Herschel Data Processing

Where putting all eggs into one basket makes sense ...

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SCIOPS 2013
on behalf of the Data Processing team

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

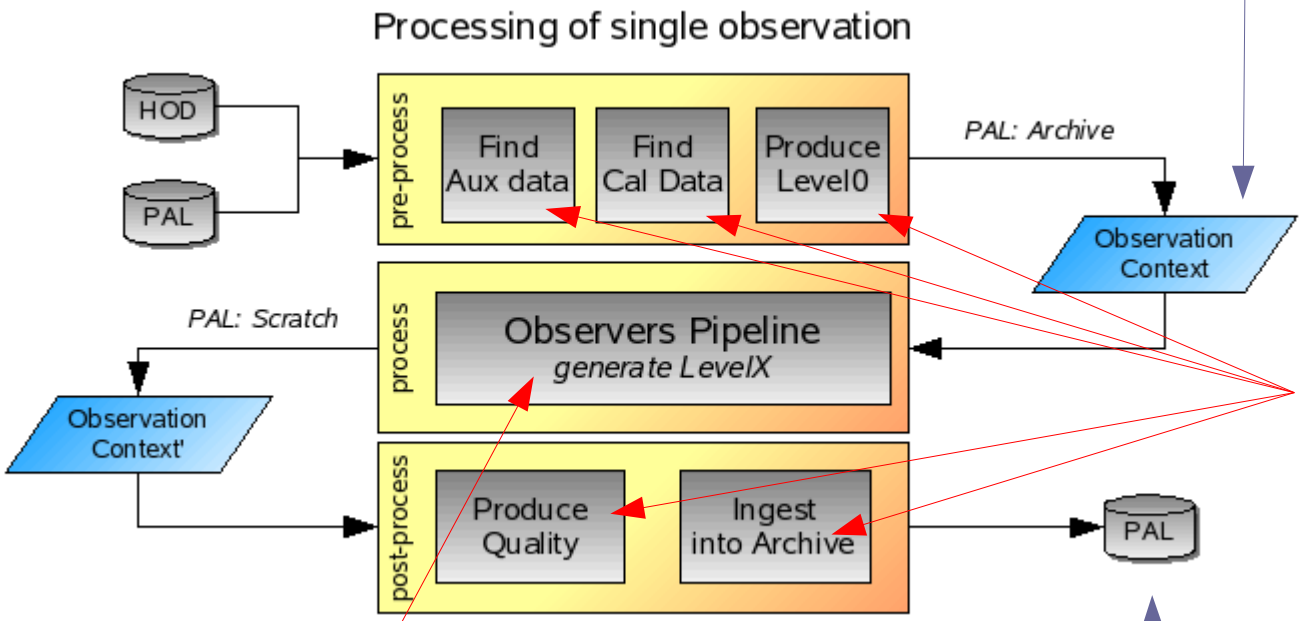
Smooth transition

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



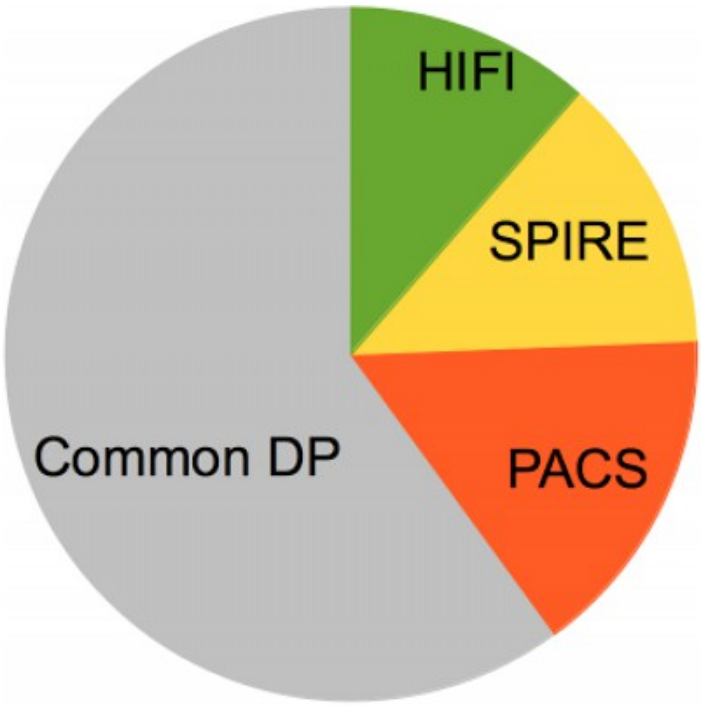
Plug-in Registry

Pipeline Registry (jython script)

I/O:Product Access Layer

Software Commonality

- **HIFI, PACS, SPIRE specific**
  - Pipelines, tasks
  - Calibration
  - (Interactive) tasks
  - Data viewers
- **Common DP**
  - Framework
  - Shared implementations



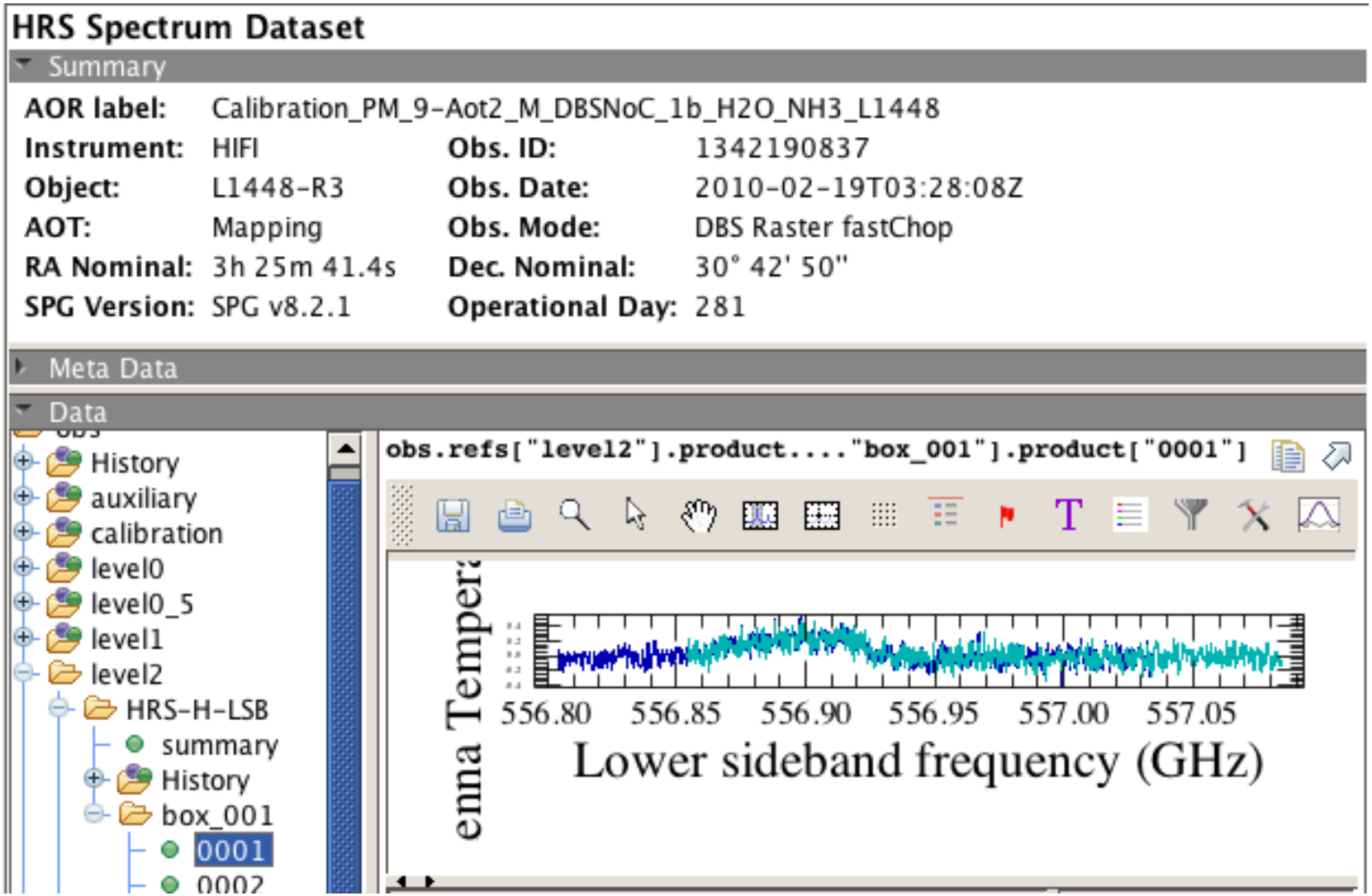
✔ **Across mission phases**
  ✔ improved code

✔ **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

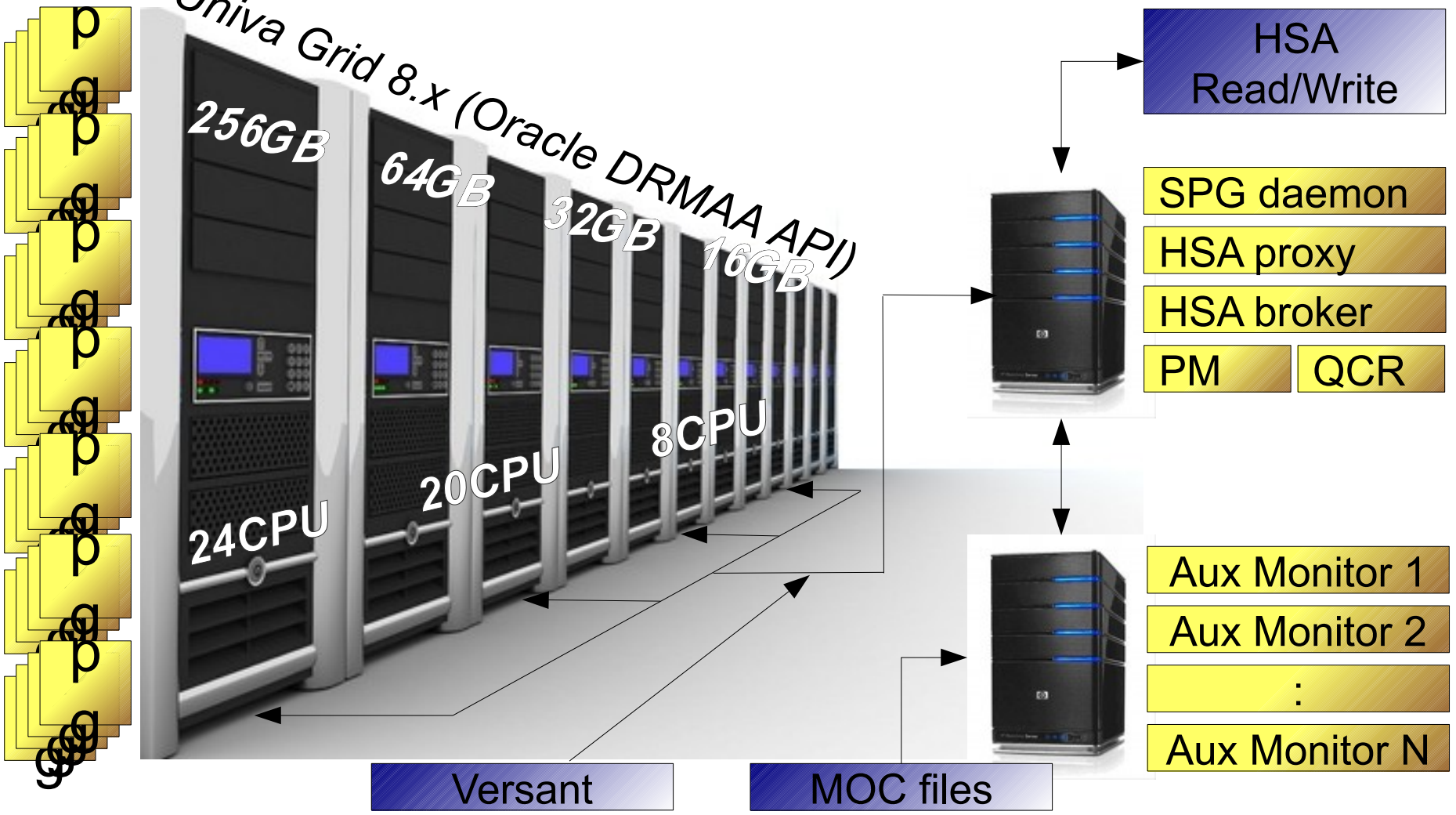
Data framework: observation representation



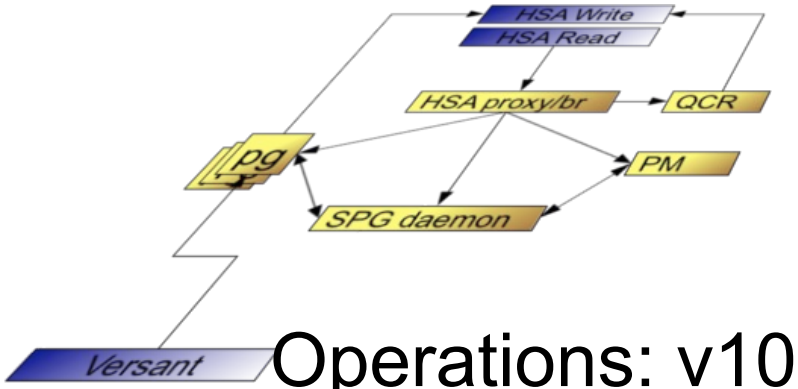
Data Processing: quick facts

- **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

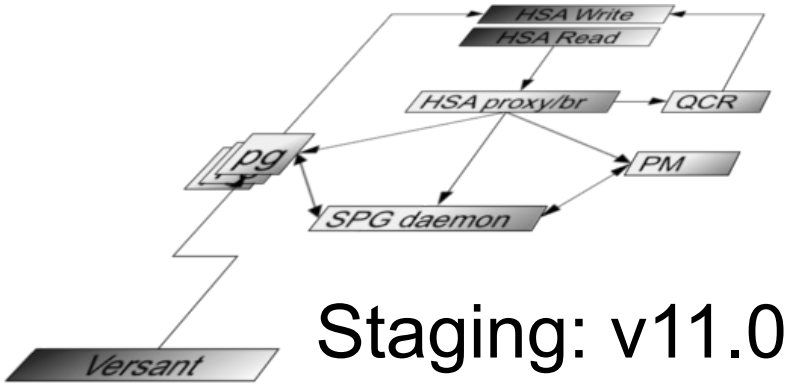


Deployment: versions

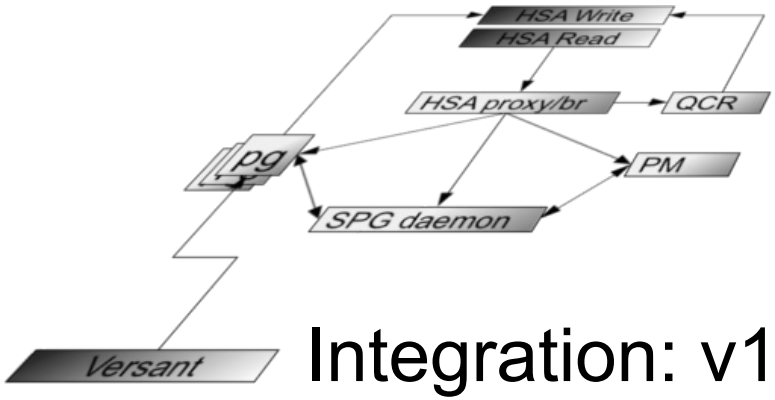


Operations: v10.3.0

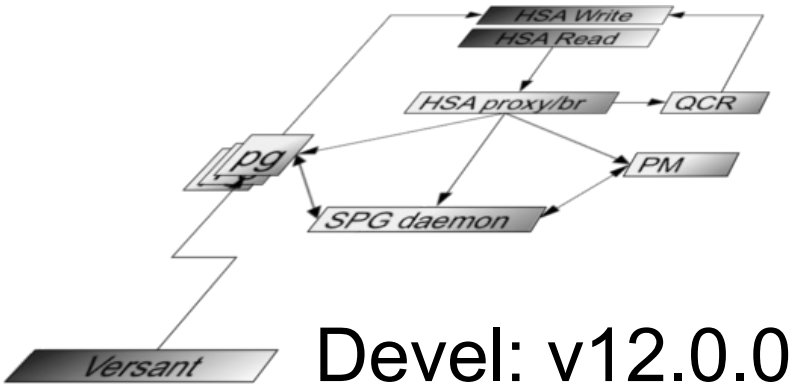
v11.0.1



Staging: v11.0.2



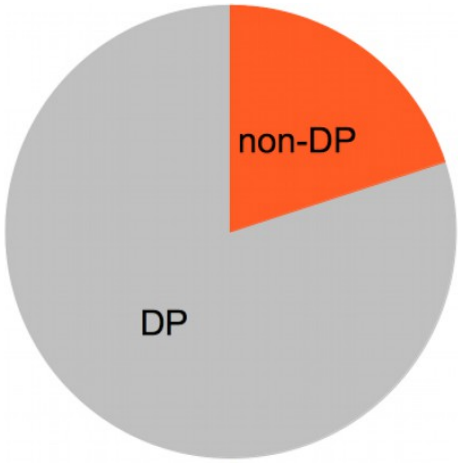
Integration: v11.1.0



Devel: v12.0.0

Continuous Integration Build system

- Projects 12
- Modules 250
- LOC 4300000



C
I
B

15 module versions delivered per day

Development: continuous integration builds

HCSS Software: Continuous Integration Builds

CIB status: IDLE

Disclaimer of Warranty

You have entered the daily build
to the extent permitted by applic
Developer builds are provided "
implied warranties of merchanta
builds is with you. Should any o

Next branch to ar

Code freeze for HCSS v

09 | 02
Days Hours

Wed Oct 17 2012 12:00:00

Developer Tracks

track	status
10.0	Development
9.0	Release testing
8.0	Operational
track	status

build	delivered	elapsed	hcss.common	hcss.odb	hcss.dp.core	hcss.dp.hifi	hcss.dp.pacs	hcss.dp.spire	hcss.apps	hcss.hscops	hcss.services	hcss.dp.all	hcss.icc.hifi	hcss.icc.pacs	hcss.icc.spire	hcss	comments
1280	2012-07-17 22:43:28 +0200	0:29:34	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	ia_obs_quality-10.2
1279	2012-07-17 22:11:10 +0200	1:01:19	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	share-1.330
1278	2012-07-17 21:07:06 +0200	0:14:37	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	hifi_pipeline_product-0.294
1277	2012-07-17 20:49:52 +0200	0:08:06	✓	✓	✓	✓	✓	✗	✓	✓	✓		✓	✓			spire_ia_pipeline_spec_util-
1276	2012-07-17 20:38:54 +0200	0:13:50	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	pacs_spg_phot-10.24
1275	2012-07-17 20:22:04 +0200	0:19:07	✓	✓	✗				✓								share_io-0.75
1274	2012-07-17 20:00:30 +0200	0:08:31	✓	✓	✓	✓	✓	✗	✓	✓	✓		✓	✓			spire_ia_pipeline_spec_util-
1273	2012-07-17 1																
1272	2012-07-17 1																
1271	2012-07-17 1																
1270	2012-07-17 1																
1269	2012-07-17 1																
1268	2012-07-17 1																
1267	2012-07-17 1																
1266	2012-07-17 1																

Build Steps

Time taken for this build is **23:11** (mm:ss).
Execution of tests revealed a total coverage of **69%** of the instructions (1253376/1813728).

module	status	version	compile main	compile test	test	coverage %	coverage #	size (MB) devel	size (MB) user	elapsed mm:ss
access		1.82	✓	✓	✓	56	18670	2.45	0.46	0:40
auxprocessors		9.15	✓	✓	✓	65	25145	14.07	0.46	2:21
binstruct		9.4	✓	✓	✓	77	40128	13.29	0.32	1:00
calsdb		4.20								
ia		1.1								
ia_dataflow		1.58								
ia_dataset		2.11								
ia_dataset_gui		10.12								
ia_dataset_history		0.31								
ia_dataset_image		10.5								
ia_dataset_spectrum		1.130								
ia_doc		0.178								
ia_document		1.300								
ia_document_pdd		1.4								
ia_document_pythontest		1.14								
ia_gui_apps		10.28								
ia_gui_ccm		1.14								
ia_gui_cube		10.30								

C I B

Coverage of ia_dataset_spectrum-1.130

See also the notes!

Module Summary

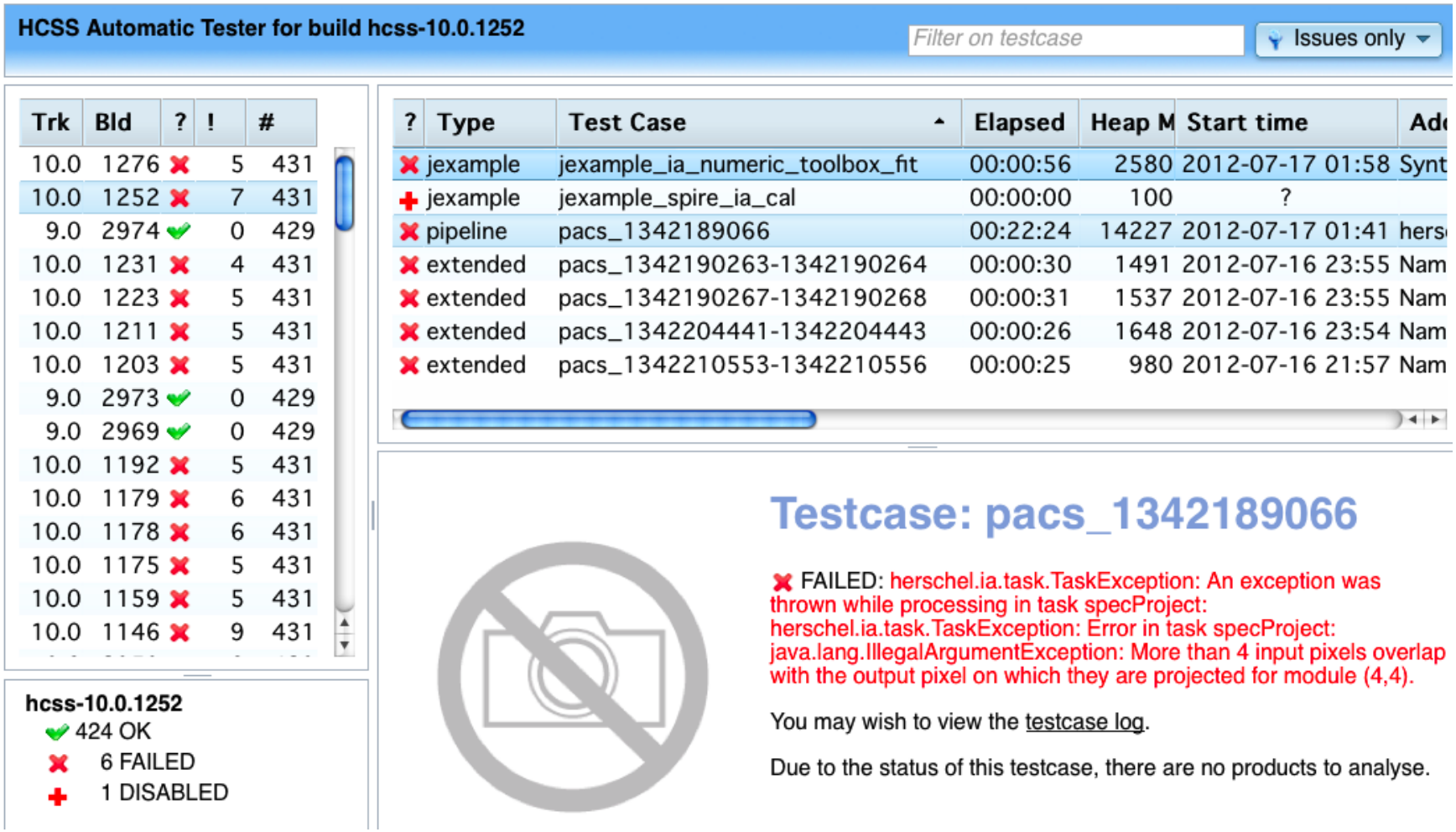
module info	%	covered	total
packages	-	-	2
files	-	-	46
classes	96	51	53
methods	85	1294	1524
executable lines	85	3618	4247
instructions	86	19332	22553

Package Summary

package	class %	class cov	class sum	method %	method cov	method sum	instruction %	instruction cov	instruction sum	line %	line cov	line sum
herschel.ia.dataset.spectrum	92	24	26	84	738	875	82	11625	14233	82	2236	2739
herschel.ia.dataset.spectrum.handler	100	27	27	86	556	649	93	7707	8320	92	1382	1508

Development: automatic (nightly) tester

- Real Data!
- Real pipelines!



HIPE: everything into a GUI

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

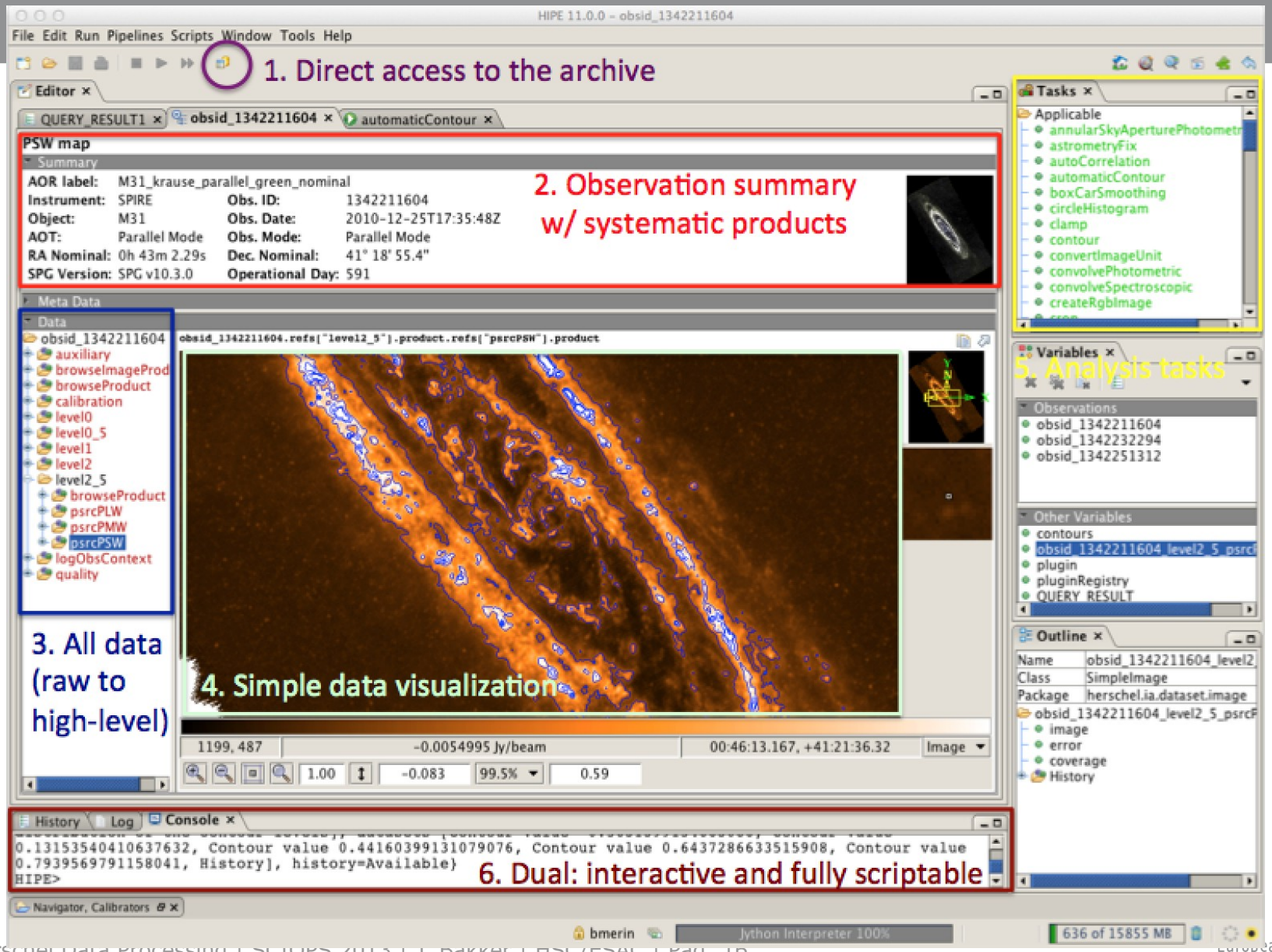
- For everybody to use
- Inside or outside Herschel
- Easy to install

- No commercial license
- Download for free

Freely available!

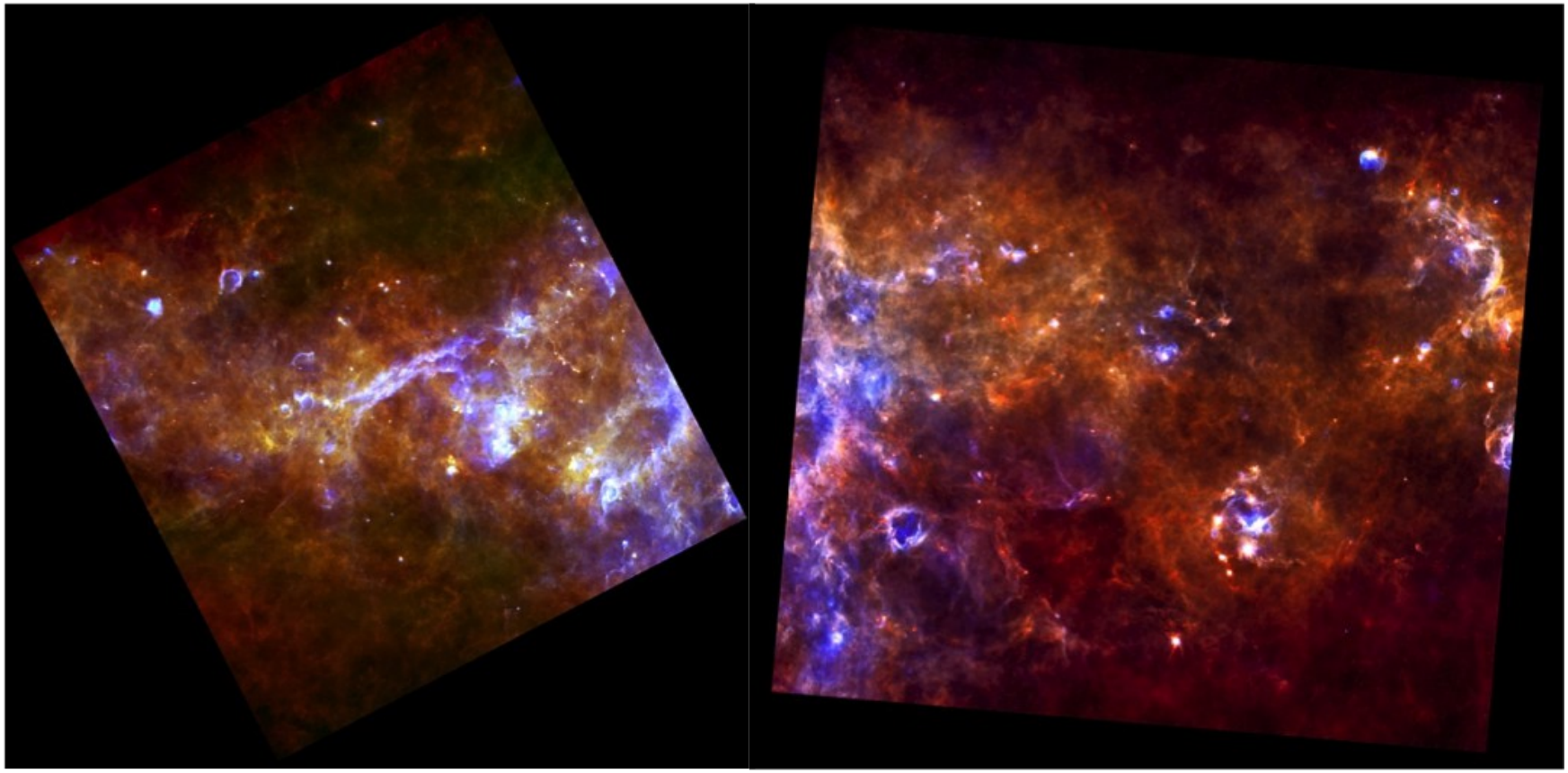
Open Source: GNU LGPL v3

HIPE: usage


HIPE 11.0.0 - obsid_1342211604
File Edit Run Pipelines Scripts Window Tools Help
1. Direct access to the archive
Editor
QUERY_RESULT1
obsid_1342211604
automaticContour
PSW map
Summary
AOR label: M31_krause_parallel_green_nominal
Instrument: SPIRE
Obs. ID: 1342211604
Object: M31
Obs. Date: 2010-12-25T17:35:48Z
AOT: Parallel Mode
Obs. Mode: Parallel Mode
RA Nominal: 0h 43m 2.29s
Dec. Nominal: 41° 18' 55.4"
SPG Version: SPG v10.3.0
Operational Day: 591
2. Observation summary w/ systematic products
Meta Data
Data
obsid_1342211604
auxiliary
browseImageProd
browseProduct
calibration
level0
level0_5
level1
level2
level2_5
browseProduct
psrcPLW
psrcPMW
psrcPSW
logObsContext
quality
3. All data (raw to high-level)
obsid_1342211604.refs["level2_5"].product.refs["psrcPSW"].product
4. Simple data visualization
1199, 487
-0.0054995 Jy/beam
00:46:13.167, +41:21:36.32
Image
1.00
-0.083
99.5%
0.59
Tasks
Applicable
annularSkyAperturePhotometr
astrometryFix
autoCorrelation
automaticContour
boxCarSmoothing
circleHistogram
clamp
contour
convertImageUnit
convolvePhotometric
convolveSpectroscopic
createRgbImage
Variables
5. Analysis tasks
Observations
obsid_1342211604
obsid_1342232294
obsid_1342251312
Other Variables
contours
obsid_1342211604_level2_5_psrcP
plugin
pluginRegistry
QUERY_RESULT
Outline
Name obsid_1342211604_level2
Class SimpleImage
Package herschel.ia.dataset.image
obsid_1342211604_level2_5_psrcP
image
error
coverage
History
History
Log
Console
0.13153540410637632, Contour value 0.44160399131079076, Contour value 0.6437286633515908, Contour value 0.7939569791158041, History], history=Available}
HIPE>
6. Dual: interactive and fully scriptable
Navigator, Calibrators
bmerin
Jython Interpreter 100%
636 of 15855 MB

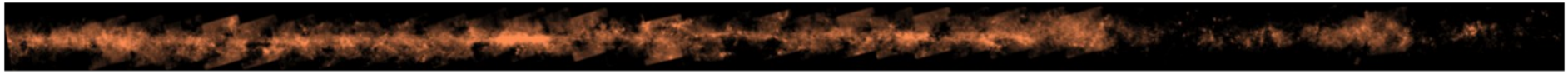
High level products

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



High level products

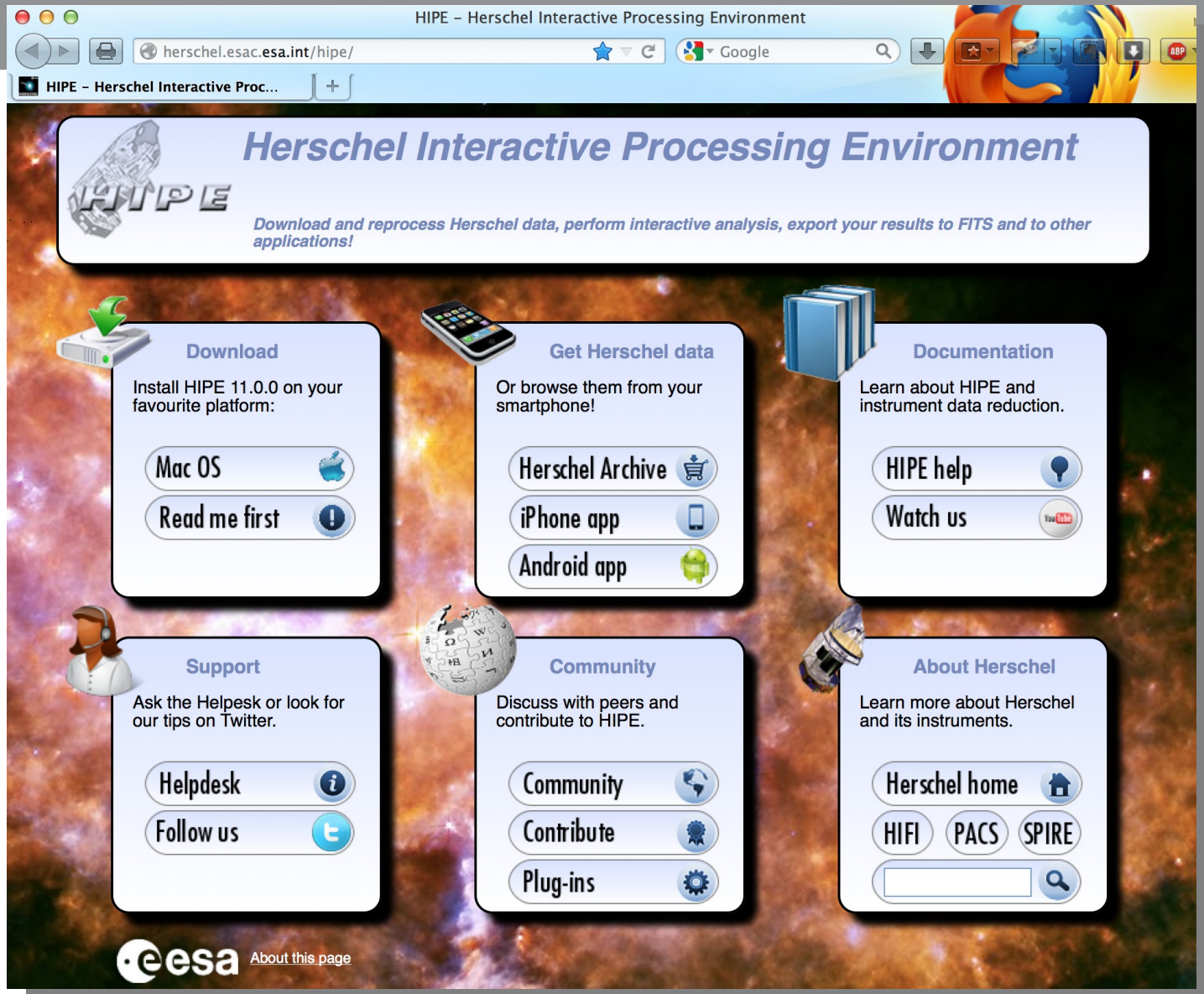
- **Level 3: full programme**
  - SPIRE mosaic
  - Systematic Pipeline product
  - Available with HIPE 11 from the Herschel Science Archive



View of 45 tiles (90º) 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



Some links to Herschel DP software

- **HIPE**
  - http://herschel.esac.esa.int/hipe/
- **Continuous Integration System**
  - http://herschel.esac.esa.int/hcss/build.php
- **Automatic Tester**
  - http://herschel.esac.esa.int/at/
- **Code Quality**
  - http://herschel.esac.esa.int/sonar/