Where putting all eggs into one basket makes sense ...
Data Processing Software

- Provide common DP software product
  - across all three Herschel instruments
  - used by astronomers and calibration scientists
  - used by HSC and ICCs for standard product generation
  - with similar interfaces and look-and-feel
  - across all mission phases

- Same software & easy to install
  - for automated/batch data processing
  - for interactive analysis

- Easy, direct and transparent access to all
  - products (standard, calibration, auxiliary, browse) products
  - tools, algorithms & pipelines

To get the best science possible out of the Herschel mission
Data Processing: from cradle to grave

- Instrument level tests
- Pre-launch system operational verification tests
- Check-out and performance verification phase
- Operations
- Post operations
- Herschel legacy archive

Smooth transition
Data processing: software faces

- **Interactive Analysis Applications**
  - Observer IA
  - Calibration IA
  - Quick Look

- **Product Generation Applications**
  - Standard
  - Bulk re-processing
  - On-demand
  - Quality Control

- **Languages in use**
  - Java (core)
  - Jython (scripting, pipelines)
  - XML/HTML (documentation)
Product generator framework

**Data Model: Products**

**Pipeline Registry**
(jython script)

**Plug-in Registry**

**I/O: Product Access Layer**

**Processing of single observation**

- HOD
- PAL
- PAL: Scratch
- Observation Context

**Process**
- Observers Pipeline
  - generate LevelIX
- Process
  - Produce Quality
  - Ingest into Archive
- Produce Level0
- Find Cal Data
- Find Aux data

**PAL: Archive**

**Observation Context**
Software Commonality

- HIFI, PACS, SPIRE specific
  - Pipelines, tasks
  - Calibration
  - (Interactive) tasks
  - Data viewers

- Common DP
  - Framework
  - Shared implementations

✔ Across mission phases
  ✔ improved code

✔ Reused by all instruments
  ✔ better tested
DP Framework aspects

- **Data framework**
  - Products
  - Meta data
  - Datasets
  - Numeric arrays

- **I/O framework**
  - Product Access Layer
  - Versant Object database
  - FITS, ASCII, ...
  - Virtual Observatory tools

- **Processing framework**
  - Numeric algorithms
  - Tasks
  - Pipelines
  - Product generator

- **GUI framework**
  - Views
  - Editors
  - Perspectives
  - Triggers
Data framework: observation representation

### HRS Spectrum Dataset

<table>
<thead>
<tr>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AOR label:</strong> Calibration_PM_9-Aot2_M_DBSNoC_1b_H2O_NH3_L1448</td>
</tr>
<tr>
<td><strong>Instrument:</strong> HIFI</td>
</tr>
<tr>
<td><strong>Object:</strong> L1448-R3</td>
</tr>
<tr>
<td><strong>AOT:</strong> Mapping</td>
</tr>
<tr>
<td><strong>RA Nominal:</strong> 3h 25m 41.4s</td>
</tr>
<tr>
<td><strong>Dec. Nominal:</strong> 30° 42' 50&quot;</td>
</tr>
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<td><strong>SPG Version:</strong> SPG v8.2.1</td>
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<tr>
<td><strong>Obs. ID:</strong> 1342190837</td>
</tr>
<tr>
<td><strong>Obs. Date:</strong> 2010-02-19T03:28:08Z</td>
</tr>
<tr>
<td><strong>Obs. Mode:</strong> DBS Raster fastChop</td>
</tr>
<tr>
<td><strong>Operational Day:</strong> 281</td>
</tr>
</tbody>
</table>

### Meta Data

- **Data**
  - obs.refs["level2"].product...."box_001".product["0001"]
  - Lower sideband frequency (GHz)
Data Processing: quick facts

- **Observation availability**
  - typically 24H after observing
  - Level 0 - raw, 1, 2 – fully calibrated images and spectra

- **Available Data**
  - ~1500 operational days (OD), containing
  - >60000 observations processed (science, calibration, engineering)

- **Bulk re-processing capacity**
  - 90 OD/day *peak* | 70 OD/day *sustained*  =>  26 OD/day *overall*
    - contingencies
    - consolidation
    - extended processing (combining observations)
Deployment: grid

Univa Grid 8.x (Oracle DRMAA API)

- 256GB
- 64GB
- 32GB
- 16GB
- 24CPU
- 20CPU
- 8CPU

Versant

MOC files

- HSA Read/Write
- SPG daemon
- HSA proxy
- HSA broker
- PM
- QCR
- Aux Monitor 1
- Aux Monitor 2
- Aux Monitor N

HSA

Versant

MOC files
Deployment: versions

Operations: v10.3.0
v11.0.1

Integration: v11.1.0

Staging: v11.0.2

Devel: v12.0.0
Continuous Integration Build system

- Projects: 12
- Modules: 250
- LOC: 4300000

15 module versions delivered per day
Development: continuous integration builds

HCSS Software: Continuous Integration Builds

**Disclaimer of Warranty**

You have entered the daily builds as a developer. This document is provided to the extent permitted by applicable law and without warranty of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The risk of damage from using it is assumed by you.

**Next branch to analyze**

Build delivered: 2012-07-17 22:43:28 +0200 0:29:14

- hsc_common
- hssodb
- hssdp_core
- hssdp_effe
- hssdp_pacs
- hssdp_ssp
- hsservices
- hsscripts
- hsservices
- hcsspcc
- hcsscirc

Elapsed time: 0:29:14

Comments:

- ia_obs_quality-10.2
- share-1.330
- hifi_pipeline_product-0.264
- spire_adpipeline_spc_util
- pacs_spd_spp_phot-10.24
- share_io-0.75
- spire_adpipeline_spc_util

**Developer Tracks**

<table>
<thead>
<tr>
<th>track</th>
<th>status</th>
<th>date</th>
<th>time</th>
<th>duration</th>
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<td>1.0</td>
<td>Development</td>
<td>2012-07-17 22:43:28</td>
<td>0:29:14</td>
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<td>3.0</td>
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<td>2012-07-17 22:43:28</td>
<td>0:29:14</td>
<td></td>
</tr>
</tbody>
</table>

**Build Steps**

Time taken for this build is 23:11 (mm:ss).

Execution of tests revealed a total coverage of 89% of the instructions (1253378/1813728).

**Coverage of ia_dataset_spectrum-1.130**

---

**Package Summary**

<table>
<thead>
<tr>
<th>package</th>
<th>class</th>
<th>method</th>
<th>instruction</th>
<th>line</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>herschel.ia.dataset.spectrum</td>
<td>82</td>
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<td>268 4 738 875 82 11625 14233 82 2236 2739</td>
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<td>herschel.ia.dataset.spectrum.handler</td>
<td>100</td>
<td>27</td>
<td>27 88 556 649 33 7707 8320 82 1382 1508</td>
<td>82 90</td>
<td>27</td>
</tr>
</tbody>
</table>
Development: automatic (nightly) tester

Real Data!

Real pipelines!

Testcase: pacs_1342189066

⚠️ FAILED: herschel.ia.task.TaskException: An exception was thrown while processing in task specProject:
   herschel.ia.task.TaskException: Error in task specProject:
   java.lang.IllegalArgumentException: More than 4 input pixels overlap with the output pixel on which they are projected for module (4,4).

You may wish to view the testcase log.

Due to the status of this testcase, there are no products to analyse.
HIPE: everything into a GUI

- All features above
- Integrated in a GUI
- Jython console
- Jython editor
- Data browsers & query
- With comprehensive documentation

- For everybody to use
- Inside or outside Herschel
- Easy to install
- No commercial license
- Download for free

Freely available!
Open Source: GNU LGPL v3
HIPE: usage

1. Direct access to the archive

2. Observation summary w/ systematic products

3. All data (raw to high-level)

4. Simple data visualization

6. Dual: interactive and fully scriptable
High level products

- Level 2.5: scan/cross-scan combined
  - Two tiles of the galactic plane programme: Hi-Gal
High level products

Level 3: full programme

- SPIRE mosaic
- Systematic Pipeline product
- Available with HIPE 11 from the Herschel Science Archive

View of 45 tiles (90°) of the Galactic Plane at 250 µm (here in degraded resolution)

Credits ESA/PACS & SPIRE Consortia, Sergio Molinari, Hi-GAL Project
HIPE: on the web

Herschel Interactive Processing Environment

Download and reprocess Herschel data, perform interactive analysis, export your results to FITS and to other applications!

Download
Install HIPE 11.0.0 on your favourite platform:
- Mac OS
- Read me first

Get Herschel data
Or browse them from your smartphone!
- Herschel Archive
- iPhone app
- Android app

Documentation
Learn about HIPE and instrument data reduction.
- HIPE help
- Watch us

Support
Ask the Helpdesk or look for our tips on Twitter.
- Helpdesk
- Follow us

Community
Discuss with peers and contribute to HIPE.
- Community
- Contribute
- Plug-ins

About Herschel
Learn more about Herschel and its instruments.
- Herschel home
- HIFI
- PACS
- SPIRE
Some links to Herschel DP software

- **HIPE**
  - [http://herschel.esac.esa.int/hipe/](http://herschel.esac.esa.int/hipe/)

- **Continuous Integration System**
  - [http://herschel.esac.esa.int/hcss/build.php](http://herschel.esac.esa.int/hcss/build.php)

- **Automatic Tester**
  - [http://herschel.esac.esa.int/at/](http://herschel.esac.esa.int/at/)

- **Code Quality**
  - [http://herschel.esac.esa.int/sonar/](http://herschel.esac.esa.int/sonar/)