



# SPIRE Photometer Data Products

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on behalf of the SPIRE ICC,  
HSC and NHSC





## Guidelines

- I'll introduce SPIRE Photometer products & viewers
- Will concentrate on Level 1 (calibrated timelines) & Level 2 (maps) products.

**Reference:** “*SPIRE Data Reduction Guide*”

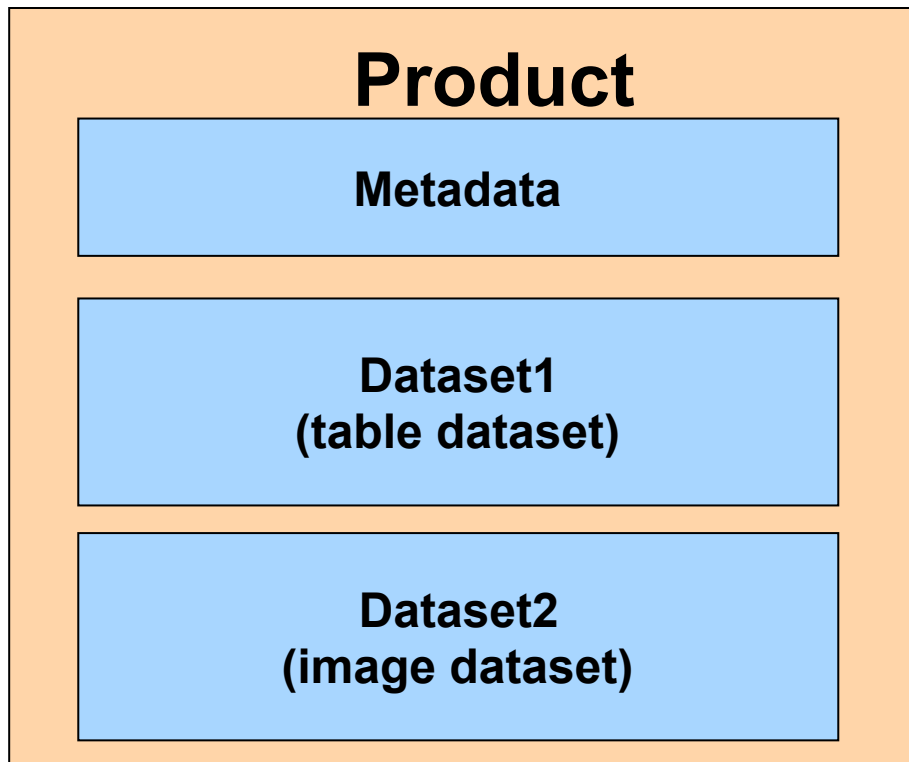
in HIPE (under “Help”) or in:

[http://herschel.esac.esa.int/hcss-doc-12.0/load/spire\\_drg/html/spire\\_drg.html](http://herschel.esac.esa.int/hcss-doc-12.0/load/spire_drg/html/spire_drg.html)



# General HIPE Product Structure

- Products are containers for datasets that can be stored within the HCSS system.
- They can be exported from HCSS system as FITS files and used by other software.

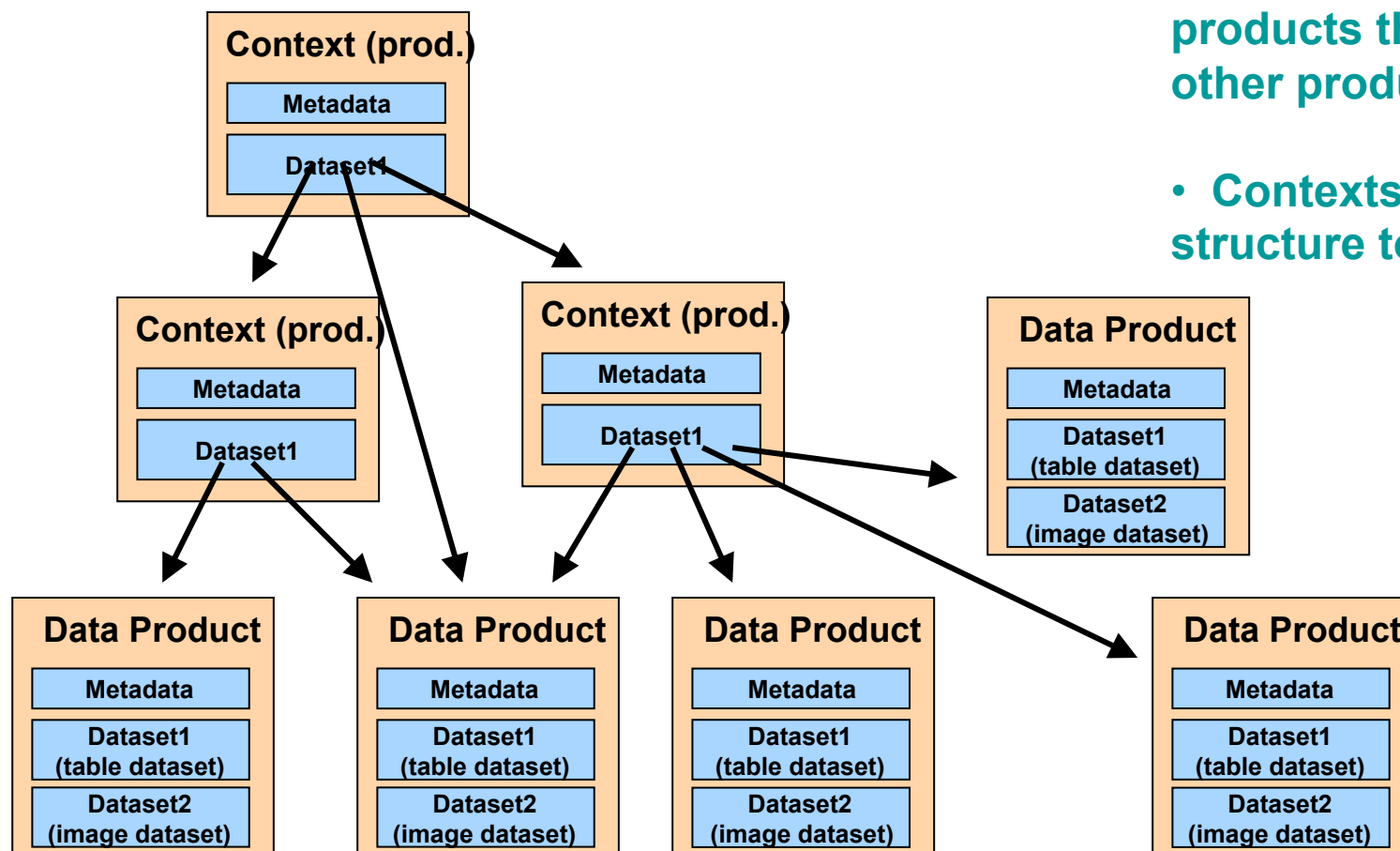


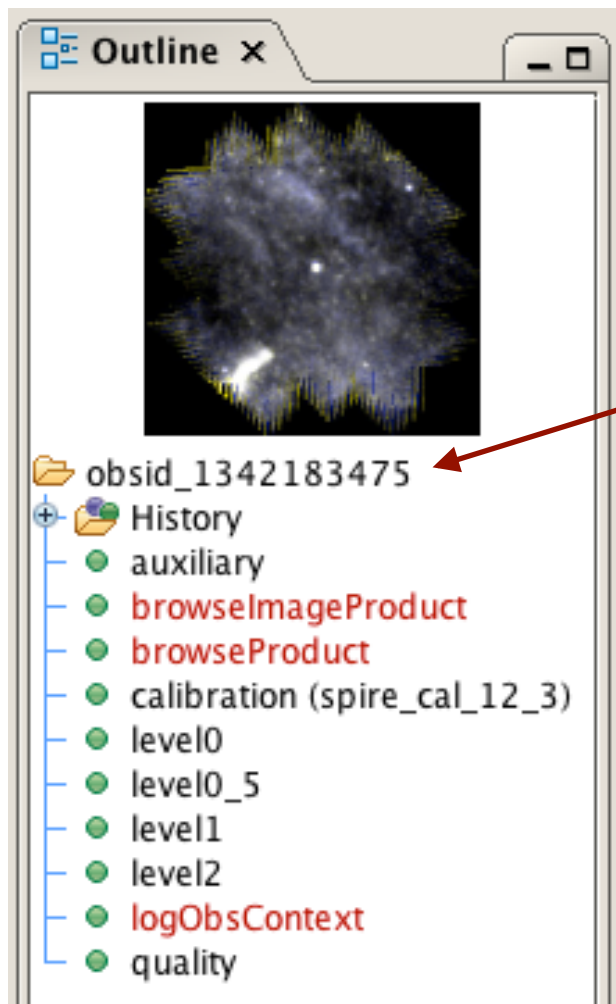
- Products contain:
  - Metadata,
  - Datasets
  - Processing history
- Types of datasets include:
  - Array dataset
  - Table dataset
  - Composite dataset
  - Spectrum1d
  - Spectrum2d
- Generic Product Types:
  - SimpleImage
  - SimpleCube
  - SpectralSimpleCube
  - Context



# Contexts

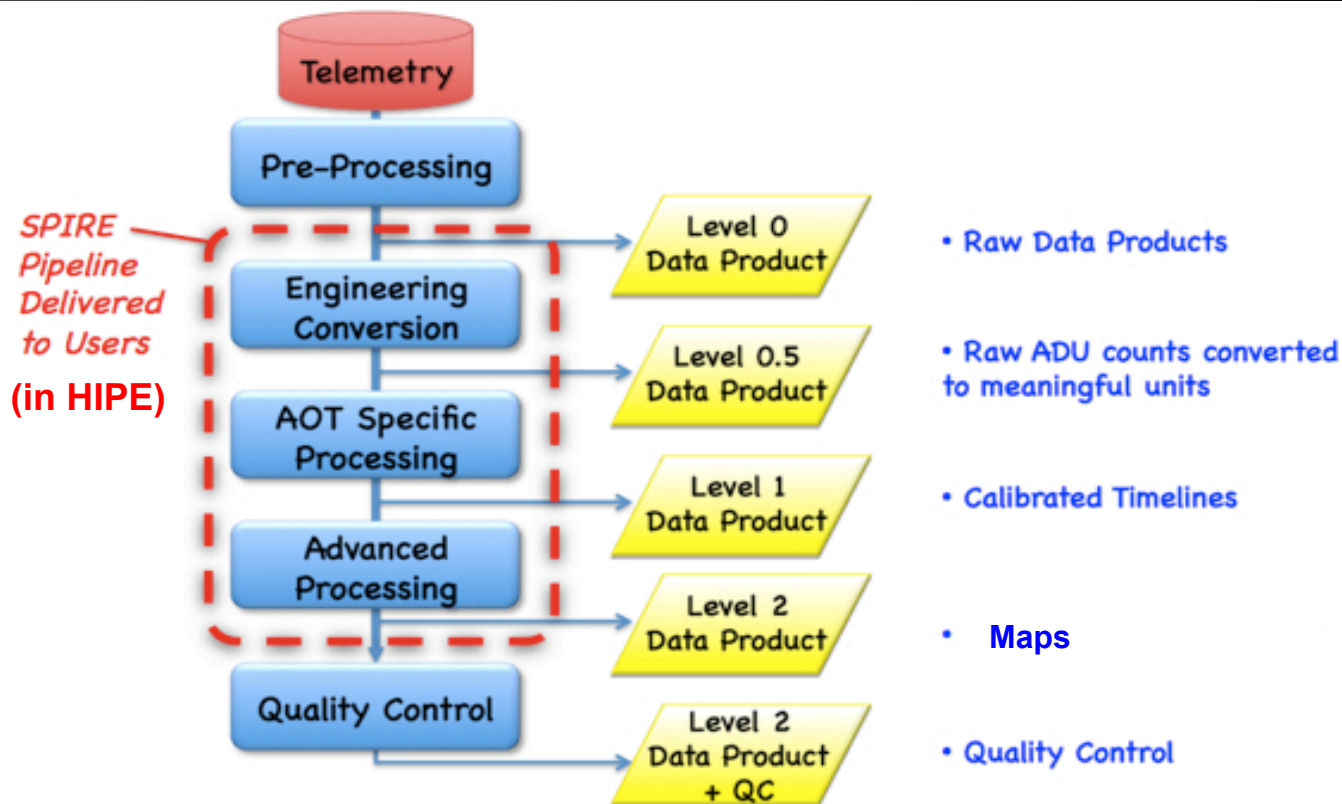
- Contexts are products that point to other products.
- Contexts provide structure to the data.



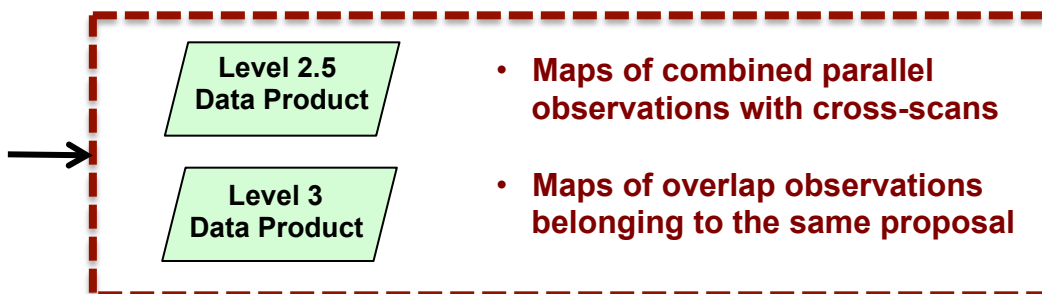


For a given observation, all data products are packed inside a single ***observation context***

**HIPE: the best tool for viewing these data products**

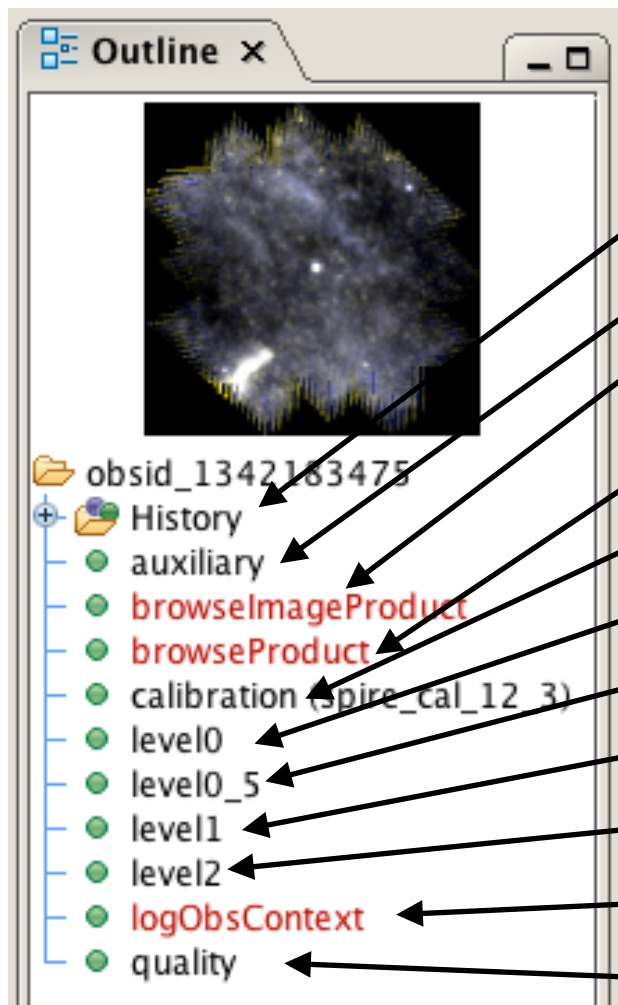


Since HIPE 11  
(only in archive data from HSA)





## Example: A large map mode observation



History of data reduction

Auxiliary data: Pointing, uplink info, etc...

Browse image product: Simple representation of final maps for a quicklook

Browse product: Another browse product

Calibration product: Cal. data used in processing

Level 0: Raw unprocessed data

Level 0.5: Data converted to engineering units

**Level 1: Calibrated timelines [Jy/beam]**

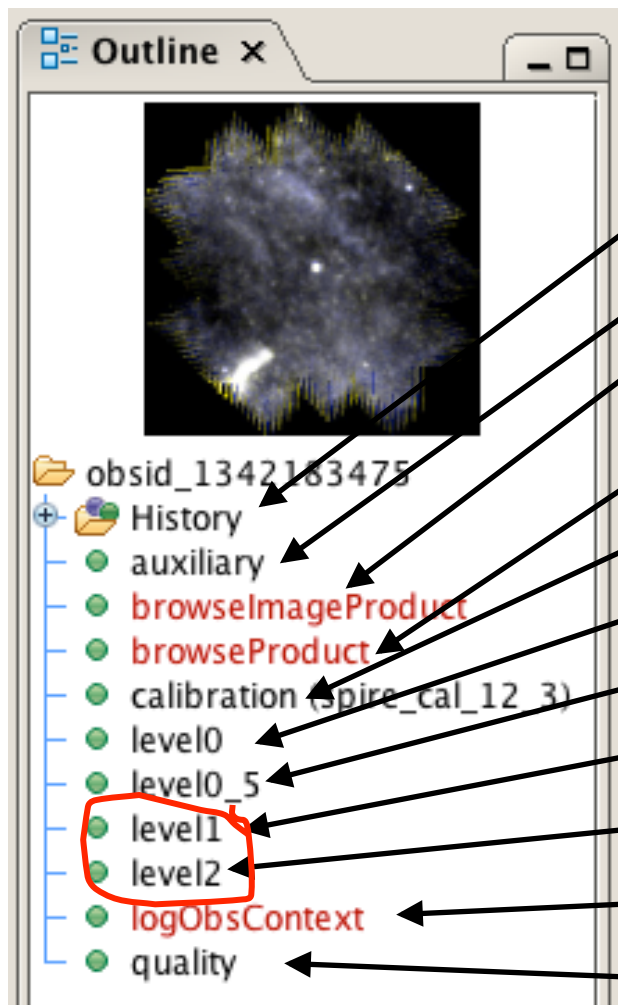
**Level 2: Maps**

Data reduction Log

Quality control: Tells whether things went O.K.



## Example: A large map mode observation



History of data reduction

Auxiliary data: Pointing, uplink info, etc...

Browse image product: Simple representation of final maps for a quicklook

Browse product: Another browse product

Calibration product: Cal. data used in processing

Level 0: Raw unprocessed data

Level 0.5: Data converted to engineering units

**Level 1: Calibrated timelines [Jy/beam]**

**Level 2: Maps**

Data reduction Log

Quality control: Tells whether things went O.K.





PSP: Photometer  
Scan Product

a PSP  
product

The screenshot displays the Herschel software interface. On the left, a data tree shows the hierarchy: Data > obsid\_1342183475 > History > level0 > level0\_5 > level1 > 0, 1, 2, 3, mask, temperature, signal, ra, dec, angVelocity, History, 4, 5, 6, 7, 8, 9, 10, 11, level2, logObsContext, quality. A red circle highlights the level1 sub-tree, and a purple arrow points to the '3' folder, labeled 'a PSP product'. The main window title is 'obsid\_1342183475.refs["level1"].product.refs[3].product'. It contains three panels: 'PLW', 'PMW', and 'PSW', each showing a grid of scan products. The 'PSW' panel is selected. To the right is a 'Quick View' plot titled 'Plot for PSWE8' with 'Start Date Mon Sep 07 09:48:11 PDT 2009'. The plot shows 'signal [Jy [1 Jy = 1.0E-26 W/m<sup>2</sup>/Hz]]' on the left y-axis (ranging from -0.20 to 0.20) and 'mask' on the right y-axis (ranging from 0 to 25) against 'sampleTime [s]' on the x-axis (ranging from -5 to 45). A legend at the bottom of the plot identifies 'PSWE8' as a blue line and 'GlitchLI Detected' as a yellow diamond. Below the plot is a 'Control Panel' with the date 'Mon Sep 07 09:48:11 PDT 2009', 'All Arrays' dropdown, 'Nominal' checkbox, 'signal' dropdown, and navigation buttons. It also shows 'Current Index 0 of 797', 'Color&Mask Preferences', 'DTE Help', 'Select index 0', and 'Select Plot Window' with 'Quick View' selected.



PSP: Photometer  
Scan Product

a PSP  
product

The screenshot displays the Herschel software interface. On the left, a 'Data' tree shows a hierarchy of levels: 'obsid\_1342183475', 'History', 'level0', 'level0 5', 'level1', and 'level2'. Under 'level1', items 0 through 11 are listed, with item 3 highlighted in blue. A red circle highlights this 'level1' section, with a purple arrow pointing to it and the text 'a PSP product'. The main window shows a grid of scan products for 'PLW', 'PMW', and 'PSW' bands. The 'PSW' band is selected, and a 'Quick View' plot is displayed. The plot is titled 'Plot for PSWE8' and shows 'signal [Jy]' on the y-axis (ranging from -0.20 to 0.20) versus 'sampleTime [s]' on the x-axis (ranging from -5 to 45). The signal is a noisy blue line fluctuating around zero. A 'mask' is indicated on the right side of the plot. The control panel at the bottom shows 'Mon Sep 07 09:48:11 PDT 2009', 'All Arrays' dropdown, 'Nominal' checkbox, and 'signal' dropdown menu. Other controls include 'Color&Mask Preferences', 'DTE Help', 'Select index 0 of 797', and 'Select Plot Window' with 'Quick View' selected.



Data

- obsid\_1342183475
- History
- auxiliary
- browseImageProduct
- browseProduct
- calibration (spire\_cal\_1
- level0
- level0\_5
- level1
  - 0
  - 1
  - 2
  - 3
- mask
- temperature
- signal
- ra
- d
- a
- H
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- level2
- logObsContext
- quality

obsid\_1342183475.refs["level1"].product.refs[3].product["signal"]

Index	sampleTime [TAI]	PSWR1 [V]	PSWD16 [Jy]	PSWT1 [V]	
0	1.6310333254263422E9	0.0038730567	0.018896336620374876	0.008585698	0.0229
1	1.6310333254801018E9	0.0038730192	-0.0458312677688158	0.008585677	0.0799
2	1.6310333255338614E9	0.0038730148	-0.01722243898578052	0.00858575	-0.003
3	1.631033325587621E9	0.0038729478	0.02471595532230969	0.008585663	-0.085
4	1.6310333256413808E9	0.0038730253	-0.08280805223651294	0.008585834	-0.029
5	1.6310333256951404E9	0.0038730078	-0.018821959430650514	0.008585873	0.0199
6	1.6310333257489E9	0.0038730674	0.018583024805113035	0.008585546	-0.040
7	1.6310333258026597E9	0.0038729622	-0.009582375223115724	0.008585675	0.0349
8	1.6310333258564193E9	0.0038730663	-0.061972145969346804	0.008585766	-0.086
9	1.6310333259101758E9	0.0038730805	0.04479690915875073	0.008585774	-0.038
10	1.6310333259639354E9	0.0038730027	0.035151238506361204	0.008585605	0.0081
11	1.6310333260176952E9	0.0038730719	0.030185426538511473	0.008585951	-0.011
12	1.6310333260714548E9	0.00387305	-0.014365439350084108	0.008585613	-0.085
13	1.6310333261252143E9	0.0038730467	0.033520217006727415	0.008585716	-0.007
14	1.6310333261789742E9	0.0038730865	-0.0018299567050493182	0.008585679	0.0159
15	1.6310333262327341E9	0.0038730768	-0.051112000877336305	0.008585748	8.4319
16	1.631033326286494E9	0.0038730043	-0.03632298582263355	0.008585834	0.0133
17	1.6310333263402539E9	0.0038730244	0.015499676530882078	0.008585662	0.0179
18	1.6310333263940138E9	0.0038730772	-0.0676603066272295	0.0085858125	0.0353
19	1.6310333264477737E9	0.0038730097	-0.003093724185899538	0.008585662	-0.076
20	1.6310333265015318E9	0.003872991	-0.07669812911219959	0.008585783	-0.035
21	1.6310333265552917E9	0.0038731026	0.005197192495390135	0.008585812	-0.017
22	1.6310333266090512E9	0.00387298	0.05328857428364392	0.008585707	0.0158
23	1.6310333266628077E9	0.0038731645	-0.02060592644877956	0.00858573	0.0102
24	1.6310333267165673E9	0.0038729664	0.03377437121204968	0.008585636	0.0164
25	1.631033326770327E9	0.003873103	-0.08918384187884693	0.008585765	-0.069
26	1.6310333268240867E9	0.0038730954	-0.024496381217912477	0.008585691	-0.034
27	1.6310333268778462E9	0.0038729664	-0.008896415168718141	0.008585738	-0.006

Context menu for 'signal':

- Open (Enter)
- Open With
  - OverPlotter
  - TablePlotter
  - Dataset Viewer** (circled in red)
  - Power Spectrum Generator
- Send To
- Create Variable





Data

- obsid\_1342183475
- History
- auxiliary
- browseImageProduct
- browseProduct
- calibration (spire\_cal\_1)
- level0
- level0\_5
- level1
  - 0
  - 1
  - 2
  - 3
- mask
- temperature
- signal
- ra
- d
- a
- H
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- level2
- logObsContext
- quality

obsid\_1342183475.refs["level1"].product.refs[3].product["signal"]

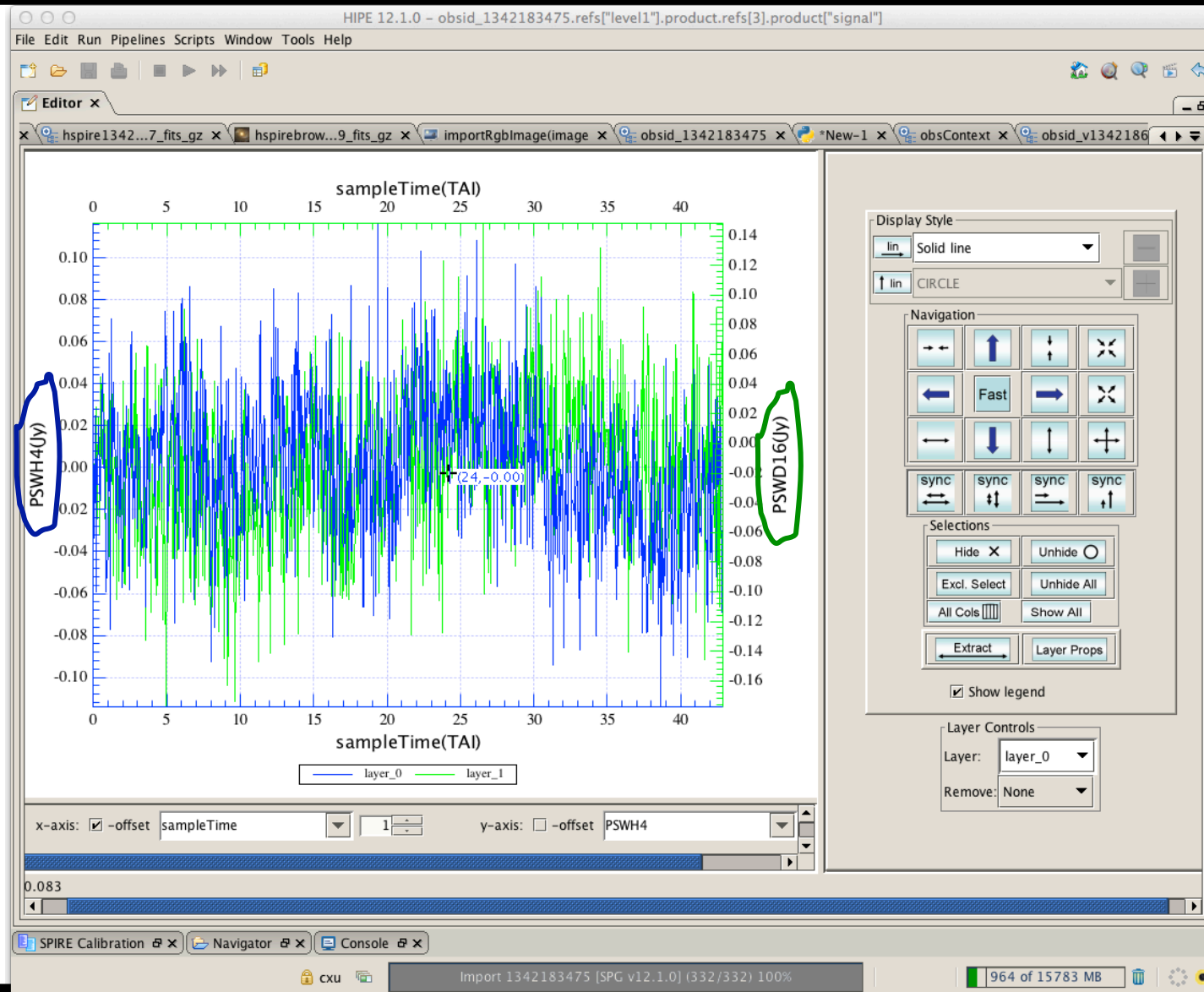
Index	sampleTime [TAI]	PSWR1 [V]	PSWD16 [Jy]	PSWT1 [V]	
0	1.6310333254263422E9	0.0038730567	0.018896336620374876	0.008585698	0.0229
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2	1.6310333255338614E9	0.0038730148	-0.01722243898578052	0.00858575	-0.003
3	1.631033325587621E9	0.0038729478	0.02471595532230969	0.008585663	-0.085
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5	1.6310333256951404E9	0.0038730078	-0.018821959430650514	0.008585873	0.0199
6	1.6310333257489E9	0.0038730674	0.018583024805113035	0.008585546	-0.040
7	1.6310333258026597E9	0.0038729622	-0.009582375223115724	0.008585675	0.0349
8	1.6310333258564193E9	0.0038730663	-0.061972145969346804	0.008585766	-0.086
9	1.6310333259101758E9	0.0038730805	0.04479690915875073	0.008585774	-0.038
10	1.6310333259639354E9	0.0038730027	0.035151238506361204	0.008585605	0.0081
11	1.6310333260176952E9	0.0038730719	0.030185426538511473	0.008585951	-0.011
12	1.6310333260714548E9	0.00387305	-0.014365439350084108	0.008585613	-0.085
13	1.6310333261252143E9	0.0038730467	0.033520217006727415	0.008585716	-0.007
14	1.6310333261789742E9	0.0038730865	-0.0018299567050493182	0.008585679	0.0159
15	1.6310333262327341E9	0.0038730768	-0.051112000877336305	0.008585748	8.4319
16	1.631033326286494E9	0.0038730043	-0.03632298582263355	0.008585834	0.0133
17	1.6310333263396539E9	0.0038730244	0.015499676530882078	0.008585662	0.0179
18	1.6310333263928138E9	0.0038730772	-0.0676603066272295	0.0085858125	0.0353
19	1.6310333264459737E9	0.0038730097	-0.003093724185899538	0.008585662	-0.076
20	1.6310333265015318E9	0.003872991	-0.07669812911219959	0.008585783	-0.035
21	1.6310333265552917E9	0.0038731026	0.005197192495390135	0.008585812	-0.017
22	1.6310333266090512E9	0.00387298	0.05328857428364392	0.008585707	0.0158
23	1.6310333266628077E9	0.0038731645	-0.02060592644877956	0.00858573	0.0102
24	1.6310333267165673E9	0.0038729664	0.03377437121204968	0.008585636	0.0164
25	1.631033326770327E9	0.003873103	-0.08918384187884693	0.008585765	-0.069
26	1.6310333268240867E9	0.0038730954	-0.024496381217912477	0.008585691	-0.034
27	1.6310333268778462E9	0.0038729664	-0.008896415168718141	0.008585738	-0.006

Context menu for 'signal':

- Open (Enter)
- Open With**
  - OverPloter**
  - TablePloter
  - Dataset Viewer
  - Power Spectrum Generator
- Send To
- Create Variable



**OverPloter:**  
Can compare  
timelines of  
different  
detectors.





The screenshot shows the Herschel Archive software interface. On the left is a tree view under 'Data' with folders 'level0\_5', 'level1', and 'level2'. Under 'level2', there are sub-folders for 'extdPLW', 'psrcPLW', 'extdPMW', 'psrcPMW', 'extdPSW', and 'psrcPSW', each containing 'diag' and 'w' files. Annotations on the left point to these folders: a pink box labeled 'extended emission maps (MJy/sr)' points to the 'extd' folders, and a green box labeled 'point source maps (Jy/beam)' points to the 'psrc' folders. The main window displays a large orange emission map titled 'obsid\_1342183475.refs["lev...ct.refs["extdPLW"]].product'. A mouse cursor is over the map. A smaller inset map in the top right shows a coordinate system with 'N', 'E', and 'X' axes. At the bottom, a status bar shows coordinates '79.6, 36.1', flux density '8.5120 MJy/sr', and position '13:55:17.253, -66:28:01.24'. Below the status bar are zoom and pan controls.



**extdMaps and psrcMaps are calibrated differently, and they are NOT inter-changeable by just multiplying a constant!!!**

The screenshot shows the Herschel Archive interface. On the left, a file tree is visible under the 'Data' folder, containing subfolders 'level0\_5', 'level1', and 'level2'. Under 'level2', there are two main categories: 'extended emission maps (MJy/sr)' and 'point source maps (Jy/beam)'. The 'extended emission maps' category includes files like 'extdPLW', 'extdPLWdiag', 'extdPMW', 'extdPMWdiag', 'extdPSW', and 'extdPSWdiag'. The 'point source maps' category includes files like 'psrcPLW', 'psrcPLWdiag', 'psrcPMW', 'psrcPMWdiag', 'psrcPSW', and 'psrcPSWdiag'. The main window displays a map visualization of the 'extdPLW' file, showing a bright, irregularly shaped region with a color scale from black to orange. A mouse cursor is visible over the map. At the bottom of the window, there is a status bar with the following information: '79.6, 36.1 | 8.5120 MJy/sr | 13:55:17.253, -66:28:01.24 | Image'. Below the status bar, there are several icons for zooming and a numerical display showing '2.35', '7.2', and '99.5%'.

extended emission maps (MJy/sr)

point source maps (Jy/beam)





obsid\_1342183475.refs["level2"...oduct.refs["extdPLW"].product

56.0, 61.0 | 8.5717 MJy/sr | 13:54:19.130, -66:33:31.81 | Image

2.60 | 7.2 | 99.5%





Meta Data

name	value	unit	description
description	Diagnostic Tabledataset for Destriper		Name of this product
instrument	SPIRE		Instrument attached to this product
arrayName	PLW		Name of bolometer array
chiSquareAll	798.7161171658684		Sum of chiSquares
validTimelines	492		Total number of valid signal timelines in Level1
convergedTi...	480		Total number of converged signal timelines
iterThresh	1.0E-10		Threshold used to determine chiSqure conver...
maxIter	100		Maximum number of iterations

Data

obsid\_1342183475.refs["level2"...product["PLWDiagnosticTable"]]

Index	channelName	detIndex	scanNumber	iter	chiSqu:
2	PLWA3	164	0	1	1.308272584
3	PLWA4	165	0	1	1.810243801
4	PLWA5	156	0	1	1.834509663
5	PLWA6	148	0	0	0.0
6	PLWA7	147	0	7	2.020754456
7	PLWA8	146	0	13	1.907281040
8	PLWA9	149	0	2	2.389517200
9	PLWB1	163	0	1	1.311624825
10	PLWB2	162	0	1	1.687998357
11	PLWB3	160	0	1	1.547482805
12	PLWB4	158	0	1	1.445467177
13	PLWB5	154	0	1	1.845987951
14	PLWB6	155	0	4	1.849501713
15	PLWB7	152	0	2	1.780900321
16	PLWB8	151	0	2	1.940607889



**ssoMaps:**  
Including  
SSO motion  
correction

Summary

AOR label:	Calibration_phot_1-SPhoto-15x15ABRep1-Neptune	Obs. ID:	1342186882
Instrument:	SPIRE	Obs. Date:	2009-11-11T08:37:05Z
Object:	Neptune	Obs. Mode:	Large Map
AOT:	Photometer	RA Nominal:	21h 44m 2.54s
RA Nominal:	21h 44m 2.54s	Dec. Nominal:	-14° 4' 23.67"
SPG Version:	SPG v12.1.0	Operational Day:	181
Bias Mode:	nominal	Total Repetitions:	1

Meta Data

Data

- level2
  - extdPLW
  - extdPLWdiag
  - extdPMW
  - extdPMWdiag
  - extdPSW
  - extdPSWdiag
  - psrcPLW
  - psrcPLWdiag
  - psrcPMW
  - psrcPMWdiag
  - psrcPSW
  - psrcPSWdiag
  - ssoPLW**
    - image
    - error
    - coverage
    - History
  - ssoPLWdiag
  - ssoPMW
  - ssoPMWdiag
  - ssoPSW
  - ssoPSWdiag
  - logObsContext

obsid\_v1342186882.refs["level2"].product.refs["ssoPLW"].product

89.0, 122.5    -0.00051306 Jy/beam    21:43:18.751, -14:03:03.87    Image

1.61    -0.066    99.5%    0.99

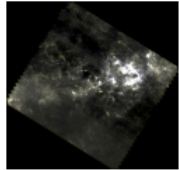


## Example: A parallel mode observation in a large survey (HiGal):

**Browse Product**

Summary

AOR label: SPPara-Orth - Field 305\_0  
Instrument: SPIRE      Obs. ID: 1342189083  
Object: Field 305\_0      Obs. Date: 2010-01-08T10:27:43Z  
AOT: Parallel Mode      Obs. Mode: Parallel Mode  
RA Nominal: 15h 16m 35.72s      Dec. Nominal: -62° 49' 20.56"  
SPG Version: SPG v11.1.0      Operational Day: 239  
Bias Mode: nominal



Meta Data

Data

- obsContext
- History
- auxiliary
- browseImageProduct
- browseProduct
- calibration
- level0
- level0\_5
- level1
- level2
- level2\_5**
  - browseProduct
  - extdPLW
  - extdPLWdiag
  - extdPMW
  - extdPMWdiag
  - extdPSW
  - extdPSWdiag
  - psrcPLW
  - psrcPLWdiag
  - psrcPMW
  - psrcPMWdiag
  - psrcPSW
  - psrcPSWdiag
- level3
  - 0
    - browseProduct
    - extdPLW
    - extdPMW
    - extdPSW
  - 1
- logObsContext
- quality
- qualitySummary

8526, 7637      25:11:43.100, +11:43:13.72

0.03      99.5%

**Level 2.5 for parallel mode observations only:**

- In PACS/SPIRE parallel mode, the cross scans for the same target have to be carried out in two separate observations (PACS cannot change the scan direction inside an observation).
- Therefore, the Level 2 maps of an obs in parallel mode include scans in a single direction, and their quality is inferior to maps with cross scans.
- The Level 2.5 maps, including cross scan data in the two observations for the same target, have much better quality.
- They have the same structure as Level 2 products.



## Example: A parallel mode observation in a large survey (HiGal):

**Browse Product**

Summary

AOR label:	SPPara-Orth - Field 305_0		
Instrument:	SPIRE	Obs. ID:	1342189083
Object:	Field 305_0	Obs. Date:	2010-01-08T10:27:43Z
AOT:	Parallel Mode	Obs. Mode:	Parallel Mode
RA Nominal:	13h 16m 35.72s	Dec. Nominal:	-62° 49' 20.56"
SPG Version:	SPG v11.1.0	Operational Day:	239
Bias Mode:	nominal		

Meta Data

Data

obsContext.refs["Level3"].product.refs[0].product.refs["browseProduct"].product

**Level 3: Mosaics of overlap observations belonging to the same proposal**

~ 45 deg × 4 deg

(the width of the survey is ~ 90 deg, therefore there is another mosaic covering the other half of the survey)

8526, 7637      25:11:43.100, +11:43:13.72

0.03      99.5%



- For a given SPIRE Photometer observation, all data products are organized within a single **Observation Context**.
- Major products are in the following **Levels**:
  - Level 0: Raw data.
  - Level 0.5: Data converted to engineering units.
  - **Level 1: Calibrated scan timelines (in astrophysical units).**
  - **Level 2: Maps (and diagnostic tables).**
  - Level 2.5: Maps of *combined parallel observations* with cross-scans (with the same structures as the Level 2 products).
  - Level 3: Mosaics of overlap observations belonging to the same proposal.
- If you want to make a SPIRE Photometer map using your own mapmaker, all you need are the **Level 1 products (timelines of flux, RA, Dec, etc.)**.
- **Level 2 products** include three different types of maps made by a naïve mapmaker (pipeline default):
  1. point source maps (psrcMaps: in Jy/beam).
  2. extended emission maps (extdMaps: in MJy/sr).
  3. ssoMaps (for solar system objects only, with sso motion correction).