")
DoubleParameter	loFreqAvg (description="Average LO frequency Doppler-corrected to freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqUsbMin (description="Observed min frequency for USB in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqUsbMax (description="Observed max frequency for USB in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqLsbMin (description="Observed min frequency for LSB in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqLsbMax (description="Observed max frequency for LSB in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	loFrequency (description="Actual local oscillator frequency", quantity="GHz")
DoubleParameter	rmsMinUsb (description="Rms Noise USB at minimum bandwidth H and V polarizations averaged", quantity="K")
DoubleParameter	rmsNativeUsb (description="Rms Noise USB rescaled to native WBS resolution H and V polarizations averaged", quantity="K")
DoubleParameter	rmsMaxUsb (description="Rms Noise USB at maximum bandwidth H and V polarizations averaged", quantity="K")
DoubleParameter	rmsMinLsb (description="Rms Noise LSB at minimum bandwidth H and V polarizations averaged", quantity="K")
DoubleParameter	rmsNativeLsb (description="Rms Noise LSB rescaled to native WBS resolution H and V polarizations averaged", quantity="K")

DoublePa-rameter	rmsMaxLsb (description="Rms Noise LSB at maximum bandwidth H and V polarizations averaged", quantity="K")

3.1.1.2. ObservationContext for HIFI Mapping

Table 3.2. Example of the metadata keywords contained in a HIFI Mapping observation.

String-Param-eter	type (description="Product Type Identification")
String-Param-eter	creator (description="Generator of this product")
DatePa-rameter	creationDate (description="Creation date of this product")
String-Param-eter	description (description="Name of this product")
String-Param-eter	instrument (description="Instrument attached to this product")
String-Param-eter	modelName (description="Model name attached to this product")
DatePa-rameter	startDate (description="Start date of the observation")
DatePa-rameter	endDate (description="End date of the observation")
String-Param-eter	formatVersion (description="Version of product format")
String-Param-eter	obsState (description="One of CREATED, LEVEL0_PROCESSED, LEVEL0_5_PROCESSED, LEVEL1_PROCESSED, LEVEL2_PROCESSED, LEVEL2_5_PROCESSED, LEVEL3_PROCESSED")
Long-Param-eter	obsid (description="Observation identifier")
Long-Param-eter	odNumber (description="Operational day number")
String-Param-eter	cusMode (description="CUS observation mode")
String-Param-eter	instMode (description="Instrument Mode")
String-Param-eter	obsMode (description="Observation mode name")

StringParameter	processingMode (description="Processing mode selected to execute the pipeline")
StringParameter	observer (description="Observer name")
StringParameter	proposal (description="Proposal name")
StringParameter	pointingMode (description="Pointing mode")
DateParameter	slewTime (description="Predicted start time for slew before the observation")
StringParameter	origin (description="Site that created the product")
StringParameter	aorLabel (description="AOR Label as entered in HSpot")
StringParameter	aot (description="AOT Identifier")
DoubleParameter	equinox (description="Equinox of celestial coordinate system")
StringParameter	missionConfig (description="Mission configuration")
StringParameter	object (description="Target name")
StringParameter	raDeSys (description="Coordinate reference frame for the RA and DEC")
DoubleParameter	pmRA (description="Target's proper motion RA (arcsec/yr) as given by the observer", quantity="arcsec a-1")
DoubleParameter	pmDEC (description="Target's proper motion Dec (arcsec/yr) as given by the observer", quantity="arcsec a-1")
DoubleParameter	raNominal (description="Requested Right Ascension of pointing", quantity="deg")
DoubleParameter	decNominal (description="Requested Declination of pointing", quantity="deg")
DoubleParameter	ra (description="Average of ra in level 2 datasets", quantity="deg")

DoubleParameter	dec (description="Average of dec in level 2 datasets", quantity="deg")
DoubleParameter	posAngle (description="Spacecraft pointing Position angle", quantity="deg")
StringParameter	telescope (description="Name of telescope")
StringParameter	velocityDefinition (description="The velocity definition and frame")
DoubleParameter	radialVelocity (description="Spacecraft velocity along the l-of-s of the telescope wrt the LSR", quantity="km s-1")
StringParameter	calVersion (description="HIFI calibration version")
StringParameter	Band (description="Active band")
StringParameter	attitudeQuaternion (description="Pointing product quaternion applied")
DoubleParameter	pattAngle (description="Spectral map rotation angle", quantity="degrees")
DoubleParameter	tmbReference (description="Temperature (main beam) at noise reference frequency", quantity="K")
DoubleParameter	noiseRefFrequency (description="Noise reference frequency", quantity="GHz")
DoubleParameter	totNoiseEfficiency (description="Total noise efficiency", quantity="%")
DoubleParameter	driftNoiseContrib (description="Drift noise contribution", quantity="%")
StringParameter	orbitEphemerisSourceFile (description="Name of the file from where data was extracted")
DoubleParameter	solarAspectAngleMean (description="Mean Solar Aspect Angle", quantity="degrees")
DoubleParameter	solarAspectAngleRms (description="RMS Solar Aspect Angle", quantity="degrees")
BooleanParameter	hrsHscience (description="Science data are obtained with HRS-H")

BooleanParameter	hrsVscience (description="Science data are obtained with HRS-V")
BooleanParameter	wbsHscience (description="Science data are obtained with WBS-H")
BooleanParameter	wbsVscience (description="Science data are obtained with WBS-V")
DoubleParameter	loFrequencyRequest (description="User requested local oscillator frequency", quantity="GHz")
BooleanParameter	gyroAttSuspicious (description="Suspicious quality of the attitude reconstruction.")
DoubleParameter	loFreqAvg (description="Average LO frequency Doppler-corrected to freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqUsbMin (description="Observed min frequency for USB in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqUsbMax (description="Observed max frequency for USB in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqLsbMin (description="Observed min frequency for LSB in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqLsbMax (description="Observed max frequency for LSB in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	loFrequency (description="Actual local oscillator frequency", quantity="GHz")
DoubleParameter	rmsMinUsb (description="Rms Noise USB at minimum bandwidth H and V polarizations averaged", quantity="K")
DoubleParameter	rmsNativeUsb (description="Rms Noise USB rescaled to native WBS resolution H and V polarizations averaged", quantity="K")
DoubleParameter	rmsMaxUsb (description="Rms Noise USB at maximum bandwidth H and V polarizations averaged", quantity="K")
DoubleParameter	rmsMinLsb (description="Rms Noise LSB at minimum bandwidth H and V polarizations averaged", quantity="K")
DoubleParameter	rmsNativeLsb (description="Rms Noise LSB rescaled to native WBS resolution H and V polarizations averaged", quantity="K")
DoubleParameter	rmsMaxLsb (description="Rms Noise LSB at maximum bandwidth H and V polarizations averaged", quantity="K")

3.1.1.3. ObservationContext for HIFI Spectral Scan

Table 3.3. Example of the metadata keywords contained in a HIFI Spectral Scan.

String-Parameter	type (description="Product Type Identification")
String-Parameter	creator (description="Generator of this product")
DateParameter	creationDate (description="Creation date of this product")
String-Parameter	description (description="Name of this product")
String-Parameter	instrument (description="Instrument attached to this product")
String-Parameter	modelName (description="Model name attached to this product")
DateParameter	startDate (description="Start date of the observation")
DateParameter	endDate (description="End date of the observation")
String-Parameter	formatVersion (description="Version of product format")
String-Parameter	obsState (description="One of CREATED, LEVEL0_PROCESSED, LEVEL0_5_PROCESSED, LEVEL1_PROCESSED, LEVEL2_PROCESSED, LEVEL2_5_PROCESSED, LEVEL3_PROCESSED")
Long-Parameter	obsid (description="Observation identifier")
Long-Parameter	odNumber (description="Operational day number")
String-Parameter	cusMode (description="CUS observation mode")
String-Parameter	instMode (description="Instrument Mode")
String-Parameter	obsMode (description="Observation mode name")
String-Parameter	processingMode (description="Processing mode selected to execute the pipeline")

String-Parameter	observer (description="Observer name")
String-Parameter	proposal (description="Proposal name")
String-Parameter	pointingMode (description="Pointing mode")
DateParameter	slewTime (description="Predicted start time for slew before the observation")
String-Parameter	origin (description="Site that created the product")
String-Parameter	aorLabel (description="AOR Label as entered in HSpot")
String-Parameter	aot (description="AOT Identifier")
DoubleParameter	equinox (description="Equinox of celestial coordinate system")
String-Parameter	missionConfig (description="Mission configuration")
String-Parameter	object (description="Target name")
String-Parameter	raDeSys (description="Coordinate reference frame for the RA and DEC")
DoubleParameter	pmRA (description="Target's proper motion RA (arcsec/yr) as given by the observer", quantity="arcsec a-1")
DoubleParameter	pmDEC (description="Target's proper motion Dec (arcsec/yr) as given by the observer", quantity="arcsec a-1")
DoubleParameter	raNominal (description="Requested Right Ascension of pointing", quantity="deg")
DoubleParameter	decNominal (description="Requested Declination of pointing", quantity="deg")
DoubleParameter	ra (description="Average of ra in level 2 datasets", quantity="deg")
DoubleParameter	dec (description="Average of dec in level 2 datasets", quantity="deg")

DoubleParameter	posAngle (description="Spacecraft pointing Position angle", quantity="deg")
StringParameter	telescope (description="Name of telescope")
StringParameter	velocityDefinition (description="The velocity definition and frame")
DoubleParameter	radialVelocity (description="Spacecraft velocity along the l-of-s of the telescope wrt the LSR", quantity="km s-1")
StringParameter	calVersion (description="HIFI calibration version")
StringParameter	Band (description="Active band")
StringParameter	attitudeQuaternion (description="Pointing product quaternion applied")
LongParameter	redundancy (description="Spectral Scan redundancy requested")
DoubleParameter	tmbReference (description="Temperature (main beam) at noise reference frequency", quantity="K")
DoubleParameter	noiseRefFrequency (description="Noise reference frequency", quantity="GHz")
DoubleParameter	totNoiseEfficiency (description="Total noise efficiency", quantity="%")
DoubleParameter	driftNoiseContrib (description="Drift noise contribution", quantity="%")
StringParameter	orbitEphemerisSourceFile (description="Name of the file from where data was extracted")
DoubleParameter	solarAspectAngleMean (description="Mean Solar Aspect Angle", quantity="degrees")
DoubleParameter	solarAspectAngleRms (description="RMS Solar Aspect Angle", quantity="degrees")
BooleanParameter	hrsHscience (description="Science data are obtained with HRS-H")
BooleanParameter	hrsVscience (description="Science data are obtained with HRS-V")

BooleanParameter	wbsHscience (description="Science data are obtained with WBS-H")
BooleanParameter	wbsVscience (description="Science data are obtained with WBS-V")
DoubleParameter	loFrequencyStartRequest (description="User requested beginning frequency of the spectral scan.", quantity="GHz")
DoubleParameter	loFrequencyEndRequest (description="User requested final frequency of the spectral scan.", quantity="GHz")
BooleanParameter	gyroAttSuspicious (description="Suspicious quality of the attitude reconstruction.")
DoubleParameter	loFreqMin (description="Min LO frequency of the spectral scan Doppler-corrected to freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	loFreqMax (description="Max LO frequency of the spectral scan Doppler-corrected to freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqMin (description="Observed min frequency in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	obsFreqMax (description="Observed max frequency in freqFrame (SPECSYS)", quantity="GHz")
DoubleParameter	loFrequencyStart (description="Actual start local oscillator frequency", quantity="GHz")
DoubleParameter	loFrequencyEnd (description="Actual end local oscillator frequency", quantity="GHz")
DoubleParameter	rmsNoiseHvVsTsys (description="The noise ratio of the two polarisation exceeds that expected from the measured Tsys ratio by more than 10%. Their ratio is given in the value column.")
DoubleParameter	rmsNoiseHV (description="One of the two polarisations is noisier than the other by more than SQRT(2). Their noise ratio is given in the value column")
DoubleParameter	rmsDSBMin (description="Rms DSB Noise at minimum bandwidth H and V polarizations averaged", quantity="K")
DoubleParameter	rmsDSBNative (description="Rms DSB Noise rescaled to native WBS resolution H and V polarizations averaged", quantity="K")
DoubleParameter	rmsDSBMax (description="Rms DSB Noise at maximum bandwidth H and V polarizations averaged", quantity="K")
DoubleParameter	rmsSSBMin (description="Rms Deconvolved SSB Noise at minimum bandwidth H and V polarizations averaged", quantity="K")

DoubleParameter	rmsSSBNative (description="Rms Deconvolved SSB Noise rescaled to native WBS resolution H and V polarizations averaged", quantity="K")
DoubleParameter	rmsSSBMax (description="Rms Deconvolved SSB Noise at maximum bandwidth H and V polarizations averaged", quantity="K")

3.1.2. HIFI Level 0, Level 0.5, Level 1 and level 2 contexts

The HIFI Level 0, Level 0.5, Level 1 and Level 2 contexts contain one type of context. Its global structure does not change when the data is processed between Level 0 and Level 2. The HIFI Levels 0, 0.5, 1 and 2 contain the HIFI Timeline product, which is a map context that groups a number of HIFI Spectrum Datasets, wrapped in products, normally one per building block.

Product description	**Product type**
HIFI level 0 context	HifiRawData
HIFI WBS-H context	HifiTimelineProduct
WBS-H product per building block	HifiSpectrumDataset
HIFI WBS-V context	HifiTimelineProduct
WBS-V products per building block	HifiSpectrumDataset
HIFI HRS-H context	HifiTimelineProduct
HRS-H products per building block	HifiSpectrumDataset
HIFI HRS-V context	HifiTimelineProduct
HRS-V products per building block	HifiSpectrumDataset

- HIFI Level 0.5 context: Globally the Level 0.5 context has the same structure as the Level 0 product. Backend (HRS or WBS) specific effects are removed as much as possible. A frequency scale has been added.
- HIFI level 1 context: As mentioned above, the level 1 context still has the same global structure but now the flux columns are calibrated. Each row in the HIFI Spectrum Dataset corresponds to a calibrated single on-board integration. The integrations are not added in the standard processing.
- HIFI Level 2 context: The Level 2 context also has the same global structure but now the fluxes are on the T_a* scale and the data at the same LO frequency and spatial position are averaged together.

Level 0.5 is removed from the HIFI observational products, upon successful generation of a Level 1 context. The reason for this is to save disk space. Level 0.5 can always be reprocessed from level 0 data.

3.1.3. HIFI Level 2 context

A high level description of the HIFI level-2 products is given here. Depending on the AOT different products will be made. Broadly there are 3 kinds of HIFI AOTs: Single point observations, spectral scan observations and mapping observations. The first two of these will produce one or more single spectra while the last will produce a spectral cube.

HIFI Single Point Observation. By processing the data in a HifiTimelineProduct by e.g. removing the reference, averaging the on-source spectra and concatenating subbands smaller SpectrumDatasets are obtained. All of these products are full HifiSpectrumDatasets and, as such, fundamentally identical to the spectrum data sets generated in level-1 processing (except for the number of spectra). In general only one spectrum will be contained in the HifiSpectrumDataset. The meta information associated

with these data sets is more extended than what is available for the level-1 spectrum data set. The overall container of these reduced HifiSpectrumDatasets is still a HifiTimelineProduct.

HIFI Spectral Scan Observation. A spectral scan observation contains several point observations at different LO settings such that they might form a single continuous spectrum, when deconvolved. As deconvolution is still beyond level-2 spectral scan observations are similar to the single point observations of the previous paragraph.

HIFI Mapping Observations. HIFI on the fly mapping and raster data are three dimensional in nature; the data contain spectra corresponding to a (fairly) regular position grid on the sky. Normally OTF cq. raster data is processed from a HifiSpectrumDataset into a regularly gridded data cube with equally spaced pixels in position and frequency coordinates. Such data cubes are stored as a HifiSpectralCube product which will be directly derived from the generic SpectralSimpleCube data product.

3.1.4. HIFI Level 2.5 context

A high-level description of the HIFI Level 2.5 products is given here. Level 2.5 products are those that will be provided as stand-alone browse products in the HSA. Depending on the AOT different products will be made. Broadly there are three kinds of HIFI AOTs: single point observations, spectral scan observations and spectral mapping observations. The first two of these will produce one or more single spectra while the last will produce a spectral cube.

Single point observations. Level 2.5 products correspond to stitched (i.e. only one concatenated spectrometer sub-band) level 2 spectra for each of the polarisations and backends applicable to the obsid. In the case of the HRS, individual level 2 sub-bands may not necessarily overlap in frequency and the corresponding gaps will be filled with NaNs. Finally, Frequency Switching observations will be folded.

Spectral scan observations. Level 2.5 products correspond to the outcome of the `doDeconvolution` task run on both polarisation of the WBS. No deconvolved products are provided for the HRS data, even if they have been taken serendipitously during the observation. No baseline correction is done prior to deconvolution and it is expected that in many cases you will need to go back to the Level 2 HTP and clean the data prior to re-running `doDeconvolution`. This can be done using the interactive Level 2.5 pipeline.

Mapping observations. Level 2.5 products are cubes created from level 2 products regridded onto a regular spatial grid for each of the polarisations and backend applicable to the obsid. The cube dimension are derived from the geometry of the executed map. For moving targets, the maps are in the comoving frame. Unlike the point mode observations, only WBS spectra are systematically stitched. HRS spectra are stitched only in case the corresponding level 2 sub band overlap in frequency. Finally, maps combined with Frequency Switching observations will be folded.

3.2. HIFI calibration products

There are two kinds of Calibration products. Products which are provided in advance and products which are derived from the HifiTimelineProduct and are used at the same time. These latter products are saved in the ObservationContext and can (later) be used for trend analysis and quality control.

A note about nomenclature: A calibration product specific for HRS starts with CalHrs... and one specific for WBS starts with CalWbs... When it only starts with Cal it is generic.

3.2.1. HIFI calibration products 1: Predefined calibration products

Product class	Product Description
CalBbid	A table containing the meaning of the different building blocks types, some attributes and their meaning

Product class	Product Description
CalCoupCoeff	Product that contains for each (physical band) the coupling coefficients eta_hot and eta_cold (for a given freq grid). (Name in Observation Context: couplingEfficiency_H/V)
CalForwardEff	Product containing baseline ripple model from OFF scans. Every ripple model has a time tag and quality. (Name in Observation Context: forwardEfficiency_H/V)
CalHKTable	A table containing the HK items which should be selected in the HifiSpectrumDatasets for the different backend and in different situations.
CalSidebandGain	It contains the sideband gain values. (Name in Observation Context: sidebandGain_H/V)
CalUpConvertLO	It contains the upconverter factor needed for the frequencies in bands 6 and 7
CalHrsPowCorr	A product containing values for the power gain non-linearity correction. It has 2 tables: PowCorrVSigma which is the vSigma vector and PowCorrGain which is the gain vector.
CalHrsQDCFast	Only MetaData containing the values for the fast Quantization distortion correction.
CalHrsQDCFull	A product containing values for the full Quantization distortion correction. It has 5 datasets. • QDCFullMSigma: Tabledataset containing mSigma vector. • QDCFullRo: Tabledataset containing ro vector. • QDCFullVSigma: Tabledataset containing vSigma vector. • QDCFullGridDim: Tabledataset containing grid dimensions. • QDCFullGrid: Tabledataset containing grid or 3d table.
CalHrsBadChans	Product which contains the bad channels table for HRS
CalWbsBadPixel	Product which contains the bad pixels table for WBS. (Name in Observation Context: badPixels)
CalWbsFreqCoeff	It contains one Table Dataset with 5 columns, one for time and for each of the four CCD's, a set of polynomial coefficients that define how to convert pixel index to IF frequency for that time.
CalWbsFreqTuning	The parameter used for the fitting of COMB spectra. (Name in Observation Context: combFitParameters)
CalWbsLinearCoeff	Contains the coefficients for the non linearity correction of WBS bands. (Name in Observation Context: linearityCoefficient)

3.2.2. HIFI calibration products 2: Calibration products derived from the HifiTimelineProduct

Product class	Product Description
Attenuator	
CalFluxHotCold	A context product containing the hot-cold calibration. (Name in Observation Context: Tsys)
CalOffBaseline	Product containing the baseline spectra obtained by the MkOffSmooth module which processes off data sets

Product class	Product Description
CalWbsBadPixel	Product which contains the bad pixels table for WBS. (Name in Observation Context: BadPixelProposed)
CalWbsFreq	The frequency calibration context for the WBS. (Name in Observation Context: WbsFreq)
CalWbsZero	Zero context for zeros spectra and relative checks. ((Name in Observation Context: Zero)
FreqRanges	Product containing the measures for frequency drifts potentially occurring during an observation. (Name in Observation Context: FrequencyGroups)

3.3. HIFI Quality products

Product class	Product Description
CommandFailureProduct	Level 0 Quality Product: Command Failures
DataframeCountQualityProduct	Level 0 Quality Product: Dataframe count
QHtpLevel0	Level 0 Quality product
RuntimeErrorProduct	Level 0 Quality Product: Runtime errors
QWbsComb	Level 0.5 Quality context that contains the 4 single CCD-COMB Quality Product
QWbsCcd	Level 0.5 Quality product that Contain the result of the COMB fitting analysis for the specific CCD
QWbsFreq	Level 0.5 Quality context that contains all the COMB Quality Product for the specific observation
QWbsSpikes	Level 0.5 Quality product that contains the channels where a spike has been detected in the COMB
QWbsZero	Level 0.5 Quality product that contains the zero's "maximum", "minimum", "average", "variance"
CalPhases	Level 1 Quality product that contains information about the different phases observed with an observation. Phases are identified (depending on the observing mode) from the Chopper / buffer or the LoFrequency / buffer.

3.4. HIFI Trend Analysis products

Product class	Product Description
FpuTrendProduct	Fpu Trend Product
LoTrendProduct	LO Trend Product
WbsTrendProduct	WBS Trend Product
StatisticsTrendProduct	Statistics Trend Product
TsysTrendTable	Tsys Trend Product

Chapter 4. PACS Products Description

4.1. PACS observational products

4.1.1. PACS Observation Context metadata

The PACS Observation Context Product contains a list of metadata keywords which give the majority of the parameters that identify the observation. These are examples for the three PACS modes:

4.1.1.1. ObservationContext for PACS Photometry

Table 4.1. Example of the metadata keywords contained in a PACS Photometry observation.

String-Parameter	type (description="Product Type Identification")
String-Parameter	creator (description="Generator of this product")
DateParameter	creationDate (description="Creation date of this product")
String-Parameter	description (description="Name of this product")
String-Parameter	instrument (description="Instrument attached to this product")
String-Parameter	modelName (description="Model name attached to this product")
DateParameter	startDate (description="Start date of the observation")
DateParameter	endDate (description="End date of the observation")
String-Parameter	formatVersion (description="Version of product format")
String-Parameter	obsState (description="One of CREATED, LEVEL0_PROCESSED, LEVEL0_5_PROCESSED, LEVEL1_PROCESSED, LEVEL2_PROCESSED, LEVEL2_5_PROCESSED, LEVEL3_PROCESSED")
Long-Parameter	obsid (description="Observation Identifier")
Long-Parameter	odNumber (description="Operational Day Number count")
String-Parameter	cusMode (description="CUS observation mode")

String-Parameter	instMode (description="Instrument Mode")
String-Parameter	obsMode (description="Observation mode name")
String-Parameter	processingMode (description="Processing mode selected to execute the pipeline")
String-Parameter	ConcatenatedOBSIDs (description="AORs concatenated with this obs in HSPOT")
String-Parameter	observer (description="Observer name")
String-Parameter	proposal (description="Proposal name")
String-Parameter	pointingMode (description="Pointing mode")
DateParameter	slewTime (description="Scheduled start time of the slew")
String-Parameter	origin (description="Site that created the product")
String-Parameter	aorLabel (description="AOR Label as entered in HSpot")
String-Parameter	aot (description="AOT Identifier")
DoubleParameter	equinox (description="Equinox of celestial coordinate system")
String-Parameter	missionConfig (description="Mission configuration")
String-Parameter	object (description="Target name")
String-Parameter	raDeSys (description="Coordinate reference frame for the RA and DEC")
DoubleParameter	pmRA (description="Target's proper motion, RA", quantity="arcsec a-1")
DoubleParameter	pmDEC (description="Target's proper motion, Dec", quantity="arcsec a-1")

DoubleParameter	raNominal (description="Requested Right Ascension of pointing", quantity="deg")
DoubleParameter	decNominal (description="Requested Declination of pointing", quantity="deg")
DoubleParameter	ra (description="Actual Right Ascension of pointing", quantity="deg")
DoubleParameter	dec (description="Actual Declination of pointing", quantity="deg")
DoubleParameter	posAngle (description="Position Angle of pointing", quantity="deg")
StringParameter	telescope (description="Name of telescope")
StringParameter	velocityDefinition (description="The velocity definition and frame")
DoubleParameter	radialVelocity (description="Spacecraft velocity along the l-of-s of the telescope wrt the LSR: v / c = (lambda_rest - lambda) / lambda_rest", quantity="km s-1")
StringParameter	calVersion (description="Version of calibration tree used")
LongParameter	obsRequestId (description="Observation Request Identifier")
LongParameter	obsRequestVersion (description="Observation Request Version")
StringParameter	title (description="Title")
StringParameter	target (description="Target")
StringParameter	targetType (description="Target Type")
StringParameter	subinstrument (description="Sub Instrument")
StringParameter	observingMode (description="Observing mode summary")
LongParameter	overhead (description="Overhead")

LongParameter	tslewmin (description="Minimum slew time")
BooleanParameter	mapScanHomCoverage (description="HSPOT: scan map homogeneous coverage selected")
BooleanParameter	mapScanSquare (description="HSPOT: scan map square coverage selected")
DoubleParameter	fluxExtBlu (description="HSPOT: extended source flux estimate blue", quantity="mJy")
DoubleParameter	fluxExtRed (description="HSPOT: extended source flux estimate red", quantity="mJy")
DoubleParameter	fluxPntBlu (description="HSPOT: point source flux estimate blue", quantity="mJy")
DoubleParameter	fluxPntRed (description="HSPOT: point source flux estimate red", quantity="mJy")
DoubleParameter	mapScanAngle (description="HSPOT: scan map position angle", quantity="deg")
DoubleParameter	mapScanConstrFrom (description="HSPOT: scan map constraint angle from", quantity="deg")
DoubleParameter	mapScanConstrTo (description="HSPOT: scan map constraint angle to (deg)", quantity="deg")
DoubleParameter	mapScanCrossScan (description="HSPOT: scan map leg separation", quantity="arcsec")
DoubleParameter	mapScanLegLength (description="HSPOT: scan map leg length", quantity="arcmin")
LongParameter	mapScanNumLegs (description="HSPOT: number of scan map legs")
LongParameter	naifid (description="SSO NAIF identifier (DEPRECATED: use naifId instead)")
LongParameter	repFactor (description="HSPOT: number of map repetition")
StringParameter	blue (description="HSPOT: PACS blue filter selection (values blue1 or blue2)")
StringParameter	mapScanAngleRef (description="HSPOT: scan map reference (sky or inst)")

StringParameter	mapScanSpeed (description="HSPOT: scan map rate (high, medium or low)")
StringParameter	source (description="pointing mode: point: single, large: mapping")
DateParameter	odStartTime (description="Operational Day start time")
StringParameter	missionConfiguration (description="Mission Configuration version")
StringParameter	instrumentConfiguration (description="Instrument Configuration")
DateParameter	startTime (description="Start time (DEPRECATED, use startDate instead)")
DateParameter	endTime (description="End time (DEPRECATED, use endDate instead)")
DoubleParameter	BOL_VD_B_1 (description="Bias blue group 1")
BooleanParameter	BOL_VU_B_1 (description="Bias blue Voltage Up group 1")
DoubleParameter	BOL_VD_B_2 (description="Bias blue group 2")
BooleanParameter	BOL_VU_B_2 (description="Bias blue Voltage Up group 2")
DoubleParameter	BOL_VD_B_3 (description="Bias blue group 3")
BooleanParameter	BOL_VU_B_3 (description="Bias blue Voltage Up group 3")
DoubleParameter	BOL_VD_B_4 (description="Bias blue group 4")
BooleanParameter	BOL_VU_B_4 (description="Bias blue Voltage Up group 4")
DoubleParameter	BOL_VD_R_1 (description="Bias red group 1")
BooleanParameter	BOL_VU_R_1 (description="Bias red Voltage Up group 1")
DoubleParameter	BOL_VD_R_2 (description="Bias red group 2")

BooleanParameter	BOL_VU_R_2 (description="Bias red Voltage Up group 2")
DoubleParameter	compVersion (description="PACS compression algorithm version")
DoubleParameter	algoNumber (description="PACS compression algorithm number")
StringParameter	algorithm (description="PACS compression algorithm description")
DoubleParameter	compNumber (description="PACS compression algorithm number")
StringParameter	compMode (description="PACS compression algorithm model")
StringParameter	PACS_PHOT_GAIN (description="Photometer Gain")
StringParameter	PACS_PHOT_MODE (description="Bolometer readout mode")
DoubleParameter	solarAspectAngleMean (description="averaged Solar Aspect Angle", quantity="deg")
DoubleParameter	solarAspectAngleRms (description="standard deviation of the Solar Aspect Angle", quantity="deg")
DoubleParameter	mapScanVelocity (description="Nominal scanning velocity", quantity="arcsec s-1")
StringParameter	processingParams (description="All the observation identifiers, separated by commas, involved in the production of level 2.5/level 3 products")

4.1.1.2. ObservationContext for PACS Line Spectroscopy

Table 4.2. Example of the metadata keywords contained in a PACS Line Spectroscopy observation.

StringParameter	type (description="Product Type Identification")
StringParameter	creator (description="Generator of this product")
DateParameter	creationDate (description="Creation date of this product")

String-Parameter	description (description="Name of this product")
String-Parameter	instrument (description="Instrument attached to this product")
String-Parameter	modelName (description="Model name attached to this product")
DateParameter	startDate (description="Start date of the observation")
DateParameter	endDate (description="End date of the observation")
String-Parameter	formatVersion (description="Version of product format")
String-Parameter	obsState (description="One of CREATED, LEVEL0_PROCESSED, LEVEL0_5_PROCESSED, LEVEL1_PROCESSED, LEVEL2_PROCESSED, LEVEL2_5_PROCESSED, LEVEL3_PROCESSED")
Long-Parameter	obsid (description="Observation Identifier")
Long-Parameter	odNumber (description="Operational Day Number count")
String-Parameter	cusMode (description="CUS observation mode")
String-Parameter	instMode (description="Instrument Mode")
String-Parameter	obsMode (description="Observation mode name")
String-Parameter	processingMode (description="SPG pipeline processing mode selected")
String-Parameter	observer (description="Observer name")
String-Parameter	proposal (description="Proposal name")
String-Parameter	pointingMode (description="Pointing mode")
DateParameter	slewTime (description="Scheduled start time of the slew")
String-Parameter	origin (description="Site that created the product")

StringParameter	aorLabel (description="AOR Label as entered in HSpot")
StringParameter	aot (description="AOT Identifier")
DoubleParameter	equinox (description="Equinox of celestial coordinate system")
StringParameter	missionConfig (description="Mission configuration")
StringParameter	object (description="Target name")
StringParameter	raDeSys (description="Coordinate reference frame for the RA and DEC")
DoubleParameter	pmRA (description="Target's proper motion, RA", quantity="arcsec a-1")
DoubleParameter	pmDEC (description="Target's proper motion, Dec", quantity="arcsec a-1")
DoubleParameter	raNominal (description="Requested Right Ascension of pointing", quantity="deg")
DoubleParameter	decNominal (description="Requested Declination of pointing", quantity="deg")
DoubleParameter	ra (description="Actual Right Ascension of pointing", quantity="deg")
DoubleParameter	dec (description="Actual Declination of pointing", quantity="deg")
DoubleParameter	posAngle (description="Position Angle of pointing", quantity="deg")
StringParameter	telescope (description="Name of telescope")
StringParameter	velocityDefinition (description="The velocity definition and frame")
DoubleParameter	radialVelocity (description="Spacecraft velocity along the l-of-s of the telescope wrt the LSR: v / c = (lambda_rest - lambda) / lambda_rest", quantity="km s-1")
StringParameter	calVersion (description="Version of calibration tree used")

LongParameter	obsRequestId (description="Observation Request Identifier")
LongParameter	obsRequestVersion (description="Observation Request Version")
StringParameter	title (description="Title")
StringParameter	target (description="Target")
StringParameter	targetType (description="Target Type")
StringParameter	subinstrument (description="Sub Instrument")
StringParameter	observingMode (description="Observing mode summary")
LongParameter	overhead (description="Overhead")
LongParameter	tslewmin (description="Minimum slew time")
BooleanParameter	chopNod (description="HSPOT: True for chop/nod, else False")
BooleanParameter	faintLines (description="HSPOT: faint line mode selected")
BooleanParameter	gratScan (description="unchopped range scan observation?")
BooleanParameter	mapRasterAngleRefFrame (description="raster ref. frame aligned w: (T) instrument y-z, (F) sky")
BooleanParameter	refSelected (description="HSPOT: instrument reference frame chosen for the raster")
DoubleParameter	decoff (description="Actual declination of the off position", quantity="deg")
DoubleParameter	lineStep (description="HSPOT: raster line step", quantity="arcsec")
DoubleParameter	pointStep (description="HSPOT: raster column (point) step", quantity="arcsec")

DoubleParameter	raoff (description="RA of the off position for unchopped", quantity="deg")
DoubleParameter	redshiftValue (description="HSPOT: redshift")
LongParameter	mapGratScanOffRep (description="no. raster steps b4 off is visited")
LongParameter	naifid (description="SSO NAIF identifier (DEPRECATED: use naifId instead)")
LongParameter	userNODcycles (description="HSPOT: number of ABBA nod cycle repetitions")
StringParameter	fluxUnit (description="HSPOT: units for the estimated fluxes")
StringParameter	lWave (description="HSPOT: line central wavelengths")
StringParameter	lcontFlux (description="HSPOT: estimated continuum fluxes")
StringParameter	lineFlux (description="HSPOT: estimated line fluxes")
StringParameter	lineId (description="line ID")
StringParameter	lineWidth (description="HSPOT: estimated line widths")
StringParameter	lines (description="HSPOT: description of observed lines")
StringParameter	orderSel (description="HSPOT: blue band (order2: 50-70um, order3: 70-100um)")
StringParameter	redshiftType (description="HSPOT: redshift type: redshift or optical")
StringParameter	repeatLine (description="HSPOT: line scan repetitions")
StringParameter	source (description="pointing mode: point: single, large: mapping")
StringParameter	widthUnit (description="HSPOT: units for the estimated line widths")

DateParameter	odStartTime (description="Operational Day start time")
StringParameter	missionConfiguration (description="Mission Configuration version")
StringParameter	instrumentConfiguration (description="Instrument Configuration")
DateParameter	startTime (description="Start time (DEPRECATED, use startDate instead)")
DateParameter	endTime (description="End time (DEPRECATED, use endDate instead)")
DoubleParameter	compVersion (description="PACS compression algorithm version")
DoubleParameter	algoNumber (description="PACS compression algorithm number")
StringParameter	algorithm (description="PACS compression algorithm description")
DoubleParameter	compNumber (description="PACS compression algorithm number")
StringParameter	compMode (description="PACS compression algorithm model")
LongParameter	numSpecLines (description="Number of spectral lines")
StringParameter	Line1 (description="spectral line/range: wavelength, reps, id")
LongParameter	numRasterCol (description="HSPOT: no. raster cols: valid for rasters")
LongParameter	numRasterLines (description="HSPOT: no. raster lines: valid for rasters")
DoubleParameter	solarAspectAngleMean (description="averaged Solar Aspect Angle", quantity="deg")
DoubleParameter	solarAspectAngleRms (description="standard deviation of the Solar Aspect Angle", quantity="deg")
StringParameter	StartingTime (description="HSPOT: start time of the observation")
DoubleParameter	duration (description="HSPOT: Total duration of the observation", quantity="s")

DoublePa-rameter	rangeLow1 (description="Lower wavelength end of range scanned", quantity="micrometer")
DoublePa-rameter	rangeHigh1 (description="High wavelength end of range scanned", quantity="micrometer")
DoublePa-rameter	rangeLow2 (description="Lower wavelength end of range scanned", quantity="micrometer")
DoublePa-rameter	rangeHigh2 (description="High wavelength end of range scanned", quantity="micrometer")
Boolean-Param-eter	containsB2AData (description="At least 1 line/range has been observed in band B2A")
Boolean-Param-eter	containsB2BData (description="At least 1 line/range has been observed in band B2B")
Boolean-Param-eter	containsB3AData (description="At least 1 line/range has been observed in band B3A")

4.1.1.3. ObservationContext for PACS Range Spectroscopy

Table 4.3. Example of the metadata keywords contained in a PACS Range Spectroscopy observation.

String-Param-eter	type (description="Product Type Identification")
String-Param-eter	creator (description="Generator of this product")
DatePa-rameter	creationDate (description="Creation date of this product")
String-Param-eter	description (description="Name of this product")
String-Param-eter	instrument (description="Instrument attached to this product")
String-Param-eter	modelName (description="Model name attached to this product")
DatePa-rameter	startDate (description="Start date of the observation")
DatePa-rameter	endDate (description="End date of the observation")
String-Param-eter	formatVersion (description="Version of product format")

StringParameter	obsState (description="One of CREATED, LEVEL0_PROCESSED, LEVEL0_5_PROCESSED, LEVEL1_PROCESSED, LEVEL2_PROCESSED, LEVEL2_5_PROCESSED, LEVEL3_PROCESSED")
LongParameter	obsid (description="Observation Identifier")
LongParameter	odNumber (description="Operational Day Number count")
StringParameter	cusMode (description="CUS observation mode")
StringParameter	instMode (description="Instrument Mode")
StringParameter	obsMode (description="Observation mode name")
StringParameter	processingMode (description="Processing mode selected to execute the pipeline")
StringParameter	OnOffPosition (description="Entire product: ON-src, OFF-src, Undefined")
StringParameter	observer (description="Observer name")
StringParameter	proposal (description="Proposal name")
StringParameter	pointingMode (description="Pointing mode")
DateParameter	slewTime (description="Scheduled start time of the slew")
StringParameter	origin (description="Site that created the product")
StringParameter	aorLabel (description="AOR Label as entered in HSpot")
StringParameter	aot (description="AOT Identifier")
DoubleParameter	equinox (description="Equinox of celestial coordinate system")
StringParameter	missionConfig (description="Mission configuration")

StringParameter	object (description="Target name")
StringParameter	raDeSys (description="Coordinate reference frame for the RA and DEC")
DoubleParameter	pmRA (description="Target's proper motion, RA", quantity="arcsec a-1")
DoubleParameter	pmDEC (description="Target's proper motion, Dec", quantity="arcsec a-1")
DoubleParameter	raNominal (description="Requested Right Ascension of pointing", quantity="deg")
DoubleParameter	decNominal (description="Requested Declination of pointing", quantity="deg")
DoubleParameter	ra (description="Actual Right Ascension of pointing", quantity="deg")
DoubleParameter	dec (description="Actual Declination of pointing", quantity="deg")
DoubleParameter	posAngle (description="Position Angle of pointing", quantity="deg")
StringParameter	telescope (description="Name of telescope")
StringParameter	velocityDefinition (description="The velocity definition and frame")
DoubleParameter	radialVelocity (description="Spacecraft velocity along the l-of-s of the telescope wrt the LSR: v / c = (lambda_rest - lambda) / lambda_rest", quantity="km s-1")
StringParameter	calVersion (description="Version of calibration tree used")
LongParameter	obsRequestId (description="Observation Request Identifier")
LongParameter	obsRequestVersion (description="Observation Request Version")
StringParameter	title (description="Title")
StringParameter	target (description="Target")

String-Parameter	targetType (description="Target Type")
String-Parameter	subinstrument (description="Sub Instrument")
String-Parameter	observingMode (description="Observing mode summary")
Long-Parameter	overhead (description="Overhead")
Long-Parameter	tslewmin (description="Minimum slew time")
Boolean-Parameter	chopNod (description="HSPOT: True for chop/nod, else False")
Boolean-Parameter	gratScan (description="unchopped range scan observation?")
Boolean-Parameter	mapRasterAngleRefFrame (description="raster ref. frame aligned w: (T) instrument y-z, (F) sky")
Boolean-Parameter	refSelected (description="HSPOT: instrument reference frame chosen for the raster")
DoubleParameter	decoff (description="Actual declination of the off position", quantity="deg")
DoubleParameter	lineStep (description="HSPOT: raster line step", quantity="arcsec")
DoubleParameter	pointStep (description="HSPOT: raster column (point) step", quantity="arcsec")
DoubleParameter	raoff (description="RA of the off position for unchopped", quantity="deg")
Long-Parameter	naifid (description="SSO NAIF identifier (DEPRECATED: use naifId instead)")
Long-Parameter	userNODcycles (description="HSPOT: number of ABBA nod cycle repetitions")
String-Parameter	bluWave (description="HSPOT: blue limits for all ranges")
String-Parameter	density (description="HSPOT: wavelength sampling (nyquist/high)")

StringParameter	lcontFlux (description="HSPOT: estimated continuum fluxes")
StringParameter	lineFlux (description="HSPOT: estimated line fluxes")
StringParameter	lineWidth (description="HSPOT: estimated line widths")
StringParameter	orderSel (description="HSPOT: blue band (order2: 50-70um, order3: 70-100um)")
StringParameter	rangeId (description="HSPOT: wavelength range identifiers")
StringParameter	rangeSPOT (description="HSPOT: description of lines")
StringParameter	redWave (description="HSPOT: red limits for all ranges")
StringParameter	refWave (description="HSPOT: reference wavelengths for all ranges")
StringParameter	repeatRange (description="HSPOT: repetition factors for all ranges")
StringParameter	source (description="pointing mode: point: single, large: mapping")
StringParameter	widthUnit (description="HSPOT: units for the estimated line widths")
DateParameter	odStartTime (description="Operational Day start time")
StringParameter	missionConfiguration (description="Mission Configuration version")
StringParameter	instrumentConfiguration (description="Instrument Configuration")
DateParameter	startTime (description="Start time (DEPRECATED, use startDate instead)")
DateParameter	endTime (description="End time (DEPRECATED, use endDate instead)")
DoubleParameter	compVersion (description="PACS compression algorithm version")
DoubleParameter	algoNumber (description="PACS compression algorithm number")

StringParameter	algorithm (description="PACS compression algorithm description")
DoubleParameter	compNumber (description="PACS compression algorithm number")
StringParameter	compMode (description="PACS compression algorithm model")
LongParameter	numSpecLines (description="Number of spectral lines")
StringParameter	Line1 (description="spectral line/range: wavelength, reps, id")
LongParameter	numRasterCol (description="HSPOT: no. raster cols: valid for rasters")
LongParameter	numRasterLines (description="HSPOT: no. raster lines: valid for rasters")
DoubleParameter	solarAspectAngleMean (description="averaged Solar Aspect Angle", quantity="deg")
DoubleParameter	solarAspectAngleRms (description="standard deviation of the Solar Aspect Angle", quantity="deg")
StringParameter	StartingTime (description="start time of the observation")
DoubleParameter	duration (description="Total duration of the observation in seconds", quantity="s")
DoubleParameter	rangeLow1 (description="Lower wavelength end of range scanned", quantity="micrometer")
DoubleParameter	rangeHigh1 (description="High wavelength end of range scanned", quantity="micrometer")
DoubleParameter	rangeLow2 (description="Lower wavelength end of range scanned", quantity="micrometer")
DoubleParameter	rangeHigh2 (description="High wavelength end of range scanned", quantity="micrometer")
BooleanParameter	containsB2AData (description="At least 1 line/range has been observed in band B2A")
BooleanParameter	containsB2BData (description="At least 1 line/range has been observed in band B2B")

Boolean-Parameter	containsB3AData (description="At least 1 line/range has been observed in band B3A")
String-Parameter	processingParams (description="All the observation identifiers, separated by commas, involved in the production of level 2.5/level 3 products")
String-Parameter	ConcatenatedOBSIDs (description="AORs concatenated with this obs in HSPOT")

4.1.2. PACS photometry level-0 context

The PACS photometry level-0 context is called Herschel-PACS Photometer Timeline (type HPPT). It contains contexts products respectively associated with the timelines of the averaged bolometer signals, associated mechanism positions, detector timing information, selected housekeeping parameter measures and engineering products to monitor the health of the instrument and assess the proper execution of the observation. Each context product contains a number of products or "slices". Slices are defined such that the data does not cross building block boundaries, and the resulting product does not exceed a certain size limit. The structure of HPPT is as follows (the product "type" is given in brackets):

Product description	**Product type**
Herschel-PACS Photometry Timeline - Level 0 Context	HPPT
Photometry Averaged Blue Context	HPPAVGB
Photometry Averaged Blue Slice	HPPAVGBS
Photometry Averaged Red Context	HPPAVGR
Photometry Averaged Red Slice	HPPAVGRS
Photometry raw DecMec status Blue Context	HPPDMCB
Photometry raw DecMec status Blue Slice	HPPDMCBS
Photometry raw DecMec status Red Context	HPPDMCR
Photometry raw DecMec status Red Slice	HPPDMCRS
Photometry Nominal Housekeeping Context	HPPHK
Photometry Housekeeping Slice	HPPHKS
General Housekeeping Context	HPGENHK
General Housekeeping Slice	HPGENHKS
Engineering Context	HPENG
Telecommand verification Slice	HPTCVERS
Telecommand history Slice	HPTCHISTS
Event Slice	HPEVENTS
TM Packet Report	HPTM_PACKET_REPORT
	HPTIME_VERIFICATION
	HPOBCP_STATUS
	HPOBCP_LIST
	HPMEMORY_DUMP
	HPMEMORY_CRC
	HPLINK_CONNECTION

Product description	Product type
	HPACT_OBCP_LIST

4.1.3. PACS photometry level-0.5 context

The following level-0.5 products are under definition for the PACS photometry AOTs. Slices are defined such that the data does not cross building block boundaries, and the resulting product does not exceed a certain size limit.

Product description	Product type
PACS Photometry - level-0.5 Context	HPPT
Photometry level-0.5 Frames Blue Bolometer Context	HPPAVGB
Photometry level-0.5 Frames Blue Slice	HPPAVGBS
Photometry level-0.5 Frames Red Bolometer Context	HPPAVGR
Photometry level-0.5 Frames Red Slice	HPPAVGRS

4.1.4. PACS photometry level-1 context

The following level-1 products are under definition for the PACS photometry AOTs. Slices are defined such that the data does not cross building block boundaries, and the resulting product does not exceed a certain size limit.

Product description	Product type
PACS Photometry - level-1 Context	HPPT
Photometry level-1 Frames Blue Bolometer Context	HPPAVGB
Photometry level-1 Frames Blue Slice	HPPAVGBS
Photometry level-1 Frames Red Bolometer Context	HPPAVGR
Photometry level-1 Frames Red Slice	HPPAVGRS

4.1.5. PACS photometry level-2 context

4.1.5.1. PACS photometry point source level-2 context

Product description	Product type
PACS Photometer - level-2 context	HPPT
Photometer Point Source Product Blue Bolometer Context	HPPDMAPB
Photometer Point Source Product Blue Bolometer Slice	HPPDMAPBS
Photometer Point Source Product Red Bolometer Context	HPPDMAPR
PACS Photometer Point Source Product Red Bolometer Slice	HPPDMAPRS
Photometer Point Source Product Blue Bolometer with Astrometry Context	HPPPMAPB
Photometer Point Source Product Blue Bolometer with Astrometry Slice	HPPPMAPBS
Photometer Point Source Product Red Bolometer with Astrometry Context	HPPPMAPR
Photometer Point Source Product Red Bolometer with Astrometry Slice	HPPPMAPRS

4.1.5.2. PACS photometry scan map level-2 context

Product description	Product type
PACS Photometer - level-2 context	HPPT
Photometer Naive Map Blue Bolometer Context	HPPNMAPB
Photometer Naive Map Blue Bolometer Slice	HPPNMAPBS
Photometer Naive Map Red Bolometer Context	HPPNMAPR
Photometer Naive Map Red Bolometer Slice	HPPNMAPRS
Photometer PhotProject MAP Blue Bolometer Context	HPPPMAPB
Photometer PhotProject MAP Blue Bolometer Slice	HPPPMAPBS
Photometer PhotProject MAP Red Bolometer Context	HPPPMAPR
Photometer PhotProject MAP Red Bolometer Slice	HPPPMAPRS

HPPNMAPB & HPPNMAPR contain the averaged signal map after pixel-to-pixel offset correction.

HPPPMAPB and HPPPMAPB are products of the type `SimpleImage` and consist in 5 datasets: `image`, `coverage`, `stDev`, `HPFmask` and `error` . These products are created by the high-pass filtered `photProject` pipeline, i.e., a simple projection of each frames, after running a temporal high-pass filter with a width of n=20 (i.e subtracting a median with a width of 2*n+1 frames) This allows to filter out a significant part of the 1/f noise at the expense of removing completely ALL spatial scales larger than this width (i.e., typically larger than 1 arcmin), and creating negative undershooting around bright sources along the scan direction. The dataset 'image' carries the scientific map, the dataset 'coverage' provides a measurement of the amount of data that falls onto one spatial pixel of the final map, the dataset 'HPFmask' is a mask of the sky regions where the high-pass filter is not applied, which corresponds to the source positions on the map, the dataset 'stDev' is the standard deviation map of the flux computed in the sky pixels and it provides a measurement of the noise in each pixel, the dataset 'error' provides the error map obtained by using the `photCoverage2Noise` task.

Note

All MadMap products have been removed from the Standard Product Generation (SPG) pipeline. This means that they will not be available in the archive.

4.1.6. PACS photometry level-2.5 context

Product description	Product type
PACS Photometer - level-2.5 context	HPPT
Artifact Corrected MadMap Blue Map	HPPCORMAPB
Artifact Corrected MadMap Blue Map Slice	HPPCORMAPBS
Artifact Corrected MadMap Red Map	HPPCORMAPR
Artifact Corrected MadMap Red Map Slice	HPPCORMAPRS
MadMap Blue Map	HPPMADMAPB
MadMap Blue Map Slice	HPPMADMAPBS
MadMap Red Map	HPPMADMAPR
MadMap Red Map Slice	HPPMADMAPRS
Naïve MadMap Blue Map	HPPNAVMAPB
Naïve MadMap Blue Map Slice	HPPNAVMAPBS
Naïve MadMap Blue Red	HPPNAVMAPR
Naïve MadMap Blue Red Slice	HPPNAVMAPRS
High Pass Filtered photProject Blue Map	HPPHPFMAPB

Product description	Product type
High Pass Filtered photProject Blue Map Slice	HPPHPFMAPBS
High Pass Filtered photProject Red Map	HPPHPFMAPR
High Pass Filtered photProject Red Map Slice	HPPHPFMAPRS
JScanam Blue Map	HPPJSMAPB
JScanam Blue Map Slice	HPPJSMAPBS
JScanam Red Map	HPPJSMAPR
JScanam Red Map Slice	HPPJSMAPRS
Unimap Blue Map	HPPUNIMAPB
Unimap Blue Map Slice	HPPUNIMAPBS
Unimap Red Map	HPPUNIMAPR
Unimap Red Map Slice	HPPUNIMAPRS

The PACS Photometer Level 2.5 context contains maps produced by using the JScanam, Unimap and photProject mappers, obtained by combining the scan and cross-scan AORs. The Level 2.5 products are of the type `SimpleImage` and consist of a dataset that contains the scientific map ('image' layer), the coverage map ('coverage' layer), plus other datasets provided for the specific mapmaker. HPPHPFMAPB and HPPHPFMAPR consist in 4 datasets: image, coverage, error and stdDev. They are the combinations, by using the Mosaic task, of the Level2 observations generated with the high-pass filtered `photProject` pipeline. HPPJSMAPB and HPPJSMAPR consist in 3 datasets: image, coverage and stdDev. These products are generated by using the JScanam pipeline, an HIPE implementation of the 'destriper' mapmaker Scanamorphos. The dataset 'stDev' is the standard deviation map of the flux computed in the sky pixels and it provides a measurement of the noise in each pixel. HPPUNIMAPB and HPPUNIMAPR consist in 6 datasets: image, stdDev, coverage, pgls, gls and naive. These products are generated by using the Generalized Least Square mapmaker Unimap. The dataset 'image' carries the Weighted-GLS map, generally assumed as the most reliable scientific map, the datasets 'pgls', 'gls' and 'naive' are the Post-GLS, the GLS and the Naïve map, respectively, and the dataset 'stdDev' the standard deviation map computed at every sky pixel with respect to the samples that are falling on it, that can be properly assumed as the error map only if associated to the Naïve map.

4.1.7. PACS photometry level-3 context

Product description	Product type
PACS Photometry - level-3 Context	HPPT
Photometry level-3 JScanam Red Mosaic Map Context	HPPJSMAPR
Photometry level-3 JScanam Red Mosaic Map Context Slice	HPPJSMAPRS
Photometry level-3 JScanam Blue Mosaic Map Context	HPPJSMAPB
Photometry level-3 JScanam Blue Mosaic Map Context Slice	HPPJSMAPBS
Photometry level-3 Unimap Red Mosaic Map Context	HPPUNIMAPR
Photometry level-3 Unimap Red Mosaic Map Context Slice	HPPUNIMAPRS
Photometry level-3 Unimap Blue Mosaic Map Context	HPPUNIMAPB
Photometry level-3 Unimap Blue Mosaic Map Context Slice	HPPUNIMAPBS

The PACS level-3 photometric context contains map generated with the Mosaic task, which combines Level2.5 Unimap and Jscanam overlapping maps, on a given field and belonging to the same observing programme.

4.1.8. PACS spectroscopy level-0 context

The PACS spectroscopy level-0 context is called Herschel-PACS Spectrometer Timeline (HPST).It contains It contains contexts products respectively associated with a timeline of the averaged integration ramps, associated mechanism positions, detector timing information, selected housekeeping parameter measures and engineering products to monitor the health of the instrument and assess the proper execution of the observation. These contexts contain a number of products or "slices". Slices are defined such that the data does not cross building block boundaries, and the resulting product does not exceed a configured size limit. The HPST structure is as follows (the product "type" is given in brackets):

Product description	**Product type**
Herschel-PACS Spectroscopy Timeline - Level 0 Context	HPST
Spectroscopy Raw Blue Context	HPSRAWB
Spectroscopy Raw Blue Slice	HPSRAWBS
Spectroscopy Raw Red Context	HPSRAWR
Spectroscopy Raw Red Slice	HPSRAWRS
Spectroscopy Slope fitted Blue Context	HPSFITB
Spectroscopy Slope fitted Blue Slice	HPSFITBS
Spectroscopy Slope fitted Red Context	HPSFITR
Spectroscopy Slope fitted Red Slice	HPSFITRS
Spectroscopy raw DecMec status Blue Context	HPSDMCB
Spectroscopy raw DecMec status Blue Slice	HPSDMCBS
Spectroscopy raw DecMec status Red Context	HPSDMCR
Spectroscopy raw DecMec status Red Slice	HPSDMCRS
Spectroscopy Nominal Housekeeping Context	HPSHK
Spectroscopy Housekeeping Slice	HPSHKS
General Housekeeping Context	HPGENHK
General Housekeeping Slice	HPGENHKS
Diagnostic Housekeeping Context	HPDIAGHK
Diagnostic Housekeeping Slice	HPDIAGHKS
Engineering Context	HPENG
Telecommand verification Slice	HPTCVERS
Telecommand history Slice	HPTCHISTS
Event Slice	HPEVENTS
TM Packet Report	HPTM_PACKET_REPORT
	HPTIME_VERIFICATION
	HPOBCP_STATUS
	HPOBCP_LIST
	HPMEMORY_DUMP
	HPMEMORY_CRC
	HPLINK_CONNECTION
	HPACT_OBCP_LIST
OGSE housekeeping Context	HPOGSEHK
PACS OGSE housekeeping Slice	HPOGSEHKS

Product description	Product type
CDMS simulator context	HPCDMS
PACS CDMS simulator slice	HPCDMSS

4.1.9. PACS spectroscopy level-0.5 products

Product description	Product type
PACS Spectroscopy level-0.5 context	
Spectroscopy Slope fitted Blue Context	HPSFITB
Spectroscopy Slope fitted Blue Slice	HPSFITBS
Spectroscopy Slope fitted Red Context	HPSFITR
Spectroscopy Slope fitted Red Slice	HPSFITRS

4.1.10. PACS spectroscopy level-1 products

Product description	Product type
PACS Spectroscopy level-1 context	
PACS Spectral Cube Blue	HPS3DB
PACS Spectral Cube Blue Slice	HPS3DBS
PACS Spectral Cube Red	HPS3DR
PACS Spectral Cube Red Slice	HPS3DRS
Absolute pixel response and dark current Blue	HPSCALB
Absolute pixel response and dark current Blue Slice	HPS3CALBS
Absolute pixel response and dark current Red	HPSCALR
Absolute pixel response and dark current Red Slice	HPS3CALRS
Spectroscopy Slope fitted Blue Context	HPSFITB
Spectroscopy Slope fitted Blue Slice	HPSFITBS
Spectroscopy Slope fitted Red Context	HPSFITR
Spectroscopy Slope fitted Red Co	HPSFITRS

4.1.11. PACS spectroscopy level-2 products

Product description	Product type
PACS Spectroscopy level-2 context	
Pacs Spectroscopy 3D Projected Blue	HPS3DPB
Pacs Spectroscopy 3D Projected Blue Slice	HPS3DPBS
Pacs Spectroscopy 3D Projected Red	HPS3DPR
Pacs Spectroscopy 3D Projected Red Slice	HPS3DPRS
Pacs Spectroscopy 3D Rebinned Blue	HPS3DRB
Pacs Spectroscopy 3D Rebinned Blue Slice	HPS3DRBS
Pacs Spectroscopy 3D Rebinned Red	HPS3DRR
Pacs Spectroscopy 3D Rebinned Red Slice	HPS3DRRS
Pacs Spectroscopy 3D Drizzled Blue	HPS3DDB
Pacs Spectroscopy 3D Drizzled Blue Slice	HPS3DDBS

Product description	Product type
Pacs Spectroscopy 3D Drizzled Red	HPS3DDR
Pacs Spectroscopy 3D Drizzled Red Slice	HPS3DDRS
Pacs Spectroscopy 3D Interpolated Blue	HPS3DIB
Pacs Spectroscopy 3D Interpolated Blue Slice	HPS3DIBS
Pacs Spectroscopy 3D Interpolated Red	HPS3DIR
Pacs Spectroscopy 3D Interpolated Red Slice	HPS3DIRS
Pacs Spectroscopy 3D Equidistant Projected Blue	HPS3DEQPB
Pacs Spectroscopy 3D Equidistant Projected Blue Slice	HPS3DEQPBS
Pacs Spectroscopy 3D Equidistant Projected Red	HPS3DEQPR
Pacs Spectroscopy 3D Equidistant Projected Red Slice	HPS3DEQPRS
Pacs Spectroscopy 3D Equidistant Interpolated Blue	HPS3DEQIB
Pacs Spectroscopy 3D Equidistant Interpolated Blue Slice	HPS3DEQIBS
Pacs Spectroscopy 3D Equidistant Interpolated Red	HPS3DEQIR
Pacs Spectroscopy 3D Equidistant Interpolated Red Slice	HPS3DEQIRS
Pacs Spectroscopy 3D Equidistant Drizzled Blue	HPS3DEQDB
Pacs Spectroscopy 3D Equidistant Drizzled Blue Slice	HPS3DEQDBS
Pacs Spectroscopy 3D Equidistant Drizzled Red	HPS3DEQDR
Pacs Spectroscopy 3D Equidistant Drizzled Red Slice	HPS3DEQDRS
Pacs Spectroscopy 3D Equidistant Drizzled Blue Slice	HPS3DEQDBS
Pacs Spectroscopy 1D Spectrum Context Blue	HPSSPECB
Pacs Spectroscopy 1D Spectrum Context Blue Slice	HPS3DEQDBS
Pacs Spectroscopy 1D Spectrum Context Red	HPSSPECR
Pacs Spectroscopy 1D Spectrum Context Red Slice	HPS3DEQDRS
Pacs Spectroscopy Rebinned Cube as Table Blue	HPSTBRB
Pacs Spectroscopy Rebinned Cube as Table Blue Slice	HPSTBRBS
Pacs Spectroscopy Rebinned Cube as Table Red	HPSTBRR
Pacs Spectroscopy Rebinned Cube as Table Red Slice	HPSTBRRS

HPS3DPB and HPS3DPR are products of type SpectralSimpleCube and consist of five datasets: image, coverage, error, ImageIndex and History. The dataset "ImageIndex" contains the wavelength values. The dataset "image" carries the scientific data, signal and fluxes, created by the specProject pipeline task. This task projects a rebinned cube (the HPS3DR product) onto a regular RA/Dec grid on the sky. The grid size (corners) are determined by the task using the RA and Dec information from the rebinned cube, the output pixel size (dx,dy) is the default 3 arcseconds for standard products. In this projected cube the number of bins and resolution in the wavelength domain do not change, the cube size is lambda x N x M, where "N" and "M" mean the resampled grid size. In case of mapping observations, "specProject" loops over all raster positions and combine rasters into a single grid by adding up for each spaxel the fluxes of the contributing spaxels multiplied by their overlap weights. The cube flux values are in Jy/pixel units, the wavelength is in microns.

HPS3DRB and HPS3DRR are products of type `PacsRebinnedCube` and consist of nine datasets: image, ra, dec, qualityControl, stddev, exposure, flag, waveGrid, History and ImageIndex. The dataset 'image' carries the scientific data created by the "specWaveRebin" pipeline task. This task constructs the lambda x 5 x 5 size IFU cube which is in general the 25 spatial pixels (spaxels) of the PACS spectrometer over the full depth of the observed wavelength range. Note that each spaxel is fed by 16

pixels. Samples from the 16 spectral pixels are rebinned in a grid which is dependent on the actual wavelengths and the oversampling/upsampling factors. The oversample factor is used to increase the number of wavelength bins by the formula bins*oversample, where the number of bins is based on the theoretical resolution of your observation. The upsample factor specifies how many shifts per wavelength bin to make while rebinning. Standard products are generated with oversample=2 and upsample=3 values. The cube flux values are in Jy/pixel units, the wavelength is in microns. In case the observation consists of several spectral ranges and/or raster positions then the product is sliced into datasets of logical blocks. Such a block contains a single spectral range for a single raster position.

The pipeline-produced cubes from PACS do not have a wavelength grid that is equidistant, i.e. the bins-sizes of the spectral grid are not equal at every wavelength, but rather they scale with resolution, which in turn scales with wavelength. This was done so that even for spectra which cover the entire SED of PACS (50—220µm) a Nyquist (or better) spectral sampling is achieved at all wavelengths. This means that the spectral grid is not defined via the third axis of the World Coordinate System (WCS), i.e. we do not have values for the reference wavelength and dispersion in axis 3. Instead, the wavelength grid is contained as a dataset in the cubes. Unfortunately, this can make it cumbersome to load PACS cubes into software other than HIPE and for their spectral grid to be immediately recognised. To combat this, we have created cubes with an equidistant wavelength grid. These can be found in the `ObservationContext`s processed by SPG 13, and they are also one of the a standalone browse products that are now provided via the HSA. These equidistant cubes are created from the final pipeline Level 2/2.5 cubes:

- For Nyquist and oversampled mapping line scan observations: from the drizzled cubes (HPS3DEQD[R|B])
- For Nyquist and oversampled mapping range scan observations: from the projected cubes (HPS3DEQP[R|B])
- For all other observations (pointed and undersampled mapping, line and range scan): from the interpolated cubes (HPS3DEQI[R|B])

HPS3DDB and HPS3DDR are drizzled cubes created by the `drizzle` pipeline task that appear in Nyquist and oversampled mapping observations.

HPS3DIB and HPS3DIR are interpolated cubes created by the `specInterpolate` pipeline task and appear in pointed observations and undersampled maps. Interpolated cubes always have a spaxel size of 4.7".

HPS3TBRB and HPS3TBRR contain all the information that is in the rebinned cubes (the fluxes, errors, positions, etc) but in a tabular format.

For more information about the higher level PACS spectroscopy products, please refer to the Spectroscopy section of the PACS Products Explained manual (PPE).

4.1.12. PACS spectroscopy level-2.5

Product description	Product type
PACS Spectroscopy level-2.5 context	
Pacs Spectroscopy 1D Spectrum Context Blue	HPSSPECB
Pacs Spectroscopy 1D Spectrum Context Red	HPSSPECR

There is a product in Level 2.5 for the subset of unchopped, rangeScan observations. This table, HPSSPEC[R|B], contains the extracted spectrum of the central spaxel, and the point source calibrated spectra "c1" and "c129" from the pipeline task extractCentralSpectrum. Since the point-source calibrated spectra are taken from the centre of the cube, it is necessary that the source is located within spaxel 2,2 (the central one). However, we make no determination that the target of the observation actually is a point source - that is up to the end-user to establish. These tables are also provided as standalone browse products.

4.1.13. PACS spectroscopy level-3

Product description	Product type
PACS Spectroscopy level-3 context	
Pacs Spectroscopy 1D Spectrum Context	HPSSPEC

The spectrum tables from Level 2 for the pointed, chopNod, full SED observations, are concatenated into a single table which is placed in Level 3. This table, HPSSPEC, contains the extracted spectra for all the observations that were taken to cover the full spectral range (the full SED) of PACS for that target (this will be usually two, sometimes three, separate observations). Moreover, the red and blue camera, and all slices, are included this single table. This table is also provided as a standalone browse product.

4.2. PACS calibration products

4.2.1. PACS Common Calibration Products

Product type	Description
PacsCalCommon	*PACS Common Calibration Context*
ChopperAngle	Relation between the digital field plate readout and physical angle of the chopper mirror with respect to the PACS focal plane unit.
ChopperAngleRedundant	Relation between the digital field plate readout and physical angle of the redundant chopper mirror with respect to the PACS focal plane unit.
ChopperSkyAngle	Conversion factor for chopper physical deflection angle with respect to the focal plane unit to angle on the sky.
ChopperJitterThreshold	Thresholds in arcmins for the required position accuracy of the final chopper positions for the science and calibration window. This product is used to determine if detector signals are on a stable chopper plateau.
CsResistanceTemperature	Temperature - Resistance conversion table for the internal calibration
FilterWheel2Band	Conversion of filter wheel position to photometer or spectrometer band seen by the detectors.
ObcpDescription	Contains human-readable descriptions of the on-board control procedure on-board numbering scheme.
Siam	Spacecraft-instrument alignment matrices for the different PACS virtual apertures.
TimeDependency	Defines time dependency for calibration products.

4.2.2. PACS Photometer Calibration products

Product type	Description
PacsCalPhot	*PACS Photometer Calibration Context*
Absorption	Transmission as a function of wavelength for the entire photometer chain system
ArrayInstrument	Photometer detector array to Instrument alignment.

Product type	Description
BadPixelMask	Bad pixels mask for the photometer.
CalSources	Flux per pixel from the Calibration Sources in the blue and red channel.
ClSaturationLimits	CL saturation limits.
ClTransferFunction	SurfCal_20061120 calibration VRL-VH_BLIND for saturation limits computation.
CorrZeroLevel	Zero-level of the bolometer arrays.
CrosstalkMatrix	Crosstalk matrices for the red and blue photometer.
DetectorSortMatrix	Mapping PACS SPU-internal detector number to pixel coordinate in the PACS focal-plane.
DiffCS	Calibration Source 1-Calibration Source 2 used as reference.
FilterTransmission	Measured filter transmission profiles for the different bandpass and order selection filters in the PACS spectrometer and photometer chain.
FlatField	Pixel-to-pixel response variation for the PACS bolometer arrays.
Gain	Digits to Volts conversion of the bolometer signals.
Invntt	Inverse noise to noise correlation for MadMap.
InvnttBL	Blue Long band inverse noise to noise correlation for MadMap.
InvnttBS	Blue Short band inverse noise to noise correlation for MadMap.
InvnttRED	RED band inverse noise to noise correlation for MadMap.
Masks	PACS blue and red channel bad pixel map.
NoisePerPixel	Noise for each pixel to populate the starting values in the noise cube.
PhotometricStabilityThreshold	Thresholds used to raised an alert on bad photometric stability.
Responsivity	Responsivity for bolometer.
SatLimits	Saturation limits for the bolometer arrays.
SubArrayArray	Alignment of the different photometer sub-matrices with respect to the entire detector array.
TimeDependency	Defines time dependency for calibration products.

4.2.3. PACS Spectrometer Calibration Products

Product type	Description
PacsCalSpec	*PACS Spectrometer Calibration Context*
AbsoluteCapacitance	Contains the measured capacitances for the red and blue array.
ArrayInstrument	Array to Instrument coordinate conversion
BadPixelMask	Bad pixels mask for PACS spectrometer.
CalSourceFlux	Contains the fluxes in Jy of both calibration sources.
CapacitanceRatios	Contains the capacitance ratios for the red and the blue array
ChopperThrowDescription	Defines the chopper position readout versus a verbal description.
CrosstalkMatrix	Crosstalk matrices for the red and blue spectrometer arrays.
DarkCurrent	Dark current [V/s] for PACS spectrometer blue and red arrays.

Product type	Description
DetectorSortMatrix	Mapping PACS Signal Processing Unit-internal detector number to pixel coordinate in the PACS focal-plane.
DiscardRampHooks	Specifies the number of readouts to discard at the start of each photoconductor integration ramp.
EffectiveCapacitance	The effective capacitance of the 4 possible commandable capacitances of the spectrometer detector integrating readout circuits.
FilterBandConversion	Defines the wheel position readout to band conversion
GprHall	Grating position versus Hall sensors readback. This conversion is used in the degraded operating mode of the grating, in case of contingent functioning of the inductosyn position readout.
GprHallRedundant	Defines the redundant grating position versus Hall sensors readback.
GratingJitterThreshold	Thresholds in position readouts for the required accuracy of a stable grating position. These are used to determine the start and end of long grating slews.
KeyWavelengths	Lists the key wavelength intervals - these are wavelength ranges at which the internal calibration sources are visited inside the AOT, as well as sky calibration sources during dedicated absolute flux calibration measurements. The absolute flux of every PACS spectrum is tied to external flux calibrators via observations at these wavelengths.
LabelDescription	The status of PACS mechanisms and detector readout timing is sampled at the detector readout frequency and encoded in a label. This calibration table contains the definition of this encoding.
LittrowParameters	Parameters for the littrow equation describing the PACS grating position to wavelength calibration. The present version assumes the same calibration for all spatial pixels; in future versions this calibration will be available for every spatial pixel.
LittrowPolynomes	Grating wavelength calibration: Littrow equation parameters/polynome approximation for alpha per pixel
ModuleArray	Module to Array coordinate conversion calibration object
NoisyPixelMask	Noisy pixels mask for PACS spectrometer.
NominalResponse	Contains the nominal responses in V/s/Jy per prime key wavelength.
NonLinearity	Contains coefficient of second order polynomial to linearise signals for the red and blue array
Psf	Point spread function of the spectrometer.
RampModel	Fixed parameters of the IMEC institute analytical model for the spectrometer integrating ramps.
RampSatLimits	Signal saturation limits (voltage/digits) for the red and blue channel.
Readouts2Volts	Digits to Volts conversion for the spectrometer readout values.
RelCalSourceFlux	Contains the flux ratios of both calibration sources at key wavelengths to prime key wavelengths.
RsrfB2A	Relative Spectral Response Function - wavelength-dependent response per pixel for band B2A
RsrfB2B	Relative Spectral Response Function - wavelength-dependent response per pixel for band B2B
RsrfB3A	Relative Spectral Response Function - wavelength-dependent response per pixel for band B3A

Product type	Description
RsrfR1	Relative Spectral Response Function - wavelength-dependent response per pixel for band R1
Sensitivity	Contains the line and continuum RMS noise fluctuations for 1 second integration time
SignalSatLimits	Saturation limits of the spectrometer detector arrays
SpecProperties	Spectrometer constants to calculate spectral resolution vs. wavelength
TelescopeBackground	SED of the telescope background
TimeDependency	Defines time dependency for calibration products.
wavelengthGrid	PACS spectrometer wavelength grid for the three grating orders and for different upsamples

Chapter 5. SPIRE Products Description

5.1. SPIRE observational products

5.1.1. SPIRE Observation Context metadata

The SPIRE Observation Context Product contains a list of metadata keywords which give the majority of the parameters that identify the observation. These are examples for the three SPIRE modes:

5.1.1.1. ObservationContext for SPIRE Photometry

Table 5.1. Example of the metadata keywords contained in a SPIRE Photometry observation.

StringParameter	type (description="Product Type Identification")
StringParameter	creator (description="Generator of this product")
DateParameter	creationDate (description="Creation date of this product")
StringParameter	description (description="Name of this product")
StringParameter	instrument (description="Instrument attached to this product")
StringParameter	modelName (description="Model name attached to this product")
DateParameter	startDate (description="Start date of the observation")
DateParameter	endDate (description="End date of the observation")
StringParameter	formatVersion (description="Version of product format")
StringParameter	obsState (description="One of CREATED, LEVEL0_PROCESSED, LEVEL0_5_PROCESSED, LEVEL1_PROCESSED, LEVEL2_PROCESSED, LEVEL2_5_PROCESSED, LEVEL3_PROCESSED")
StringParameter	telescope (description="Name of telescope")
StringParameter	object (description="Target name")
StringParameter	naifId (description="SSO NAIF identifier")

StringParameter	observer (description="Observer name")
StringParameter	proposal (description="Proposal name")
LongParameter	obsid (description="Observation identifier")
LongParameter	odNumber (description="Operational day number")
StringParameter	aot (description="AOT Identifier")
StringParameter	aorLabel (description="AOR Label as entered in HSpot")
StringParameter	cusMode (description="CUS observation mode")
StringParameter	instMode (description="Instrument Mode")
StringParameter	obsMode (description="Observation mode name")
StringParameter	pointingMode (description="Pointing mode")
StringParameter	biasMode (description="Bias mode")
LongParameter	numRepetitions (description="Number of times to repeat the basic unit of the observation")
StringParameter	missionConfig (description="Mission configuration")
DoubleParameter	equinox (description="Equinox of celestial coordinate system")
StringParameter	raDeSys (description="Coordinate reference frame for the RA and DEC")
DoubleParameter	ra (description="Actual Right Ascension of pointing", quantity="deg")
DoubleParameter	raNominal (description="Requested Right Ascension of pointing", quantity="deg")

DoubleParameter	dec (description="Actual Declination of pointing", quantity="deg")
DoubleParameter	decNominal (description="Requested Declination of pointing", quantity="deg")
DoubleParameter	posAngle (description="Spacecraft pointing Position angle", quantity="deg")
DoubleParameter	radialVelocity (description="Spacecraft velocity along the l-of-s of the telescope wrt the LSR", quantity="km s-1")
StringParameter	velocityDefinition (description="The velocity definition and frame")
StringParameter	origin (description="Site that created the product")
StringParameter	processingMode (description="Processing mode selected to execute the pipeline")
StringParameter	calVersion (description="Version of the cal tree")
DateParameter	slewTime (description="Predicted start time for slew before the observation")
StringParameter	scanDirection (description="nominal, orthogonal or scanab")
StringParameter	scanSpeed (description="Speed of scan")
StringParameter	aperture (description="Instrument aperture in use")
BooleanParameter	coolerBurpDetected (description="Indicates a cooler burp")
DoubleParameter	solarAspectAngleMean (description="Mean Solar Aspect Angle", quantity="deg")
DoubleParameter	solarAspectAngleRms (description="RMS Solar Aspect Angle", quantity="deg")

5.1.1.2. ObservationContext for SPIRE Spectroscopy

Table 5.2. Example of the metadata keywords contained in a SPIRE Spectroscopy observation.

StringParameter	type (description="Product Type Identification")
StringParameter	creator (description="Generator of this product")
DateParameter	creationDate (description="Creation date of this product")
StringParameter	description (description="Name of this product")
StringParameter	instrument (description="Instrument attached to this product")
StringParameter	modelName (description="Model name attached to this product")
DateParameter	startDate (description="Start date of the observation")
DateParameter	endDate (description="End date of the observation")
StringParameter	formatVersion (description="Version of product format")
StringParameter	obsState (description="One of CREATED, LEVEL0_PROCESSED, LEVEL0_5_PROCESSED, LEVEL1_PROCESSED, LEVEL2_PROCESSED, LEVEL2_5_PROCESSED, LEVEL3_PROCESSED")
StringParameter	telescope (description="Name of telescope")
StringParameter	object (description="Target name")
StringParameter	observer (description="Observer name")
StringParameter	proposal (description="Proposal name")
LongParameter	obsid (description="Observation identifier")
LongParameter	odNumber (description="Operational day number")
StringParameter	aot (description="AOT Identifier")

StringParameter	aorLabel (description="AOR Label as entered in HSpot")
StringParameter	cusMode (description="CUS observation mode")
StringParameter	instMode (description="Instrument Mode")
StringParameter	obsMode (description="Observation mode name")
StringParameter	pointingMode (description="Pointing mode")
StringParameter	mapSampling (description="Spatial sampling of map")
StringParameter	biasMode (description="Bias mode")
LongParameter	numRepetitions (description="Number of times to repeat the basic unit of the observation")
LongParameter	numHRepetitions (description="Number of HR repetitions")
LongParameter	numLRepetitions (description="Number of LR repetitions")
StringParameter	commandedResolution (description="Commanded Spectral Resolution")
StringParameter	missionConfig (description="Mission configuration")
DoubleParameter	equinox (description="Equinox of celestial coordinate system")
StringParameter	raDeSys (description="Coordinate reference frame for the RA and DEC")
DoubleParameter	ra (description="Actual Right Ascension of pointing", quantity="deg")
DoubleParameter	raNominal (description="Requested Right Ascension of pointing", quantity="deg")
DoubleParameter	dec (description="Actual Declination of pointing", quantity="deg")

DoubleParameter	decNominal (description="Requested Declination of pointing", quantity="deg")
DoubleParameter	posAngle (description="Spacecraft pointing Position angle", quantity="deg")
DoubleParameter	pmRA (description="Target's proper motion RA (arcsec/yr) as given by the observer", quantity="arcsec a-1")
DoubleParameter	pmDEC (description="Target's proper motion Dec (arcsec/yr) as given by the observer", quantity="arcsec a-1")
DoubleParameter	raDecOffset (description="The offset between the commanded position and the actual reconstructed pointing, which includes any systematic BSM offset (bsmOffset), but not the APE", quantity="arcsec")
DoubleParameter	bsmOffset (description="BSM offset position (0.0 or 1.7 arcsec), which is corrected for by the point-source calibration. This systematic offset is included in the raDecOffset value", quantity="arcsec")
DoubleParameter	radialVelocity (description="Spacecraft velocity along the l-of-s of the telescope wrt the LSR", quantity="km s-1")
StringParameter	velocityDefinition (description="The velocity definition and frame")
StringParameter	origin (description="Site that created the product")
StringParameter	processingMode (description="Processing mode selected to execute the pipeline")
StringParameter	calVersion (description="Version of the cal tree")
DateParameter	slewTime (description="Predicted start time for slew before the observation")
StringParameter	processedAs (description="The spectral resolution that was used to process the data (HR, LR, or H+LR).")
StringParameter	aperture (description="Instrument aperture in use")
DoubleParameter	solarAspectAngleMean (description="Mean Solar Aspect Angle", quantity="deg")
DoubleParameter	solarAspectAngleRms (description="RMS Solar Aspect Angle", quantity="deg")
StringParameter	ConcatenatedOBSIDs (description="Sequence of comma separated OBSIDs, length is equal to the number of concatenated AORs to which the given OBSID belongs to")

LongParameter	photObsid000 (description="SPIRE photometer map obsid that overlaps with this observation - 000")
LongParameter	photObsid001 (description="SPIRE photometer map obsid that overlaps with this observation - 001")

5.1.2. Level-0 products

The generic Herschel definition of Level-0 data products is the following:

- *Raw telemetry data (TMPackets) as measured by the instrument, minimally manipulated and ingested as data frames into the mission data base/archive. Typically, readings are in binary units versus detector pixel number*

The SPIRE definition of Level-0 data products differs from the Herschel-wide definition in the format. In fact, SPIRE Level-0 data products are implemented as HIPE products (or subclasses) that contain raw telemetry values as extracted from SPIRE Data Frames.

The format of Level-0 data products is defined to be as simple as possible. Each product contains data coming from only one building block of a specified observation with the data from each TM packet type in a separate table dataset. All Level-0 products are made from the `BuildingBlockProduct` Java class. Note that different table datasets will be present depending on the type of building block (in other words, only the table dataset for the actual TM packets generated in the building block will be saved).

Within each product, the table datasets are identified with the name of the TM packet type. Each table dataset has a number of columns, one for each quantity stored in SpireDataFrames of the specified TM packet, that is, a column for each TM parameter contained in the specified TM packet. However, some TM parameters that are not useful for data processing (such as FrameIDs) are not stored in SpireDataFrames and will be not present in Level-0 data products. The "sdfTime", "packetTime" and "seqCount" are defined as the SpireDataFrame time, the TM packet time and the TM packet Sequence Count — these quantities are used to compute the sample time, to check its validity and to check the correct time ordering of the telemetry.

The last columns in the following table defines which in pipeline each product is used. The pipelines for different observing modes are defined as follows:

- POF2: Photometer Point Source (7-point jiggle)
- POF5: Photometer Large Map
- POF10: Photometer Small Map
- PARALLEL: SPIRE/PACS Parallel Mode (PAR for short)
- SOF1: Spectrometer single pointing (sparse sampling)
- SOF2: Spectrometer single pointing (intermediate or full sampling)
- ROF1: Spectrometer raster (sparse sampling)
- ROF2: Spectrometer raster (intermediate or full sampling)

Note that ROF1 and ROF2 products are similar to SOF2 products.

Dataset description	**Product type**	**POF2**	**POF5**	**POF10**	**PAR**	**SOF1**	**SOF2**
Photometer Detector Timeline	`PHOTF`, `PHOTSW`,	y	y	y	y		

Dataset description	Product type	POF2	POF5	POF10	PAR	SOF1	SOF2
	PHOTMW, PHOTLW						
Photometer Offset Timeline	PHOTOFF	y	y	y	y		
Spectrometer Detector Timeline	SPECF, SPECSW, SPECLW					y	y
Spectrometer Offset Timeline	SPECOFF					y	y
Nominal Housekeeping Timeline	NHK	y	y	y	y	y	y
Critical Housekeeping Timeline	CHK	y	y	y	y	y	y
Beam Steering Mirror Timeline	BSMNOMINAL	y	y	y	y	y	y
Spectrometer Mechanism Timeline	SMECSELECT, SMECSCAN					y	y
Subsystem Control Unit Timeline	SCUNOMINAL	y	y	y	y	y	y

The SPIRE level-0 context is defined as follows:

Product description	Product type
SPIRE Level-0 Context	Level0Context
Level-0 Building Block product (contents as given above)	BuildingBlockProduct

5.1.3. Level-0.5 products

Product description	Product type	POF2	POF5	POF10	PAR	SOF1	SOF2
Photometer Detector Timeline	PDT	y	y	y	y		
Photometer Offset Timeline	POT	y	y	y	y		
Spectrometer Detector Timeline	SDT					y	y
Spectrometer Offset Timeline	SOT					y	y
Nominal Housekeeping Timeline	NHKT	y	y	y	y	y	y
Critical Housekeeping Timeline	CHKT	y	y	y	y	y	y
Beam Steering Mirror Timeline	BSMT	y				y	y
Spectrometer Mechanism Timeline	SMECT					y	y
Subsystem Control Unit Timeline	SCUT	y	y	y	y	y	y

The SPIRE level-0.5 Engineering Data Processing (EDP) context is defined as follows:

Product description	Product type
SPIRE Level-0.5 EDP block context	
Level-0.5 building block context (each block is generated per observation building block)	
Level-0.5 product (as given in the table above)	

5.1.4. Level-1 products

Product description	Product type	POF2	POF5	POF10	PAR	SOF1	SOF2
Averaged Pointed Photometer Product	APPP	y					
Photometer Scan Product	PSP		y	y	y		
Spectrometer Detector Interferogram Product	SDI					y	y

5.1.5. Level-2 products

Product description	Product type	POF2	POF5	POF10	PAR	SOF1	SOF2
Jiggled Photometer Product	JPP	y					
Photometer Destriper Diagnostic Product	PDD		y	y	y		
Photometer Map Product	PMP		y	y	y		
SSO Photometer Map Product (*)	ssoPMP		y	y			
Photometer Extended Map Product	PXMP		y	y	y		
Spectrometer Point Source Spectrum	SPSS					y	
Spectrometer Detector Spectrum	SDS					y	
SPIRE Preprocessed Cube	SPC						y
Spectral Simple Cube	SSC						y

(*) ssoPMP are PMP in the reference frame of the Solar System Object, they are only present for SSOs.

5.1.6. Level-2.5 products

Product description	Product type	POF2	POF5	POF10	PAR	SOF1	SOF2
Photometer Map Product	PMP		y		y		
Photometer Extended Map Product	PXMP		y		y		
Photometer Hi-resolution Extended Map Product(*)	hiresPXP		y		y		

(*) Hi-resolution maps are only available for a subset of level2.5 observations.

5.1.7. Level-3 products

Product description	Product type	POF2	POF5	POF10	PAR	SOF1	SOF2
Photometer Extended Map Product	PXMP		y	y	y		

5.2. SPIRE calibration products

A separate set of calibration products is defined for each of the two sub-instruments on SPIRE, the photometer and the spectrometer. These are indicated by `Spec` or `Phot` in the type name after `SCal`.

The following tables summarise the calibration products required.

5.2.1. Calibration History Products

These products are not strictly calibration products as they contain the history information for certain parameters. However, they are used by the pipeline in the same way as normal calibration products. They are filled using either dedicated pre-processing pipelines during Operational Day Processing, or filled by information generated by the pipeline.

Product type	Product description
SCalResetHist	DPU Counter Reset History
SCalPhotOffsetHist	Photometer Signal Offset History
SCalSpecOffsetHist	Spectrometer Signal Offset History

Product type	Product description
SCalPhotPcal	Photometer PCAL Output Table
SCalSpecPcal	Spectrometer PCAL Output Table

5.2.2. Photometer Calibration Products

Product type	Product description
SCalPhotApertureEfficiency	Spire Aperture efficiency
SCalPhotBeamProf	Photometer Beam Profiles
SCalPhotBolPar	Bolometer Parameter Table
SCalPhotBsmOps	BSM Operations Table
SCalPhotBsmPos	BSM Position Table
SCalPhotChanMask	Channel Mask Table
SCalPhotChanGain	Channel Gain Table
SCalPhotChanRelGain	Channel Relative Gain Table
SCalPhotChanNoise	Detector Noise Spectrum
SCalPhotChanNum	Channel Number Mapping Table
SCalPhotChanTimeConst	Channel Time Constants
SCalPhotChanTimeOff	Channel Time Offset Table
SCalPhotDetAngOff	Detector Angular Offset Table
SCalPhotElecCross	Electrical Crosstalk Matrix
SCalPhotFluxConv	Flux Conversion and Non-linearity Correction Coefficients

Product type	Product description
SCalPhotColorCorrAperture	List Set of Aperture corrections
SCalPhotColorCorrBeam	SPIRE beam corrections with spectral index and temperature
SCalPhotColorCorrHfi	Spire-HFI Cross-calibration color correction
SCalPhotColorCorrK	Set of source-type correction
SCalPhotInstModeMask	Instrument Mode Mask Table
SCalPhotLpfPar	Low Pass Filter Parameter Table
SCalPhotOptCross	Optical Crosstalk Matrix
SCalPhotPcalModel	Photometer Pcal Response Model Table
SCalPhotRsrf	Photometer RSRF
SCalPhotRadialCorrBeam	Spire Beam correction product
SCalPhotTempDriftCorr	Temperature Drift Correction Coefficients

5.2.3. Spectrometer Calibration Products

Product type	Product Description
SCalSpecBandEdge	Spectral Band Edges
SCalSpecBeamParam	Spectrometer Beam Parameters and point source flux conversion
SCalSpecBeamProf	Spectrometer Beam Profiles
SCalSpecBolPar	Bolometer Parameter Table
SCalSpecBolPhase	Bolometer Phase Table
SCalSpecBrightGain	Bright Mode Gain Table
SCalSpecBsmOps	BSM Operations Table
SCalSpecBsmPos	BSM Position Table
SCalSpecChanGain	Channel Gain Table
SCalSpecChanMask	Channel Mask Table
SCalSpecChanNum	Channel Number Mapping Table
SCalSpecChanTimeConst	Channel Time Constants
SCalSpecChanTimeOff	Channel Time Offset Table
SCalSpecDetAngOff	Detector Angular Offset Table
SCalSpecElecCross	Electrical Crosstalk Matrix
SCalSpecExtCorr	Spectrometer extended calibration polynomial correction coefficients
SCalSpecInstRsrf	Spectrometer Instrument RSRF
SCalSpecLpfPar	Low Pass Filter Parameter Table
SCalSpecLrCorr	Spectrometer LR Correction Calibration Table for SLW
SCalSpecNonLinCorr	Non-linearity Correction Coefficients
SCalSpecOpdCorr	Spectrometer OPD Correction Calibration Table
SCalSpecOpdLimits	Spectrometer Opd Limits Table
SCalSpecOptCross	Optical Crosstalk Matrix
SCalSpecPcalModel	Spectrometer Pcal Response Model Table
SCalSpecPhaseCorrLim	Band Limits for Phase Correction
SCalSpecSmecStepFactor	SMEC Step Factor to convert from MPD to OPD

Product type	Product Description
SCalSpecSmecZpd	Optical Encoder and LVDT DC at ZPD
SCalSpecTeleModel	Spectrometer OD-dependent Telescope Model Correction
SCalSpecTeleRsrf	Spectrometer Telescope RSRF

Chapter 6. Auxiliary, Catalogue and Quality Products Description

6.1. Auxiliary products

Table 6.1. Auxiliary products

Name	Product type	Description
Auxiliary Context		
ACMS Telemetry Product	auxAcmsTM	Herschel ACMS Telemetry Product.
Horizons Product	auxHorizons	Herschel information from the Horizons NASA database of solar system ephemerides. More information in the corresponding product table in the PDS and the official NASA site and documentation on Horizons.
Events Log Product	auxEvLog	The events log product is intended to provide with a uniform product containing event reports from either the instruments or the spacecraft. It is generated per OD.
Missing Telemetry Product	auxMissTM	This product contains information of missing TM packets after ingestion in the HSC. It has been designed to contain the minimum information required to unambiguously identify the missing TM packets. It is generated per OD.
Out of Limits Product	auxOol	The HPMCS SCOS-2000 BEHV performs behaviour checking for all parameters specified in the MIB OCF table. This information furnished to the HSC by means of DDS auxiliary TM data products. The Out-of-limits product shall pack all the information provided therein. It is generated per OD.
Orbit Ephemeris Product	auxOrbitp auxOrbitr	The predicted and reconstructed products have identical format and contain time-dependent S/C state vector information as provided by FDS as Orbit Ephemeris Message (OEM) data. Generated per OD. More information in the corresponding product table in the PDS.
Orbit Events Products	auxOrbEvp/r	These products have identical format and contain the predicted/reconstructed orbit events data furnished by Flight Dynamics (FDS) in the (short term) orbit events file. Events include Acquisition/loss of TM/TC signal at the ground station and eclipse events information. It is generated per OD.
Herschel Pointing product	HPP	The pointing product contains time-dependent spacecraft attitude information and will be built using information provided in the Attitude History File (AHF) furnished by the Flight Dynamics

Name	Product type	Description
		System (FDS). It is generated per observation id (obsid).
SIAM Product	SIAM	This product contains the Spacecraft/Instrument Alignment Matrices transforming vectors in the Herschel spacecraft reference frame to/from vectors in the different instruments' frames. The SIAM product is valid for a given period of time in the mission until a new measurement is done and the product is updated.
Calibrated SREM Data Product	auxCalSREM	The Standard Radiation Environment Monitor (SREM) detects and counts electrons, protons and cosmic rays with a coarse spectral resolution and some 20 degrees angular resolution. This product contains the calibrated accumulation and acquisition data, including the proton/electron count rates in the three detectors, fitted particle spectra and total dose in the internal RadFET. It is generated per OD.
Raw SREM Data Product	auxRawSREM	Contains raw SREM accumulation and acquisition data, including readings from the different channels of detectors and internal RadFET, temperature and voltage data, etc. It is generated per OD.
Telecommands History Product	auxTch	This product contains information of telecommand history as furnished by the Herschel MCS by means of DDS service. It is generated per OD.
Time Correlation Product	auxTimec	The Time Correlator component within the HPMCS maintains the correlation between the spacecraft on-board time and ground time, providing interfaces to correlate OBT to UTC and vice-versa. The Time Correlation product should contain all the relevant information produced by the Time Correlator component and stored in the SCOS-2000 Time Correlator Coefficient packets. It is generated per OD.
Mission Timeline Summary Product	auxMtls	This product packs the information provided within the EPOS summary file: pointing requests data, reaction wheel profile data, ground station coverage and DTCP data and delta-V manoeuvre data. It is generated per OD. Not yet available.
Uplink Data Product	auxUpl	This product contains uplink information, including: proposal data, observation request data and observation block execution data. It is generated per observation.
HIFI Uplink Data Product	HifiUplinkProduct	HIFI-specific Uplink Data Product. It contains, additionally, a number of instrument specific parameters.

6.2. Quality Control

The Quality Control Report is a product to gather, combine and distribute information on the quality of the observation science data. Quality Control includes, per observation, the assessment of the execution of the observation by the spacecraft and the instruments, the evaluation of the success of the

data processing, the outcome of the systematic inspection of the Quick Look product and, if required, the instrument specialist and community support astronomer analysis. The Quality Control Summary Report is an extract of the Quality Control Report which compiles the final relevant and pertinent quality information for the users.

The Quality Control Report is automatically created during the Data processing for each observation. The Quality Control Report Summary is generated at the end of the quality control analysis as a result of this process.

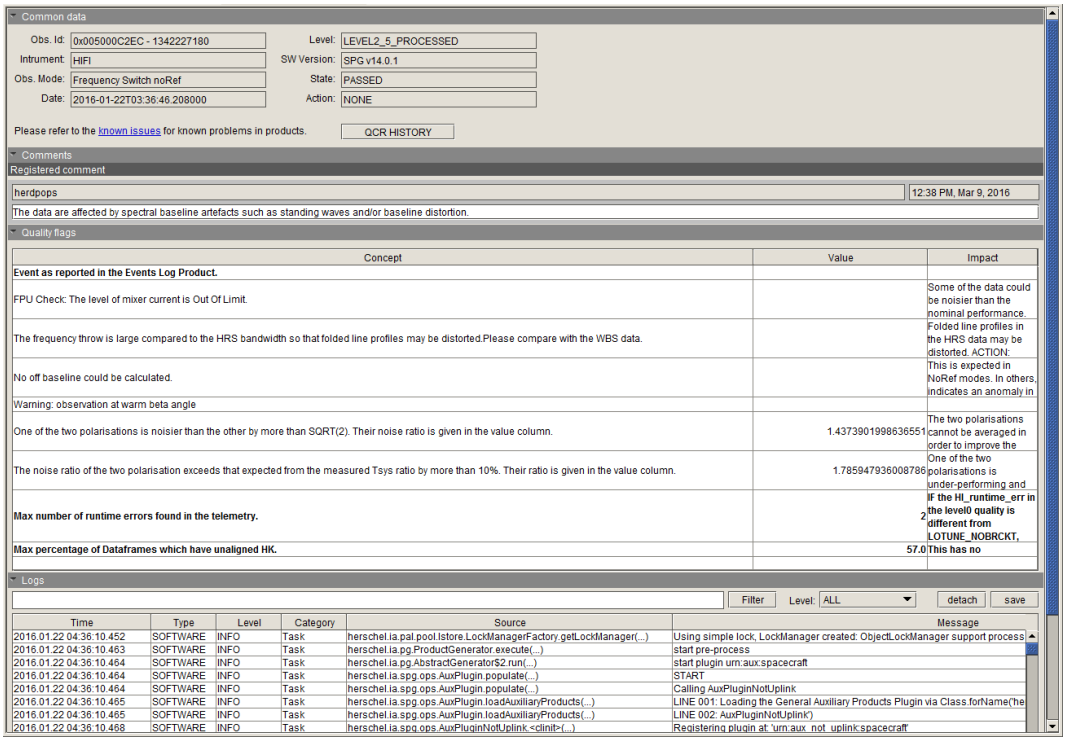

Figure 6.1. Herschel Quality Control Summary Report

Besides the attributes and the common metadata of other Herschel products, the Quality Control Reports also contains the following fields:

- **Status:** Define the state of the observation from the point of view of quality. Possible states are:
  - Pending: The quality cycle for the observation is still on-going.
  - Passed: The quality cycle for the observation is finished.
  - Failed: The observation failed the quality assessment and is either going to be rescheduled, reprocessed or discarded.
- **Comments:** Comments on the quality data written by the different actors involved in the Quality Control of the observation.
- **Quality Flags:** Quality flags are pre-defined list of fields of simple data types (strings, numbers and booleans) defined from the auxiliary products and per instrument. The quality flags are automatically assigned by the Standard Product Generation system when the pre-defined condition to raise a particular flag is matched. There are flags of different severity. The observations are quality inspected based on those flags and a human analysis is performed to assess how and how much the observation is affected by the problem reported by the quality flag. A detailed list of flags is given in the next subsection.

6.2.1. Quality Flags

The first set of Quality flags populating the Quality Control Report are derived from the auxiliary products which contain the Spacecraft and Instruments information reported by the MOC.

- **Missing Telemetry:** The observation is fully or partially affected by an interruption of the telemetry.
- **Out of Limits:** One or more parameters are out of the allowed value.
- **Event:**During the observation the MOC reported a kind of event from either the instrument or the spacecraft.
- **Telecommand Errors:**This flag reports error coming from the Telecommand History product.
- **High glitch rate:**The observation suffered an anomalously high glitch rate.
- **Pointing Problem / Suspicious Pointing:** Pointing problem means that the actual pointing was significantly off the target, or the target was not acquired at all. Suspicious pointing is applied when the pointing may not be accurate and/or the object may not be well centered.

A generic flag "S/W Problem at processing level" is raised when the Data processing system fails at any step during the processing of the observation and a number of products are missing.

The last set of flags are generated by the instrument specific pipelines.

The list of flags which are transferred from the Quality Control Report to the Quality Control Summary Report after the quality analysis as useful information for the users are listed in Appendix B in *Product Definition Supplement*.

Chapter 7. Standalone Browse Products Description

7.1. Standalone Browse Products Description

The currently offered 'Standalone Browse Products' are the following FITS products generated by the standard Herschel data processing pipelines:

- **HIFI:**The Level 2.5 products for all HIFI observations.
- **PACS Photometry:** The Level 2.5 products for PACS photometric observations produced with Scanamorphos when available (this includes the PACS component of SPIRE/PACS parallel mode observations); or the Level 2 products otherwise.
- **PACS Spectroscopy:** Reformatted Level 2 or where available, Level 2.5 products consisting of:
  - A FITS table with the spectra of the Level 2 "rebinned cubes" for all spaxels and for all raster pointings.
  - One drizzled, projected or interpolated cube per camera, with an equidistant wavelength and spatial grid; which cube is provided depends on the observing mode (mapping, tiling, pointed; line scan, range scan).
  - For pointed observations only, a FITS table containing the spectrum of the central spaxel and one (unchopped observing mode) or two (chopNod mode) versions of the point source-calibrated spectra, per camera and per wavelength range in the observation.
  - For pointed chopNod observations taken in full SED mode only, a single FITS table of the central spectrum and the two point source-calibrated spectra, but here with both cameras and the data from the two or three observations that were taken to cover the full SED contained in the same table.

  Note that for the latter two types of products, establishing whether the source is a point source located within the central spaxel, or not, is the responsibility of the user.
- **SPIRE Photometry:** Level 2.5 maps processed with the version of the pipeline for absolute calibrated extended source maps in MJy/sr for overlapping SPIRE scan and cross-scan maps when these are available (also for the SPIRE component of SPIRE/PACS parallel mode observations); or the Level 2 extended source calibrated products otherwise. For Solar System Objects, the Level 2 point-source calibrated maps in Jy/beam, corrected for the proper motion of the object.
- **SPIRE Spectroscopy:** For observations in sparse mode the Level 2 point-source calibrated spectra for the central detectors, and for spectral maps the Level 2 convolution projection spectral cubes.