Overview and the latest developments in Herschel Data Processing

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on behalf of all contributors of the Herschel mission
http://herschel.esac.esa.int/HerschelPeople.shtml

HERSCHEL SPACE OBSERVATORY

Overview

- **Overview of Herschel Data Processing**

- **Major improvements during the last year**

- **What we and HIPE can do for the Herschel community**

- **Planned improvements and milestones**

- **What you can do for the Herschel community**

- **Questions?**

Aquila / W40 observed by Herschel

ESA and the SPIRE & PACS consortia, Ph. André (CEA Saclay) for the Gould's Belt Key Programme Consortia

Data Processing Workshop
NHSC, Pasadena, CA
10 – 14 September 2012
Stephan Ott   VG #2
http://herschel.esac.esa.int/

Overview of Herschel Data Processing

Eagle Nebula, credits ESA/PACS& SPIRE Consortium, Tracey Hill, Frédérique Motte, Laboratoire AIM Paris - Saclay, CEA/IRFU - CNRS/INSU - Uni. Paris Diderot, HOBYS Key Programme Consortia

Overview of Herschel Data Processing

- **The system combines for the first time data retrieval, pipeline execution and scientific analysis in one single environment**

- **All tools for data reduction and analysis, e.g. also the expert applications for e.g. instrument calibration are part of the Data Processing System. Therefore the community has access to the same system as the instrument experts**

- **The Herschel Data Processing software is coded in Java/Jython to be license free and portable for different operating systems**

- **Formal support is provided for Windows XP, Vista and Windows 7,Linux, Mac OS X 10.5 ("Leopard"), 10.6 ("Snow Leopard") and 10.7 ("Lion")**

- **Herschel Science Centre (ESA), the Instrument Control Centres (HIFI, PACS and SPIRE) and NHSC jointly manage and contribute to the Herschel Data Processing System**
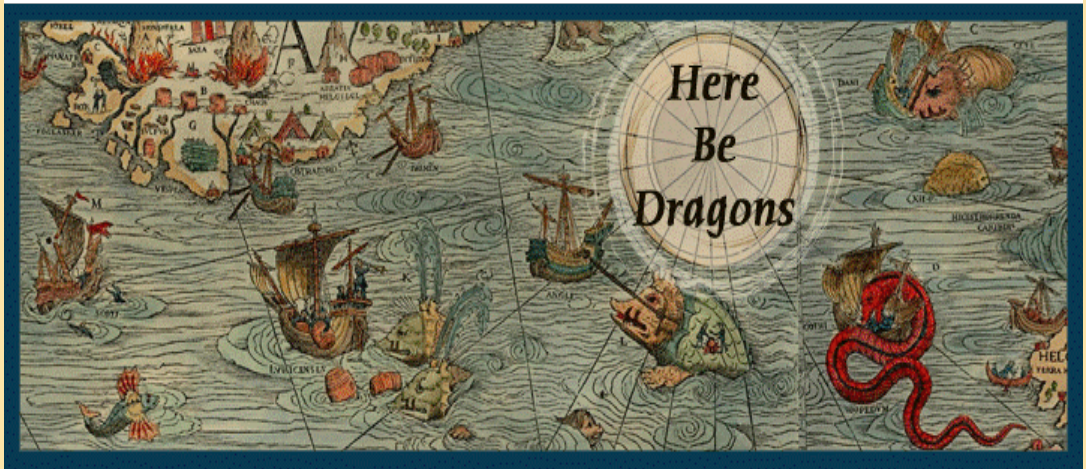
Overview of Herschel Data Processing

- **Herschel Data Processing is a major project, with over 200 contributors and currently 60 full-time equivalents working on calibration, coding, documentation, pipeline operations, quality control, testing and tutori**

- **Very distributed developm often 24/7) on Herschel Da**

- **350 data processing relate raised – and resolved – ea**

- **A major version is release months. For the _H_erschel _E_nvironment the is curren**

- **Minor versions are release HIPE 9.1 to be released so versions serve also as the generate the standard pro**

You are about to enter the Continuous Integration Build (CIB) system pages. These pages contain instances of HIPE in different stages of development. They have not been fully tested and may be unstable and/or unsuitable for your purposes. Some important functionality may be missing from these builds.

- **All HIPE user releases can be downloaded via http://herschel.esac.esa.int/HIPE_download.shtml**

- **Latest HIPE developer releases are available via http://herschel.esac.esa.int/CIB_disclaimer.html**

Here Be Dragons

Major improvements during the last year

Highlights of user tools, HIPE and pipeline system improvements

- **Reduction of crashes and freezes**

- **User friendliness (task-variable association and tooltips)**

- **Upgrade of Jython (HIPE's interpreter) from 2.1 to 2.5.2**

- **Shielding installer against corruption due to network problems**

- **New cube toolbox replaces the Cube Spectrum Analysis Toolbox (CSAT). Common look and feel with the Spectrum Explorer and improved algorithms**

- **Easier data access. Handling Herschel data is now easier with the improved MyHSA getObservation task**

- **Support for DS9 to display and process Herschel images**

- **All SED models for asteroid observations have been added to the ESAC database**

HERSCHEL SPACE OBSERVATORY

esa

HiFi ICC

nhsc

PACS

SPIRE

Highlights of user tools, HIPE and pipeline system improvements

- **Revamp of organisation of HIPE Owner's Guide. Addition of a human made index to three core manuals:** *HIPE Owner's Guide*, *Data Analysis Guide* **and** *Scripting* **and** *Data Mining Guide*

- **Possibility to leave comments on documentation at the bottom of any page in the HIPE Help System**

- **Official support to OS X 10.7 "Lion"**

- **Creation of a YouTube channel of videos tutorials and a Twitter channel of daily tips: http://www.youtube.com/hipeacademy https://twitter.com/learnhipe**

- **The complete overview can be found at http://herschel.esac.esa.int/twiki/bin/view/Public/HipeWhatsNew9x**

DS 9 support

You can now see DS9 appear in the Send To menu in HIPE

The resulting image after sending it to HIPE by clicking "SAOImage DS9" in the Send To menu

First connect to the VO in DS9

App to access Herschel Quick Look Products for Android and iPhone
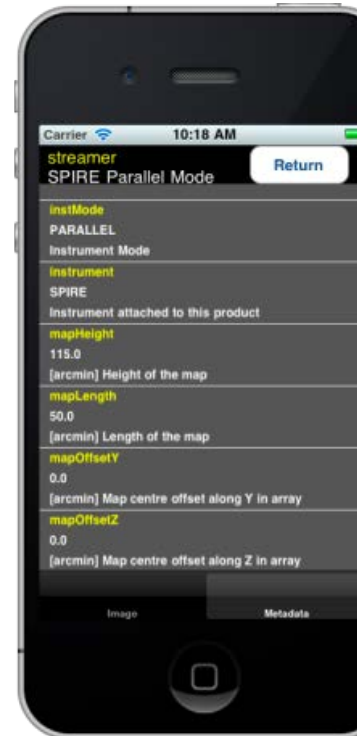
Highlights of HIFI improvements

- **40% noise reduction and improved baseline quality for level 1 products of all observations performed in bands 6 and 7**

- **HIFI level 2.5 product. For Spectral Scans it holds the deconvolved single sideband solutions; for maps it holds the cubes; for all cases it holds a copy of the level 2 HTP**

- **Browse products for simple spectra, spectral scans and maps, updated browse images for point mode observations**

- **HIFI pipeline task GUI, new interactive pipeline between level 2 and 2.5. This allows the insertion of optional pipeline steps like fitHifiFringe and fitBaseline to reduce or eliminate standing waves for strong continuum sources**

- **The HIFI User's Manual changed name to HIFI Data Reduction Guide, chapters were rearranged into more logical order**

- **Addition of several chapters (introduction, chapter, quick start guide, DBS Point Mode cookbook, "How to flag and remove flags from your data" and Unit Conversion)**

PACS
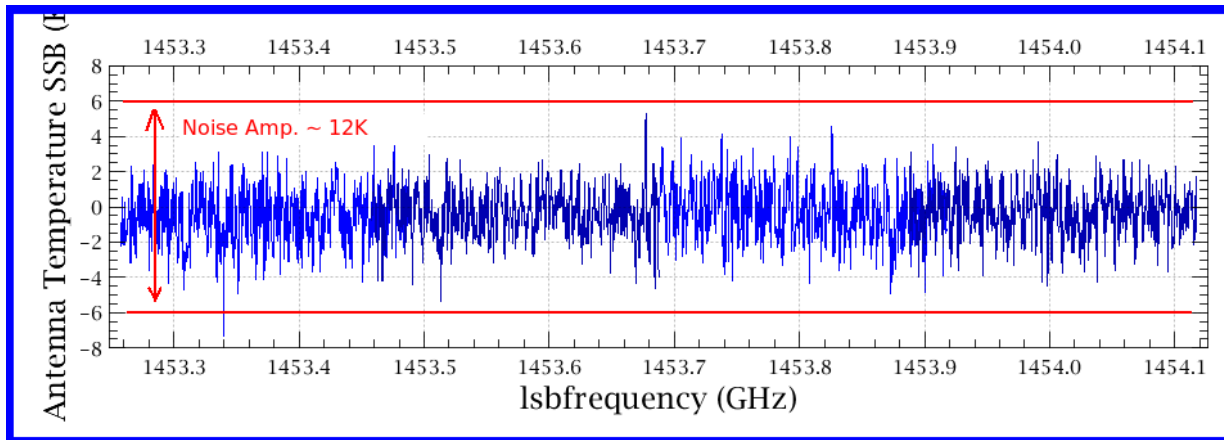
Improvements for HIFI products
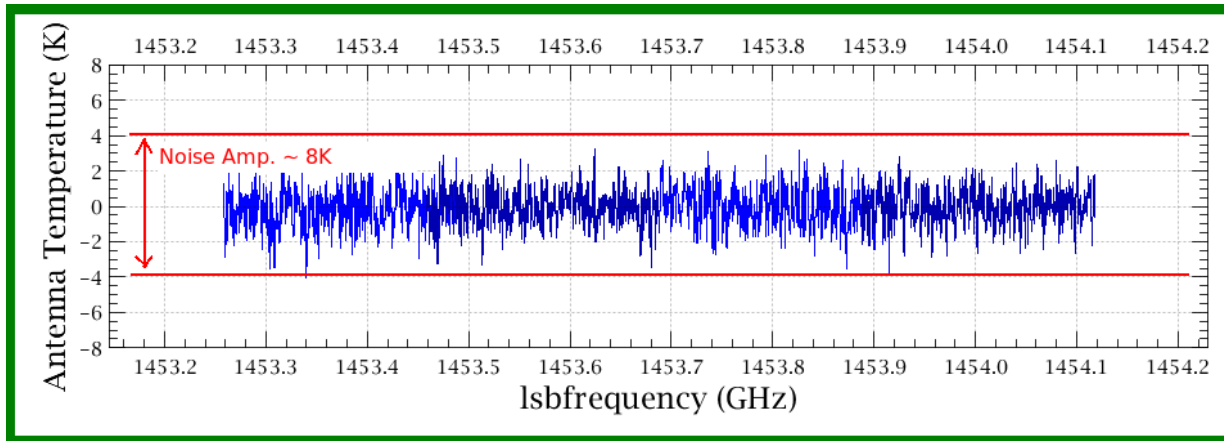

HCSS 7

HCSS 8

40% noise reduction in HIFI pipeline products

Improvements for HIFI products

Deconvolved spectrum is created and attached to the observations by the automatic (SPG) pipeline for Spectral Scans

SPG v9.0 Pipeline deconvolved Spectrum (L2.5 product)
Object : ORION-KL
Observing Mode : Spectral Scan (Band : 2a)
Observer : KPGT_ebergin_1 (HEXOS)
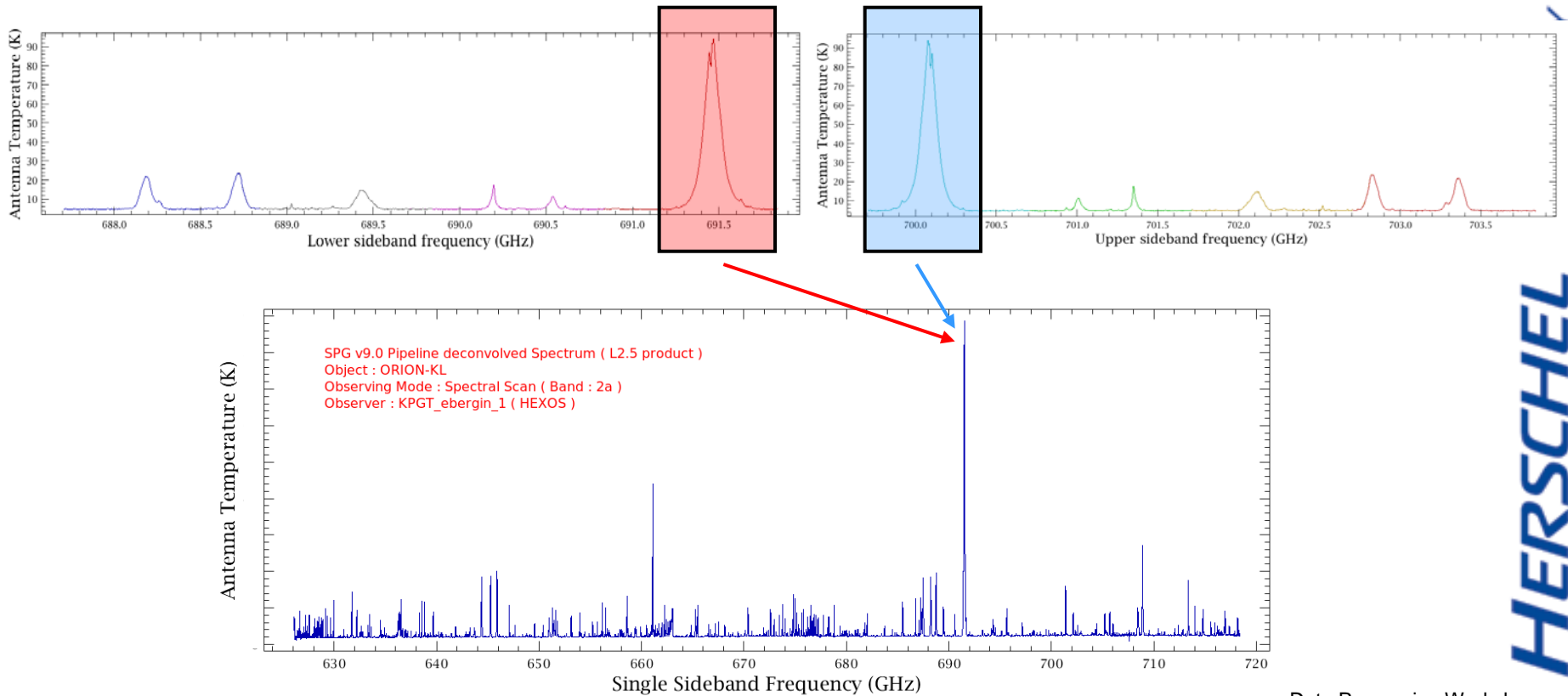
Improvements for HIFI products

Browse product is created and attached to the observations by the automatic (SPG) pipeline for Mapping modes
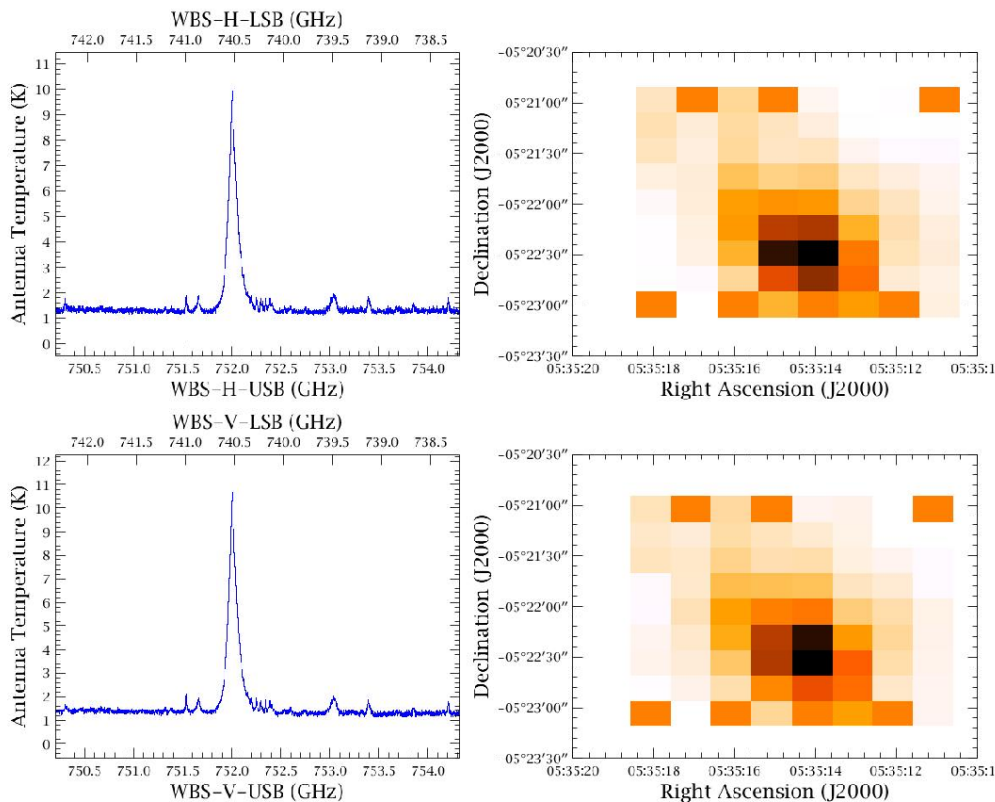
ORION Small Map

2' * 2'

Highlights of PACS improvements

- ## General
  - Improved viewers for inspecting / masking datapoints
  - Improved saving intermediate results on standard desktop machines with little memory

- ## Photometer and spectrometer browse products

- ## Photometer
  - Transient correction for miniscan map
  - Cross-talk correction for red channel
  - Addressing additional specific cases in new interactive pipeline scripts.
  - Improved MADmap scripts with a new pre-processing and a post-processing task to remove bright point-source artifacts

Highlights of PACS improvements

- ## Spectrometer
  - **Interactive reduction scripts for all observing modes**
  - **Improved spectral flatfielding for wide spectral ranges**
  - **Background normalisation method for chop/nod observations leads to improved flux calibration**
  - **Error propagation for Level 2 PACS rebinned cubes product & error bars for significance tests of line detections**
  - **Improved pipeline processing for better reliability of broadband features**
  - **Level 2.5 product generation for unchopped range mode**
  - **Correction for flux losses due to pointing jitter and pointing offset**
  - **Flux extraction for point-sources. Use of central 3x3 spaxel fluxes for a more reliable beam correction. Improved error propagation**
  - **Correction of SSO pointing coordinates**
  - **Improved drizzling routines**

Improvements for PACS photometric products

Level 2
@hcss 7.0

Level 2
@hcss 8.0

hcss 7.0
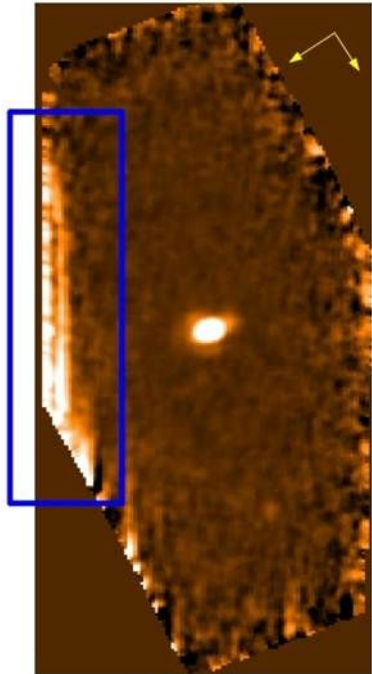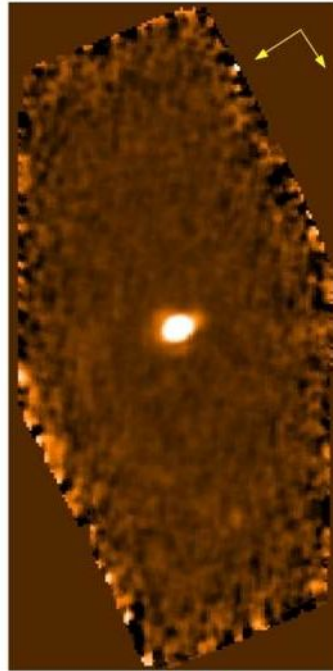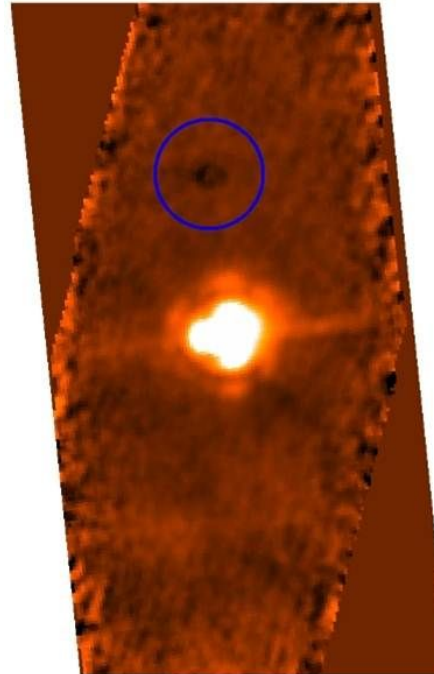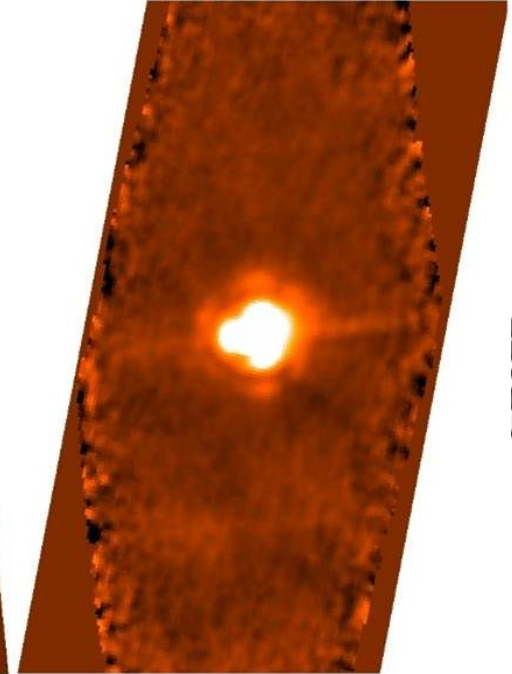
hcss 8.0

Transient correction for miniscan map

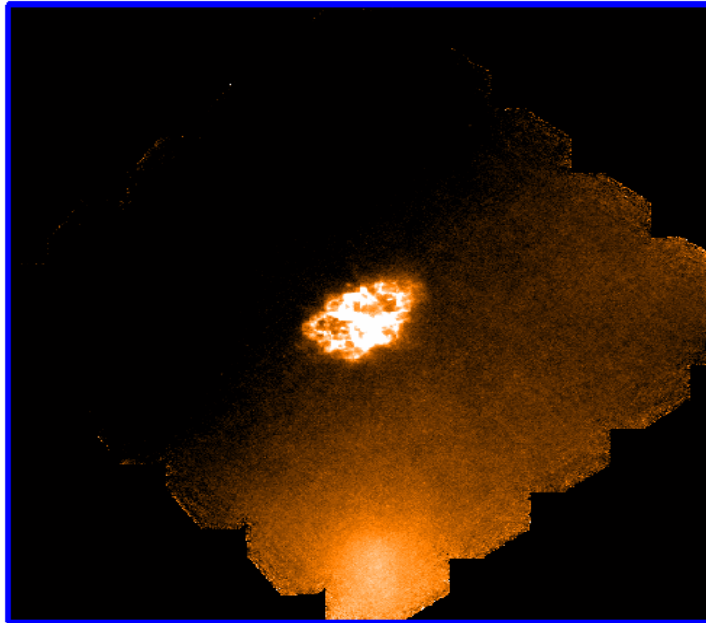**Cross-talk correction for red channel**

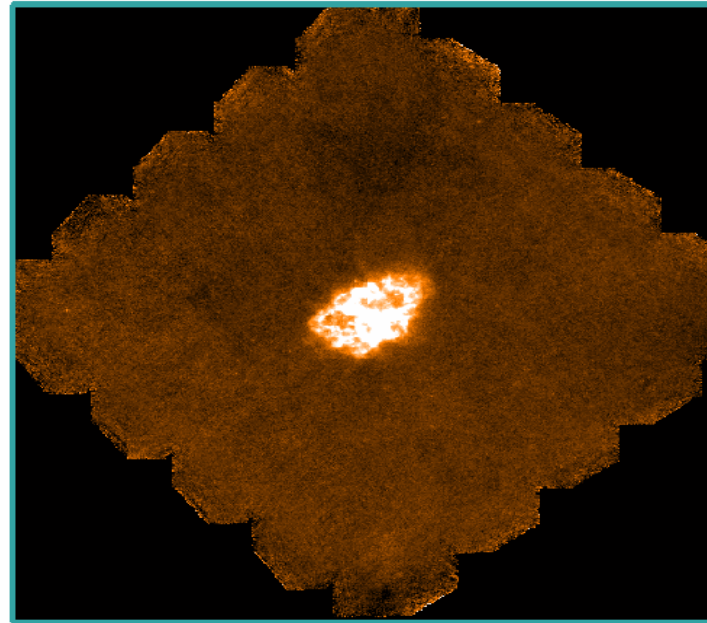HERSCHEL SPACE OBSERVATORY

Improvements for PACS photometric products

Improvements in
"photGlobalDriftCorrectionTask"

**Hcss 8.3 Bulk reprocessing
L2.5 MadMap data
@70 microns**

**Hcss 9.1 Next Bulk
reprocessing
L2.5 MadMap data
@70 microns**

Improvements for PACS photometric products

• The **non-linearity correction** has been added in hcss 9.1 correcting the fluxes of bright objects. Values of fluxes calculated in HIPE

• A **better error map** has been developed in hcss 9.1

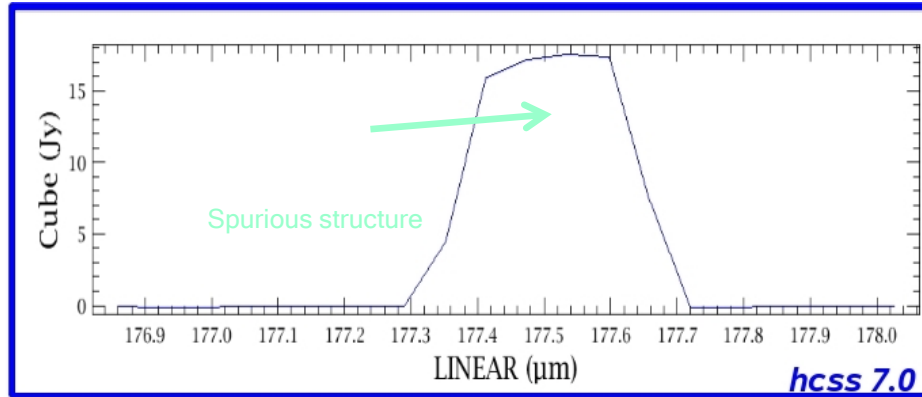| SPG version	Total flux	Intensity per pixel
HCSS 8.2	238.586	0.015
HCSS 9.1	247.810	0.016
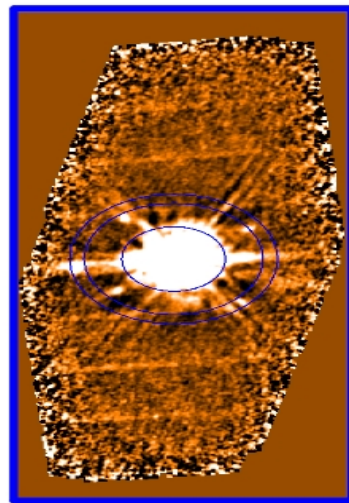
✓ *Calibration version = 32*
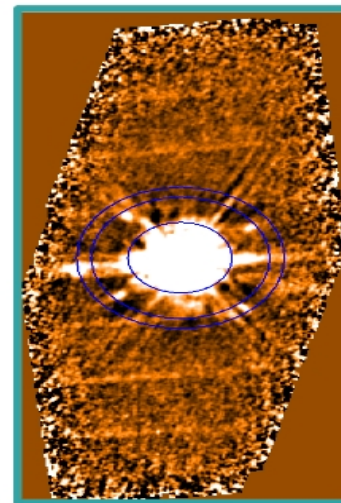
✓ *Calibration version = 41*
✓ *Non-linearity correction applied*

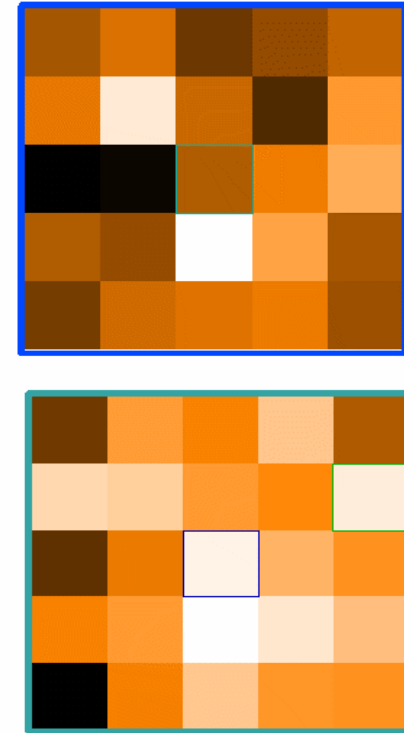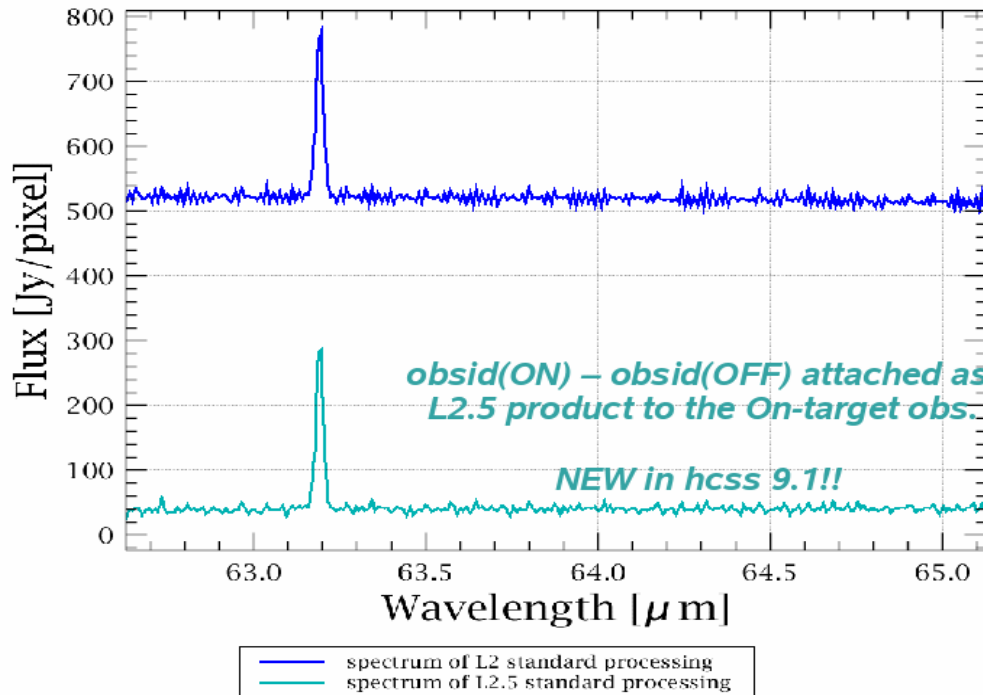# Improvements for PACS spectroscopy products
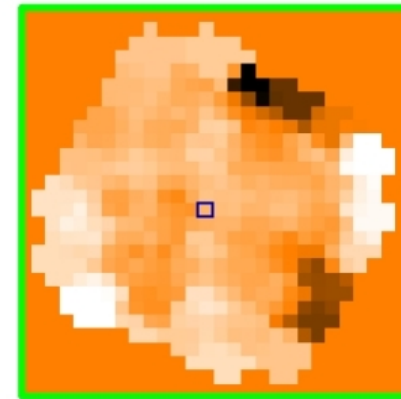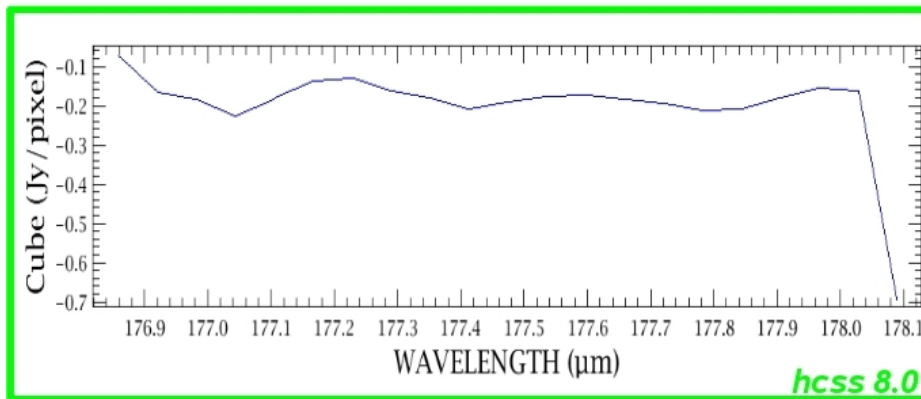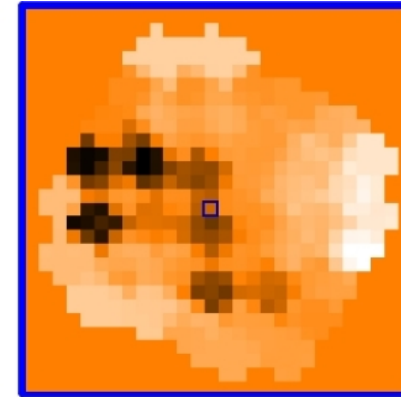
Spurious structures removed using the upgraded unchopped mode spectrometer pipeline

Improvements for PACS spectroscopy products

Background subtracted for Unchopped Range Spectrometer observations only as Extended Processing (L2.5 products) in hcss 9.1

obsid(ON) – obsid(OFF) attached as L2.5 product to the On-target obs.

NEW in hcss 9.1!!

spectrum of L2 standard processing
spectrum of L2.5 standard processing

Highlights of SPIRE improvements

- **General**
  - **Signal jump detector now handles "cooler burps"**
  - **Masking of data at non-nominal s/c velocities**
  - **Improved processing speed using multi-threading**

- **Photometer:**
  - **Creation of Level 2.5 products, combining several observations into one mosaic**
  - **Baseline removal and destriper tasks now fully available**
  - **SCalPhotChanRelGain calibration product to improve extended emission calibration**

Highlights of SPIRE improvements

- **Spectrometer**
  - **Pipeline processing of bright source mode observations with the SPIRE Spectrometer**
  - **Improvement of SCalSpecTeleRsrf to reduce the noise level in the RSRF**
  - **Improved point source and bright mode calibration. Better calibration for low resolution observations**

- **Provision of Photometer (e.g. destriper, moving object correction) and Spectrometer scripts (e.g. background subtraction, line fitting)**

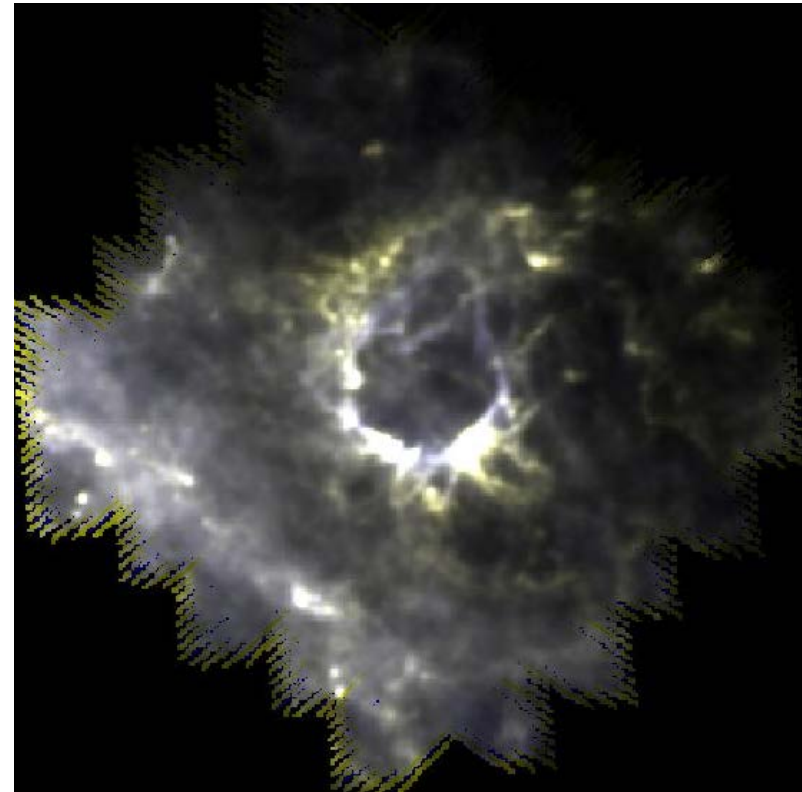- **Provision of quick start guides; revision of the data reduction guide**

Improvements for SPIRE photometric products
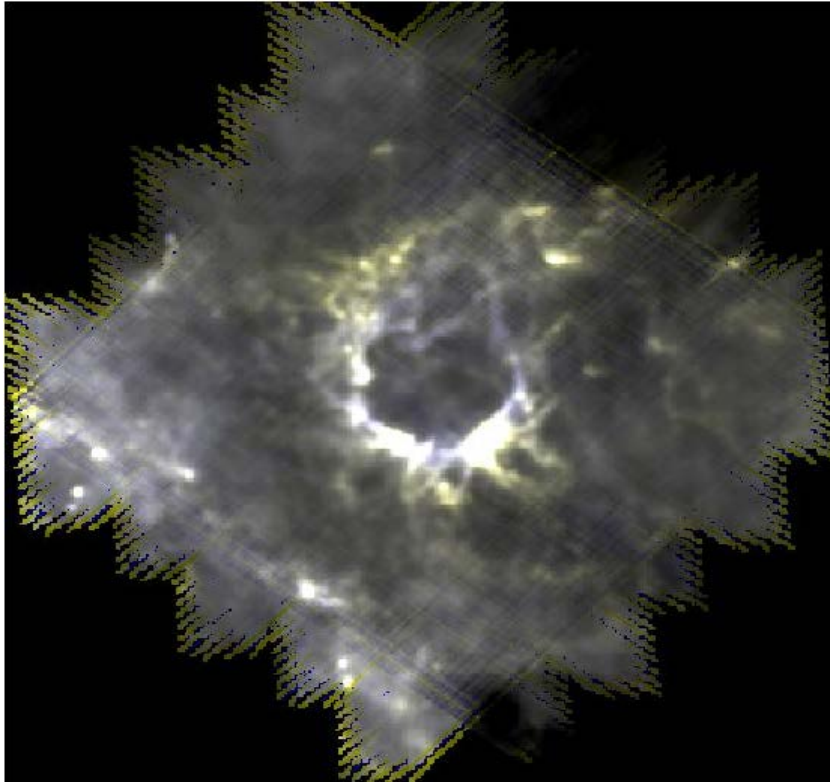
HCSS 9

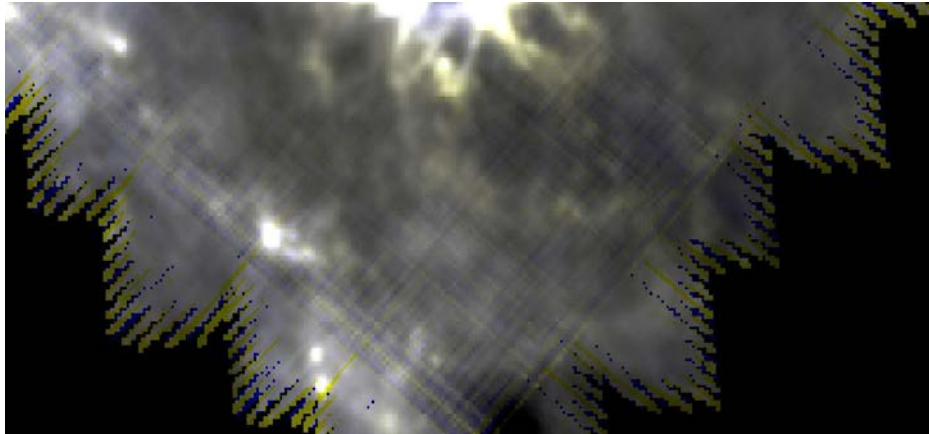HCSS 8

RCW120, PI Abergel

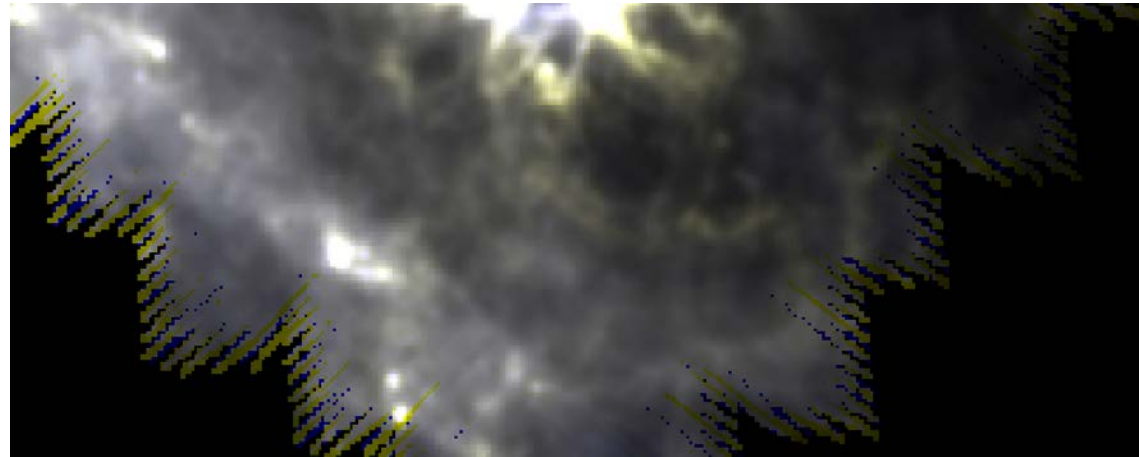# Improvements for SPIRE photometric products

HCSS 9

HCSS 8

Improvements for SPIRE photometric products
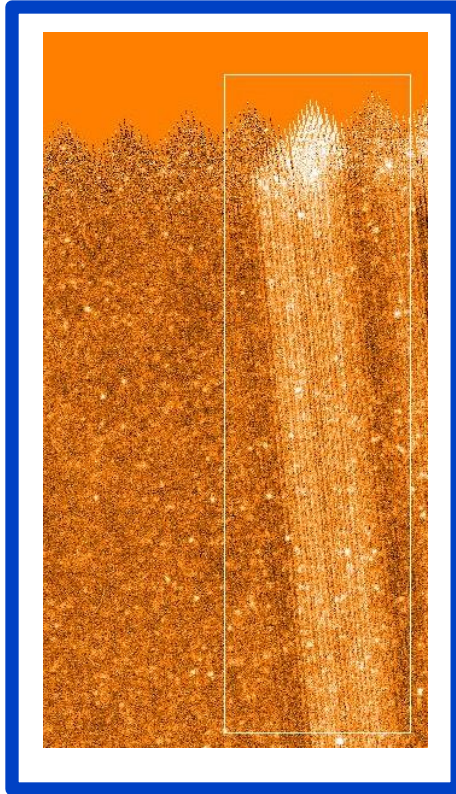
HCSS 7.0

HCSS 8.0

Improved handling of "cooler burps" in pipeline

Improvements for SPIRE FTS products
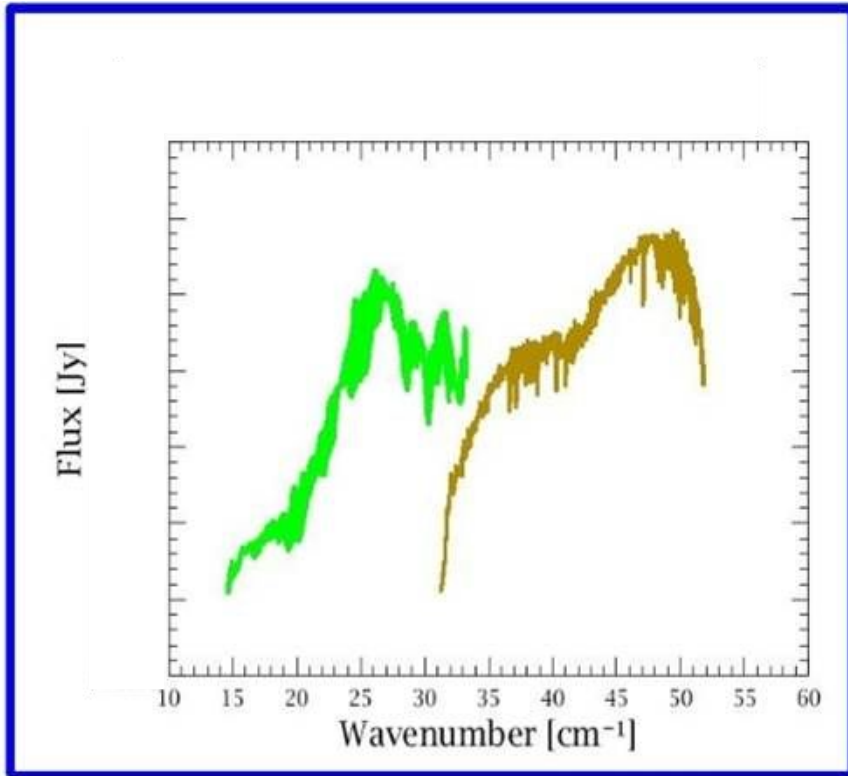
hcss 7.0
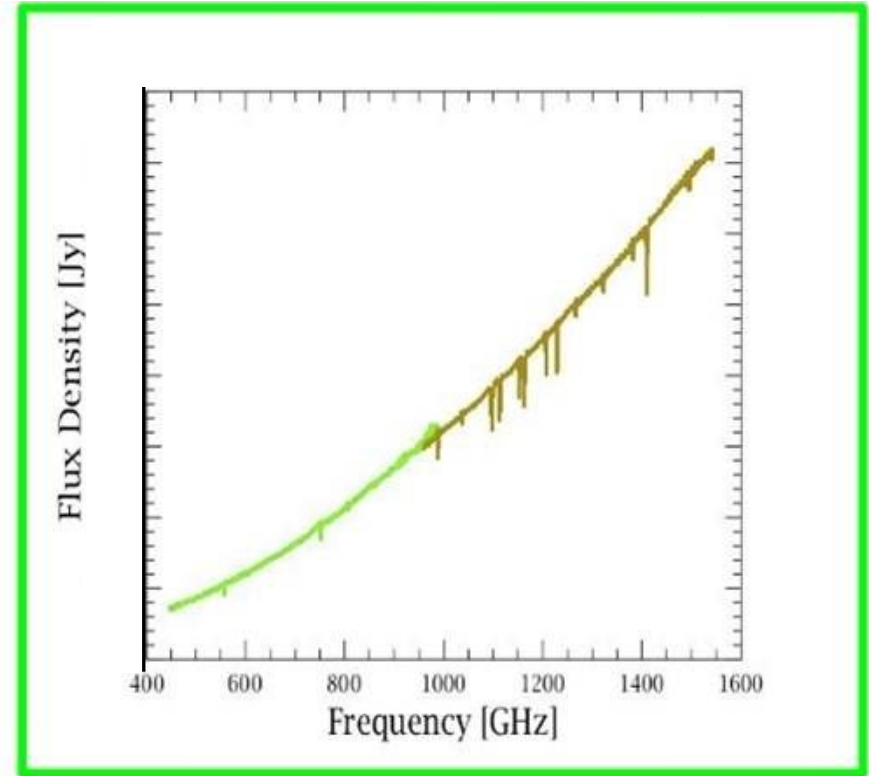
hcss 8.0

Spectrometer pipeline product of bright mode observation

What we and HIPE can do for the Herschel community

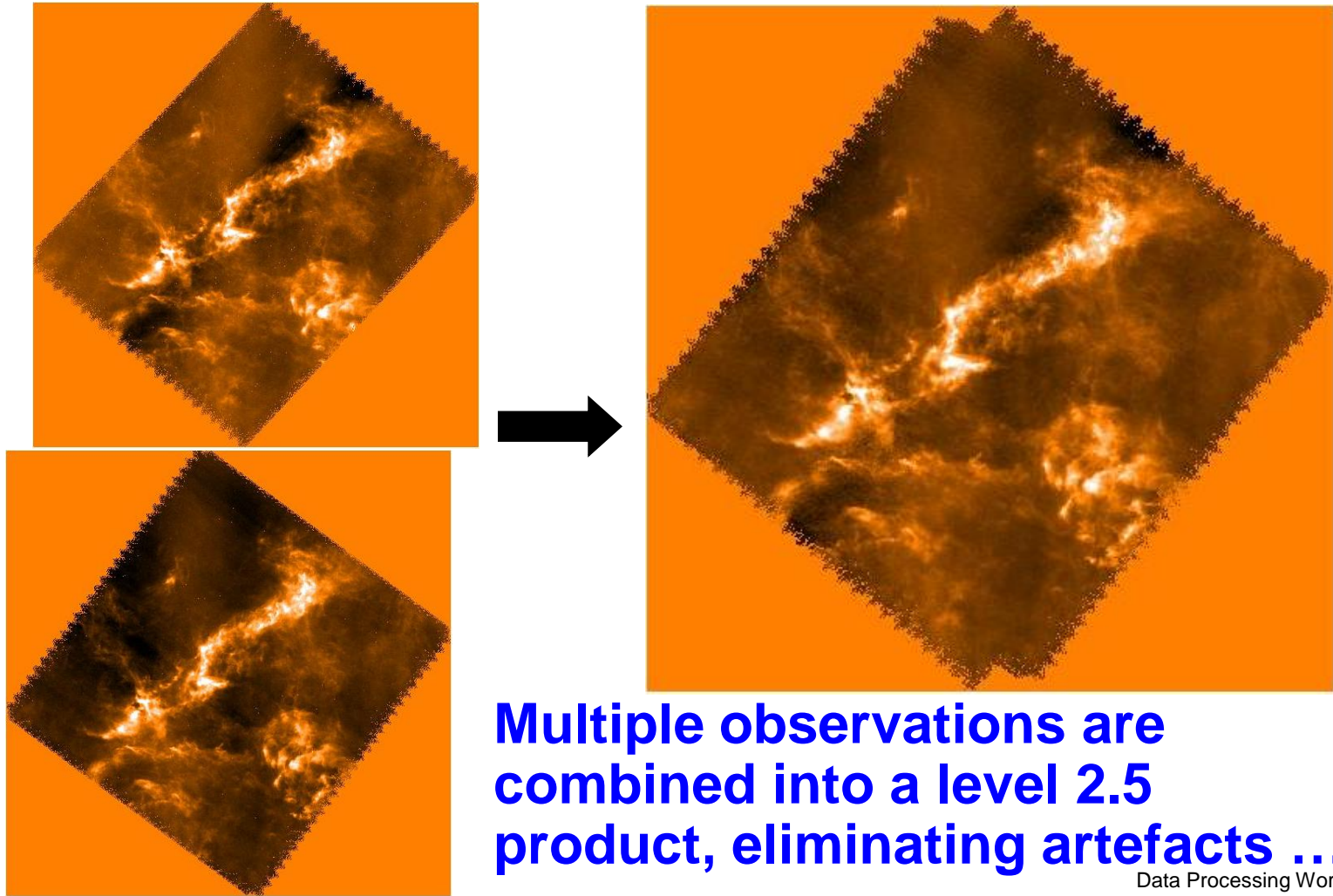# Herschel Pipeline Processing and Data Quality Control

- **Pipelines are executed on the ESAC Grid to produce Herschel Products to different reduction levels**
  - **Level 0   raw data**
  - **Level 1   instrumental and satellite effects removed**
  - **Level 2   scientific analysis can be performed. For many instrument modes we achieved a very high pipeline product quality**
  - **Level 2.5 level 2 like products combining several observations**
- **Products are available in the Herschel Science Archive after the processing is finished (usually on the same day of reception of the data from the satellite)**
- **Fast data quality control cycle by the Technical Assistants and Instrument Calibration Scientists takes a few days**
  - **data quality control is a combination of automatic screening and manual inspection**
  - **quality control reports are electronically distributed to experts**

Example of the quality of pipeline products: SPIRE photometry

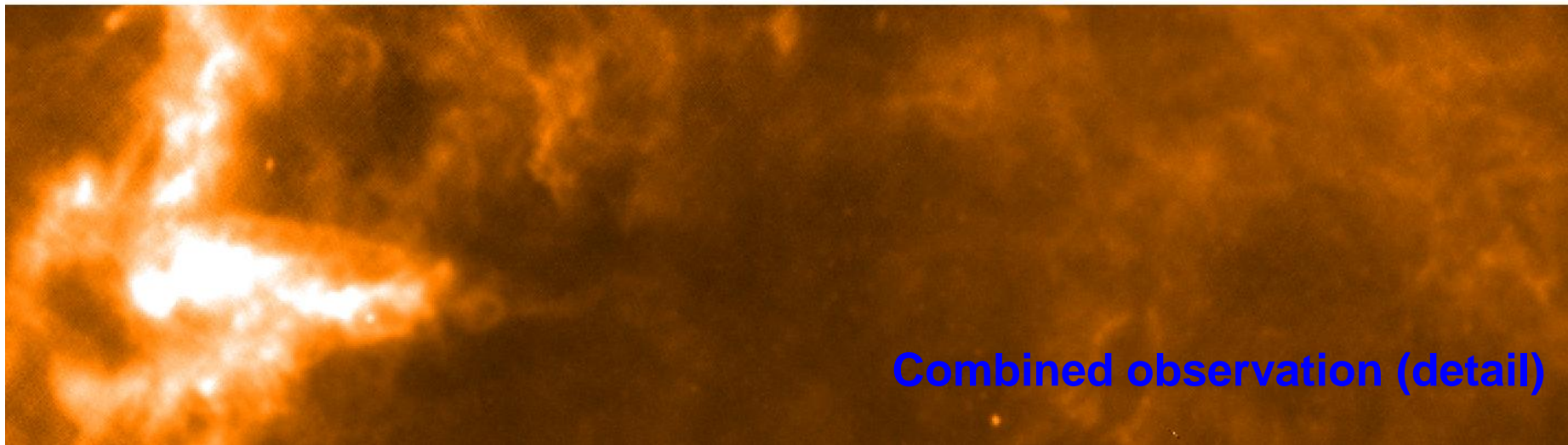**Multiple observations are combined into a level 2.5 product, eliminating artefacts …**

Example of the quality of pipeline products: SPIRE photometry
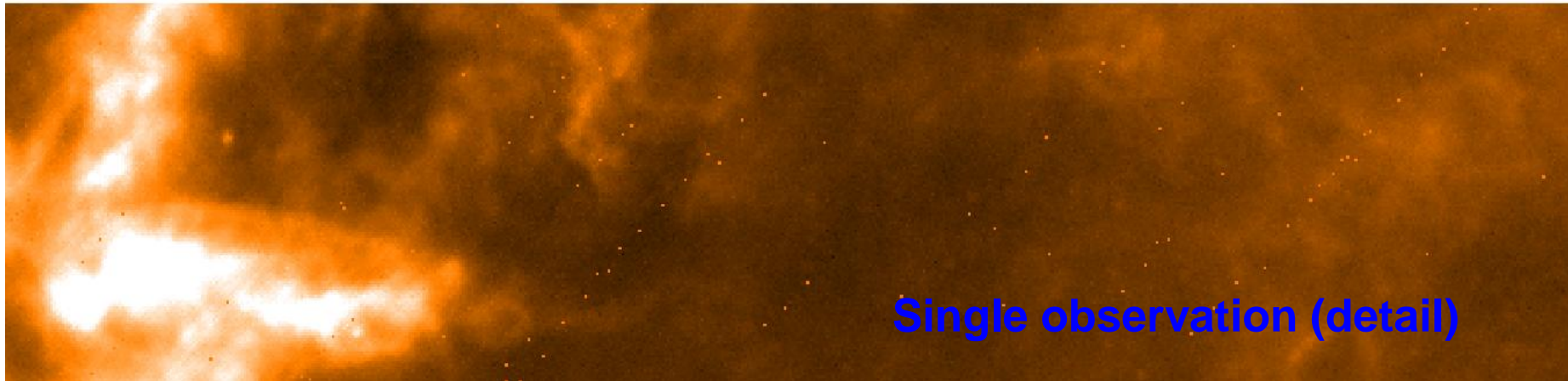
Single observation (detail)

Combined observation (detail)

Example of the quality of pipeline products: SPIRE photometry

… getting a bigger field

Galactic Centre
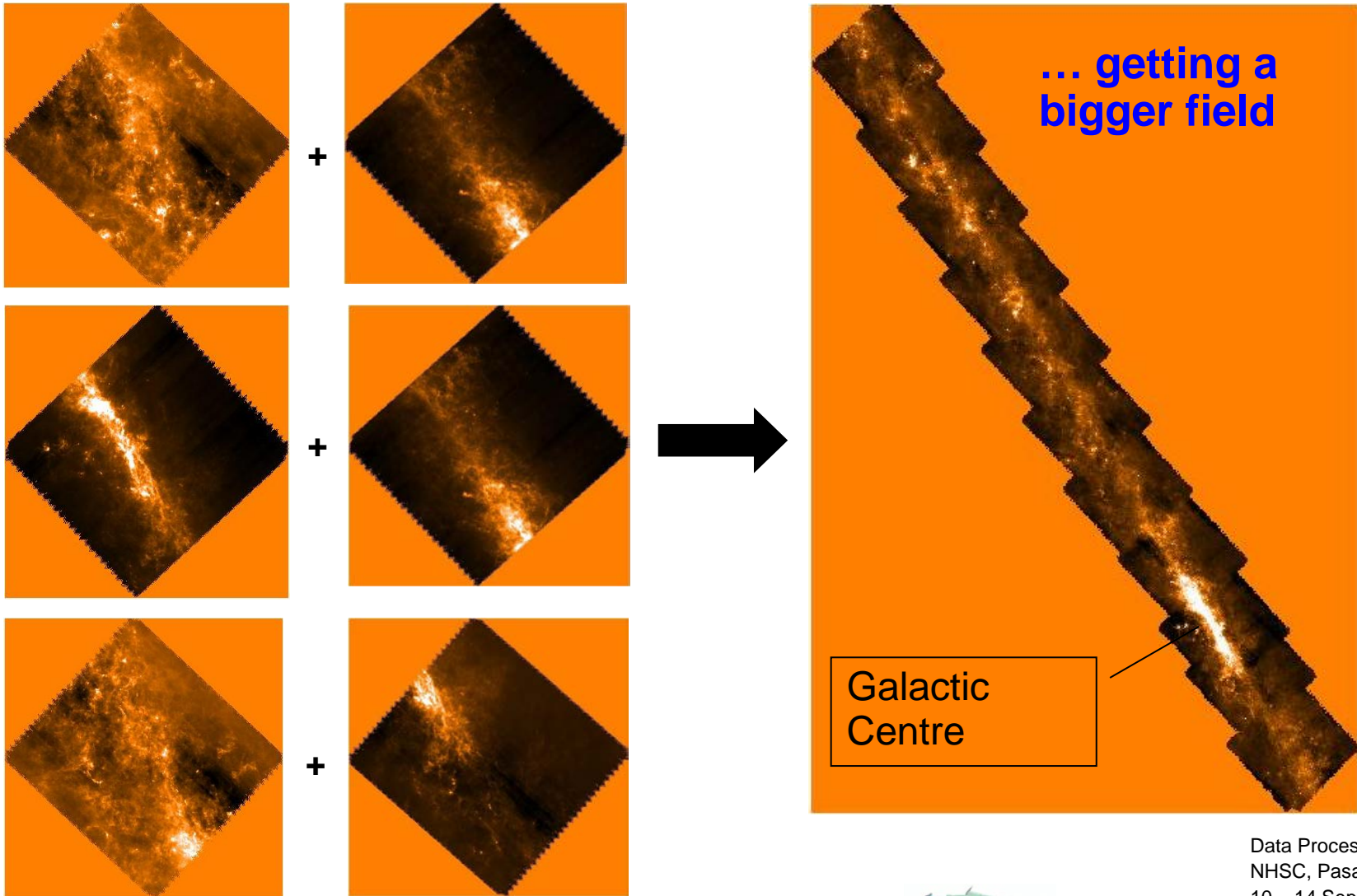
Example of the quality of pipeline products: SPIRE photometry
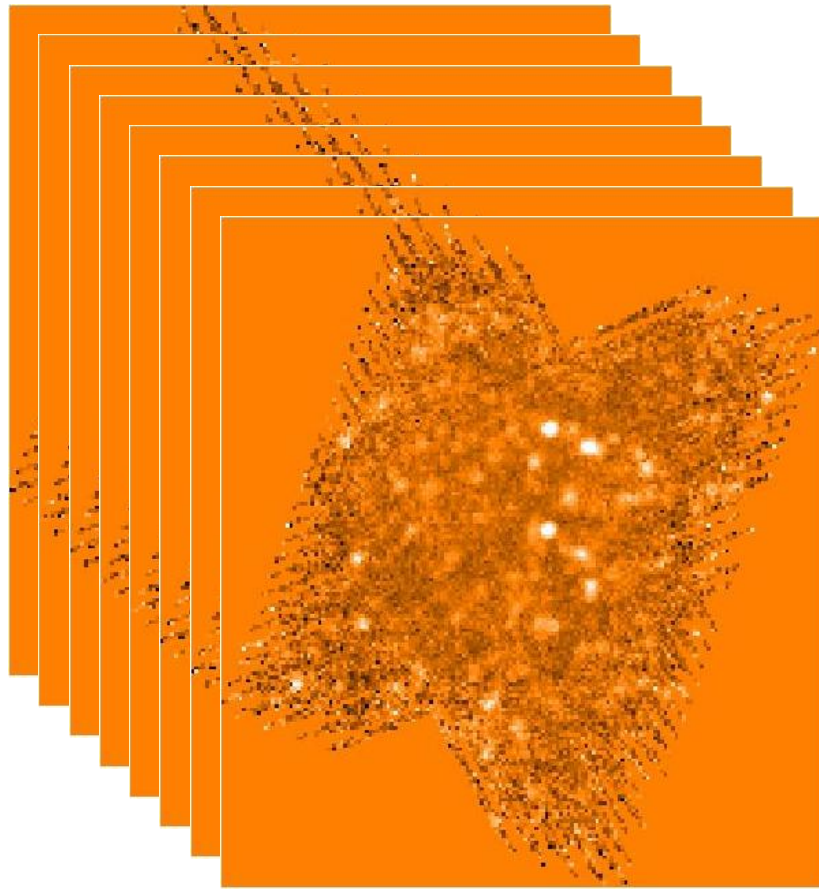
Credits: HerMES http://hermes.sussex.ac.uk
Oliver et al. 2011 in prep. & SPIRE consortium
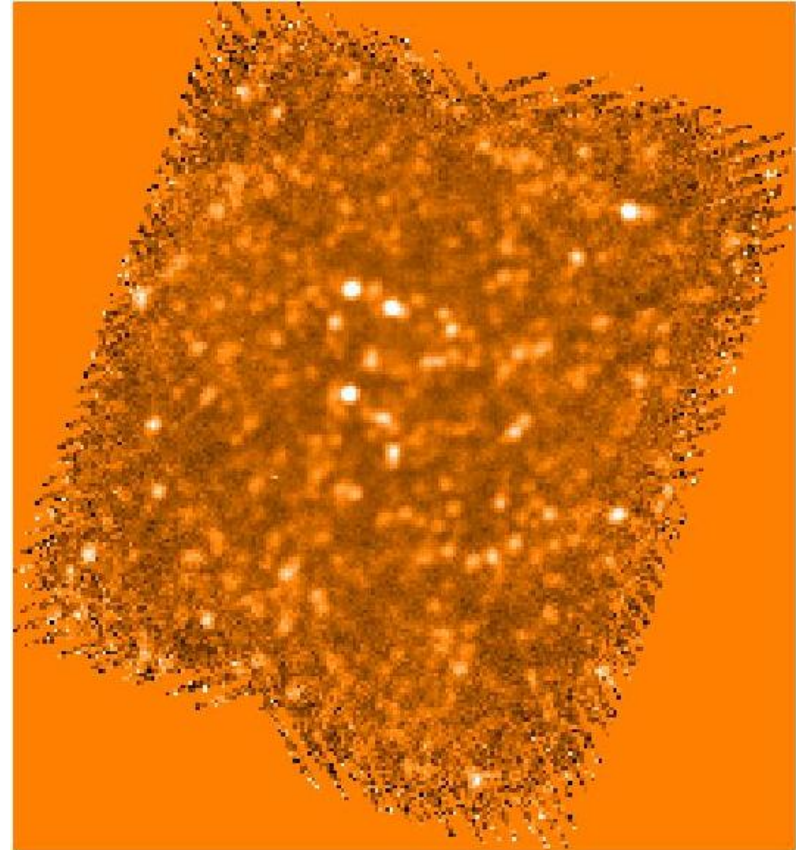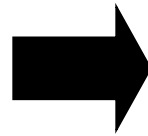
… getting a better signal to noise ratio

Herschel Science Archive, bulk and on-demand reprocessing

- **You can access the Herschel Science Archive via http://herschel.esac.esa.int/Science_Archive.shtml**

  It contains currently around 25000 publicly accessible observations (18000 hours HOTAC approved science observations, overall 19000 hours taken in standard modes)

- **HSC performs a bulk reprocessing of all da   taken up to now for each major release twic   year**

- **Bulk reprocessing w   CSS   ed one month ago**

- **Bulk reproce   eeks**

- **Automatic qualit   st quality c**

- **Spot-checks a   ons**

- **Users can re   ervations with the latest operational re   e usi g on-demand processing**

Herschel papers using archival data were published already!

These are great news – please continue to exploit the Herschel data to their   ions fullest extent!

HiFi ICC

nhsc

PACS

SPIRE

Herschel Science Archive, bulk and on-demand reprocessing

- The Herschel Science Archive has been completely re-engineered to offer improved performance and better user experience

- The new HSA User Interface offers a more modern look and feel. It includes all the functionalities previously provided, plus many new ones

- flexible way to handle query and results panels (one result panel per query, possibility to detach windows, details window to display metadata and postcards, re-sizable window for the postcards display, ...)

- two ways to visualise the Result Panels

- possibility to send observations metadata to VO compliant tools for catalogues and tables like Topcat

- faster response in general, with improved database performance, including geometrical searches add-on

Planned improvements and milestones

Data Processing Workshop
NHSC, Pasadena, CA
10 – 14 September 2012
Stephan Ott   VG #36
http://herschel.esac.esa.int/

Next Steps and Schedule

October 2012	**HIPE Forum 2012 – Interaction meeting for Calibration Scientists, Developers and Expert users**
	Bulk reprocessing with HCSS 9.1 completed
December 2012	**Release of HIPE 10.0**
January 2013	**Public map-working workshop**
March 2013	**End of Helium, start of rundown phase**
	Public calibration workshop
Spring 2013	**Bulk reprocessing with HCSS 10.x completed**
June 2013	**Release of HIPE 11.0 (last version during operations)**
July 2013 –	**Start of Herschel's post-operations phase (active archive phase)**
End 2016	**Final HIPE version and population of the Herschel Science Archive**

Priorities for HCSS 10

1. **Access to, and use of reconstructed pointing products**

2. **Improvements of calibration and data reduction pipelines**

3. **Reduction/optimisation of memory requirements by user pipelines**

4. **Migration to Java 7 (to be confirmed)**

5. **Harmonisation of Python syntax in HIPE**

6. **Improvements to display and plot**

7. **Convolution kernels cross-Herschel, cross-missions**

8. **Code improvements, including test harness coverage**
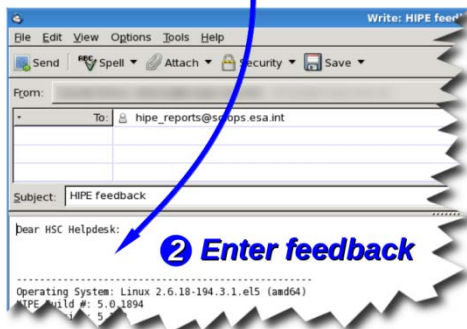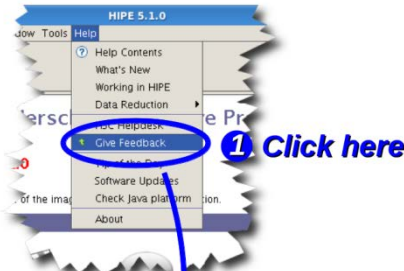
What you can do for the Herschel community

Provide your feedback

… on HIPE

… on HIPE hangs
 and crashes

… on documentation

The purpose of this document is to help you get started using HIPE with the minimum of fuss, confusion, time wasted, and Helpdesk tickets raised.

This document assumes the following:

- You have installed HIPE without any issues.
- You have registered with the Herschel system. Go to http://herschel.esac.esa.int/registration.shtml if not.
- You have an account with permission to access the Herschel Science Archive (HSA).
- You know the observation ID for at least one set of data.

By the end of this document you will have achieved the following:

- Transferred one observation for inspection from the HSA into your HIPE session.
- Developed a broad understanding of the data structure that you see.
- Learnt how to look at your data.
- Begun to have an understanding of where you can go from here, and where in the documentation to look next.

You will *not* have transferred data onto your hard disk. To learn how to do this please see the *Data Analysis Guide*: Section 1.2.1, "Getting your data, step by step".

This document is intended to be read as you carry out these actions in HIPE. It does not describe any of the other views you see in the main HIPE window. For that, please see the HIPE Owner's Guide.

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HIPE

Join the HIPE Community users' portal http://hipecommunity.wikispaces.com **and contribute with questions and answers**

Join the DP Interest Lists via http://hipecommunity.wikispaces.com **where all DP-related events are announced**

Join the DP telecons to discuss special topics of data reduction for the instruments

Join the NHSC DP webinars

Join the testing campaigns of new versions

Herschel Interactive Processing Environment

Join the HIPE development as contributor

creating "Welcome" view

Your questions for me?

E KOMO MAI