



The Herschel Data Processing System – HIPE and pipelines – doing well during Herschel’s early mission phase

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on behalf of the Herschel Science Ground Segment Consortium

<http://herschel.esac.esa.int/DpHipeContributors.shtml>



Overview



- Herschel and Herschel Data Processing
- Key S/W Elements, Status and further Milestones of Herschel Data Processing
- What can HIPE do with Herschel data?
- Summary



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Overview of Herschel



- **ESA cornerstone observatory**
 - Instruments nationally funded
- **Far Infrared (55 - 672 μm) space facility**
 - 3.5 m Cassegrain telescope – the largest space telescope ever launched
 - 3 science instruments (HIFI, PACS, SPIRE)
 - 3 years routine operational lifetime

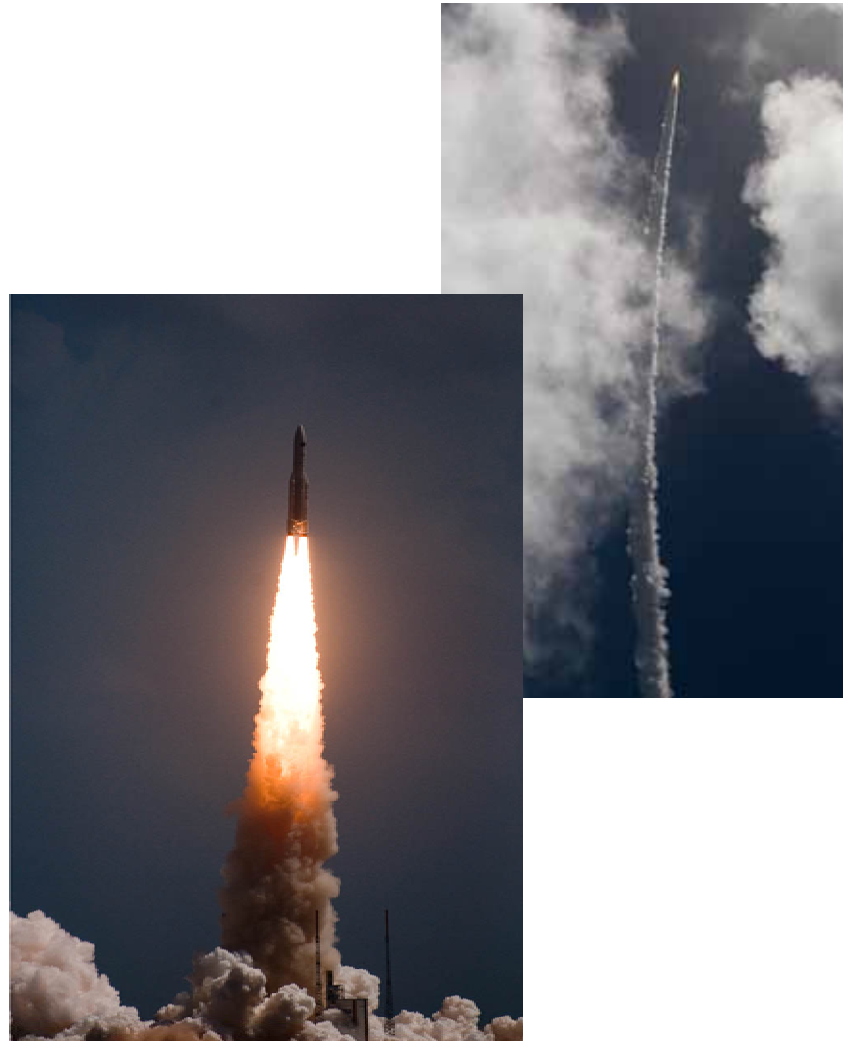
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Current Spacecraft Status

- **Herschel was launched together with Planck on an Ariane 5 ECA 14th of May 2009 on V188**
- **Herschel reached its operational orbit around L2**
- **Herschel's Commissioning Phase successfully completed mid July**
- **Herschel is close to complete its Performance Verification Phase**
- **PV Phase is followed by a one-month long Science Demonstration Phase with the Routine Science Phase starting about 6 months after launch**



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Scope and Methodology of Herschel Data Processing Development



- Development of the Herschel Data Processing System started seven years ago to support the data analysis for Instrument Level Tests
- The system is coded in Java/Jython to be license free and portable for different operating systems
- 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 'Instrument Calibration', 'Trend Analysis' and 'Quality Control' systems are part of the Data Processing System
- Herschel Science Centre (ESA), the Instrument Control Centres (HIFI, PACS and SPIRE) and NHSC jointly manage and contribute to the Herschel Data Processing System

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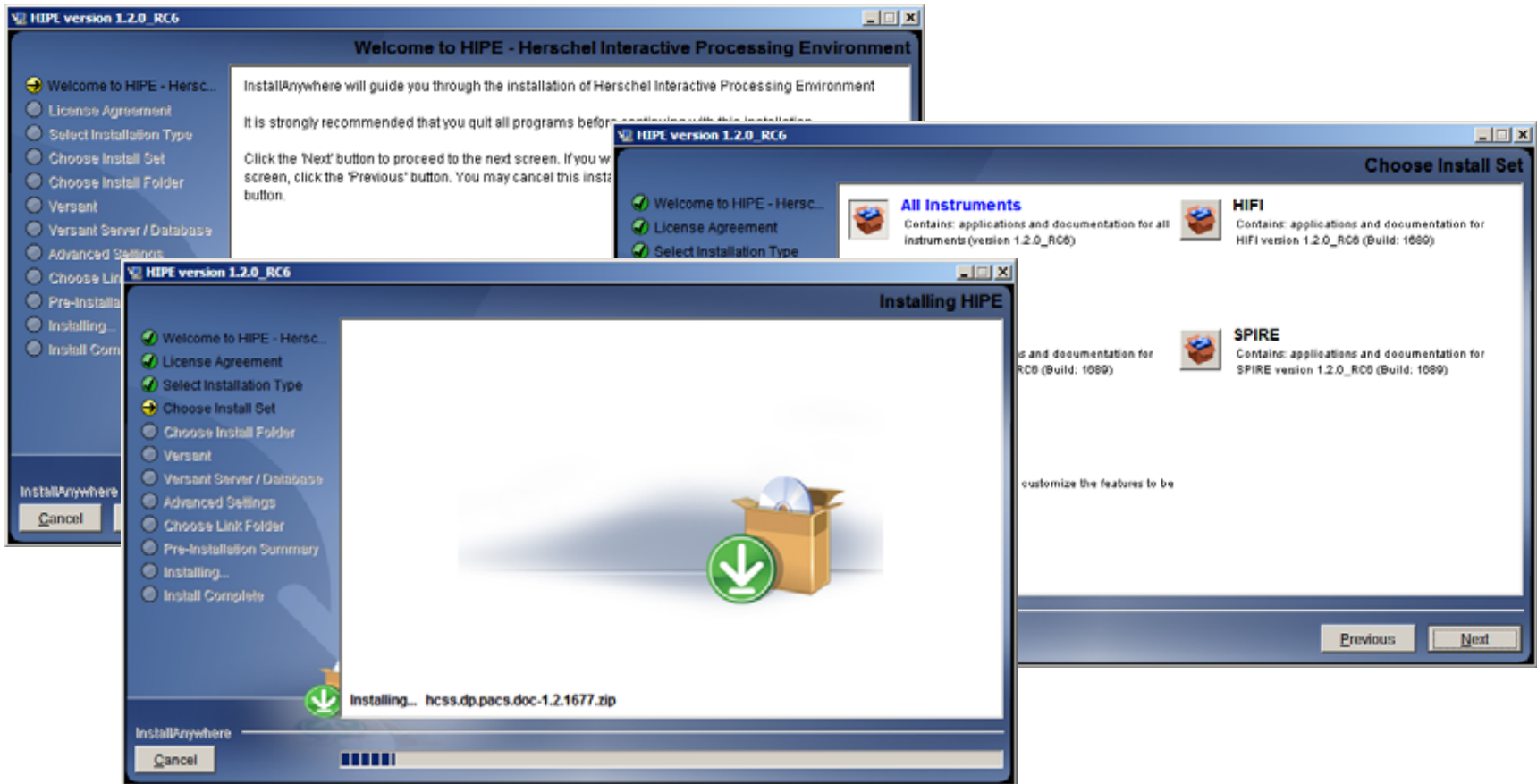


**Key S/W Elements,
Status and further
Milestones of the
Herschel Data
Processing System**



Installer

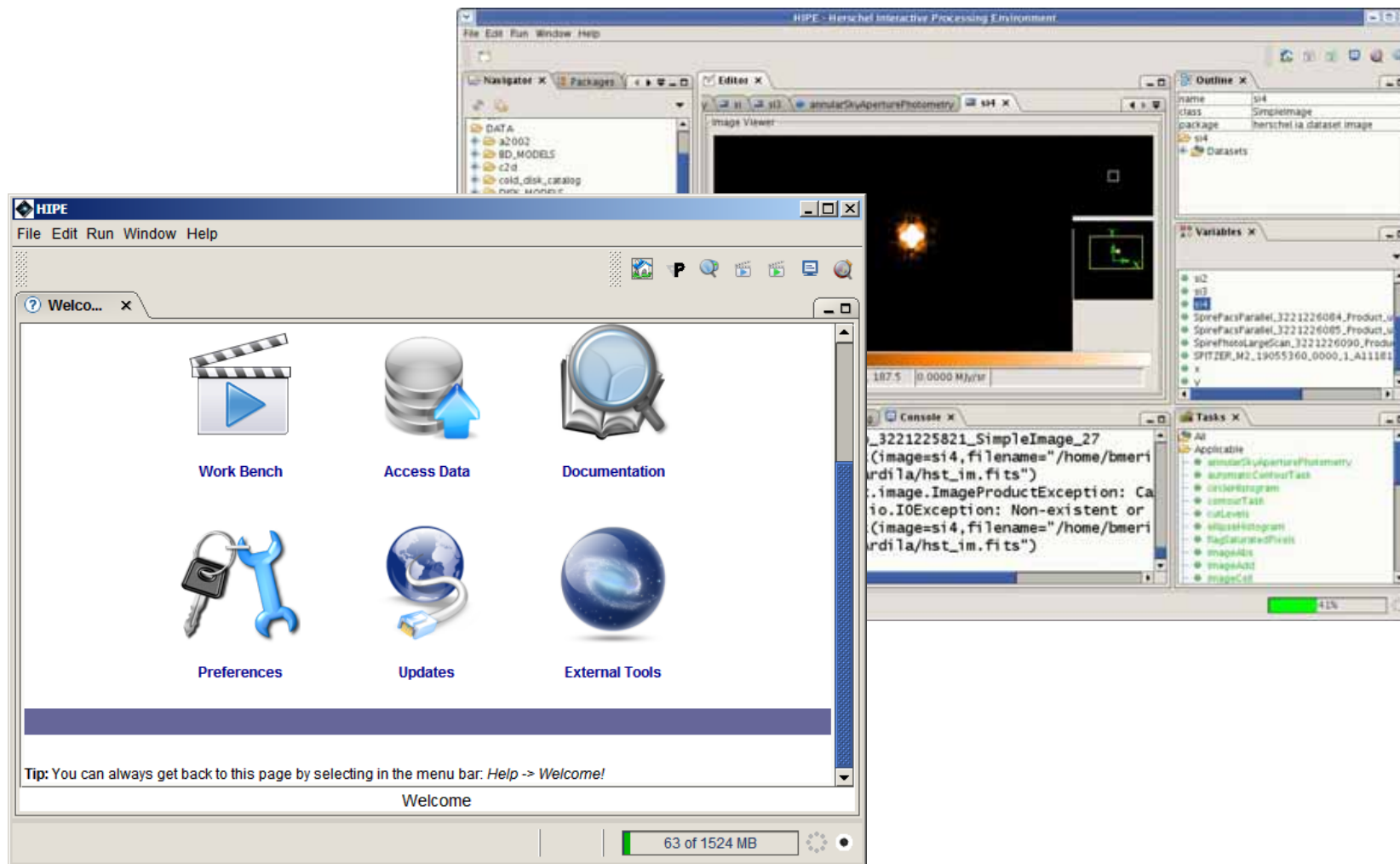
- Installers are available for Windows XP, Vista, Linux, Mac OS X and with or without the Java Runtime Environment for both user and developer versions



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Herschel Interactive Processing Environment (HIPE)



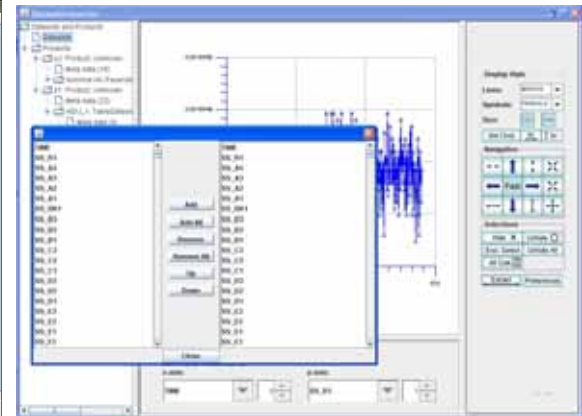
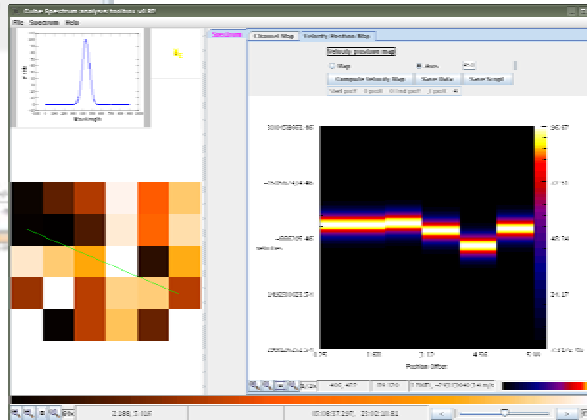
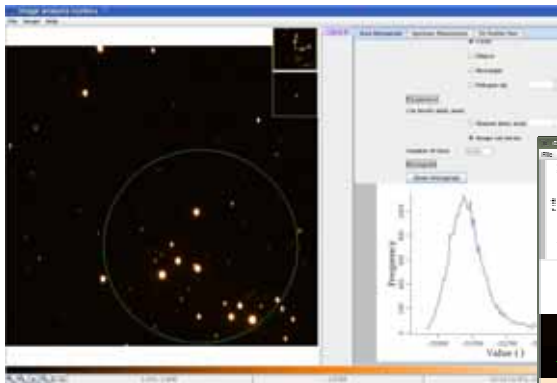
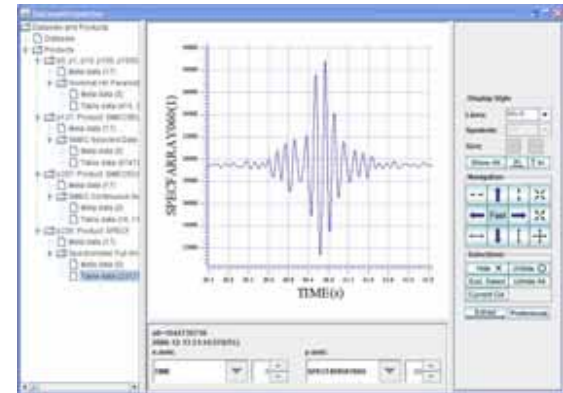
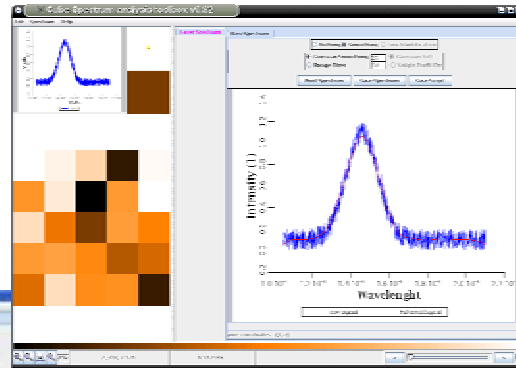
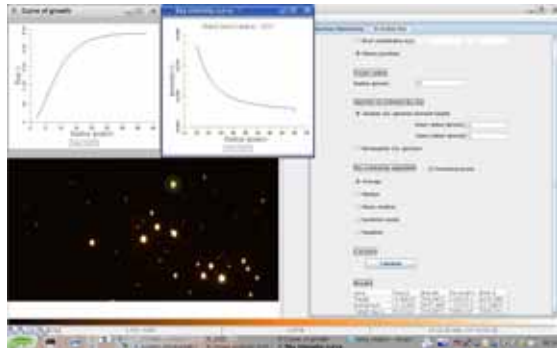
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User friendly tools

Tools to inspect images, data cubes and manipulate tables



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Documentation

- HIPE provides documentation for the framework and all instruments, including search functionality

The screenshot displays the Herschel Interactive Processing Environment Help System. It features a navigation pane on the left with categories like 'User', 'Advanced User', and 'Advanced Instrument User Documents'. The main content area shows a 'Welcome to the Herschel Interactive Processing Environment Help System' page with links to 'User' and 'Advanced User' sections. Below this, there are links to 'HOW TO' documents, 'NEW' releases, and 'FAQ'. A 'SPIRE User's Manual' page is also visible, showing its version (0.5), document number (SPIRE-RAL-DOC 003231), and date (12 September 2009). The 'Table of Contents' for the SPIRE manual includes sections like 'Preface', '1. Introduction', '2. Accessing the Raw Data', and '3. Processing the Raw Data: The Engineering Conversion Pipeline'.

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Herschel Pipeline Processing

- Pipeline is executed on the ESAC Grid using the Herschel Science Archive 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

The image displays three main software interfaces used for Herschel pipeline processing:

- Pipeline Monitor/Administrator:** Shows a list of pipeline jobs with columns for ID, Description, and State. The state column indicates various stages like 'ICRON request', 'RUNNING', and 'FAILED'.
- SPG Manager (remote session):** A table listing observation parameters such as Mode, Queue, DOY, Observation, Instrument, and Status.
- HSC Data Processing Status Operators:** A graphical interface showing a 3D visualization of the Herschel spacecraft and associated data processing status.

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ADASS XIX 06/10/2009

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VG # 11

<http://herschel.esac.esa.int/>



Herschel Quality Control

- Data quality control is a combination of automatic screening and manual inspection
- Quality control reports are electronically distributed to experts

The screenshot displays the Herschel Quality Control (OCR) software interface, which is used for managing and monitoring data quality. It consists of several interconnected windows:

- OCR Display:** Shows common data for a specific observation, including ObsId, Instrument (SPIRE), Level (LEVEL_2_PROCESSED), SW version, Date, State (PENDING), and Action (NONE). It also includes a 'Quality flags' section with event reports and a 'Log' section for JOCLogProductPanel.
- OCR Browser:** A table listing observations with columns for Observation, Instrument, and Current state.
- Product Browser:** A search interface for products, including filters for Product Class, search options, and a 'Query result' table.
- Product Panel:** A detailed view of a product, showing a list of observations and a central image viewer displaying a color-coded astronomical image.
- Comments:** A section for adding and viewing comments on the data.

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Data Access

- **HIPE is connected to the Herschel Science Archive, and data can be retrieved directly into an Interactive Analysis Session**

The screenshot displays the HIPE environment with the following components:

- Top Panel:** Herschel Science Archive 0.9b1 interface with navigation buttons like 'Query Specification', 'Latest Results', and 'Shopping Basket'.
- Left Panel:** 'Herschel Login' section with fields for 'Username' and 'Password', and a 'Log in' button.
- Main Window:** A plot titled 'obsid_3221226077.refs["calibration"].product.refs["Phot"].refs["DetAngOff"].product["PSW"]'. The y-axis is 'y:angle(°)' ranging from -200 to 200, and the x-axis is 'x:Index' ranging from 0 to 120. A cursor is positioned at (69,0).
- Right Panel:** A table of observation data with columns for 'MJD', 'J2000-RA', 'J2000-DEC', 'Category', and 'pubTTL'. The table lists several observations from 2006-12-01 to 2008-05-30.
- Bottom Panel:** 'Outline' and 'Console' windows. The 'Outline' shows a tree structure of products and contexts. The 'Console' displays a list of product names and their associated contexts.

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Current Status



- HIPE 1.1 (Performance Verification Phase version) made available to Herschel Key Program teams
- First bulk reprocessing exercise of Herschel data started
- First Science Demonstration Phase observations conducted and data provided to observers using an early version of HIPE 1.2
- HIPE 1.2 (Science Demonstration Phase version) under testing
- HIPE 2.0 (Science Routine Phase version) to be made available to Herschel community early next year
- Future HIPE versions will be released regularly

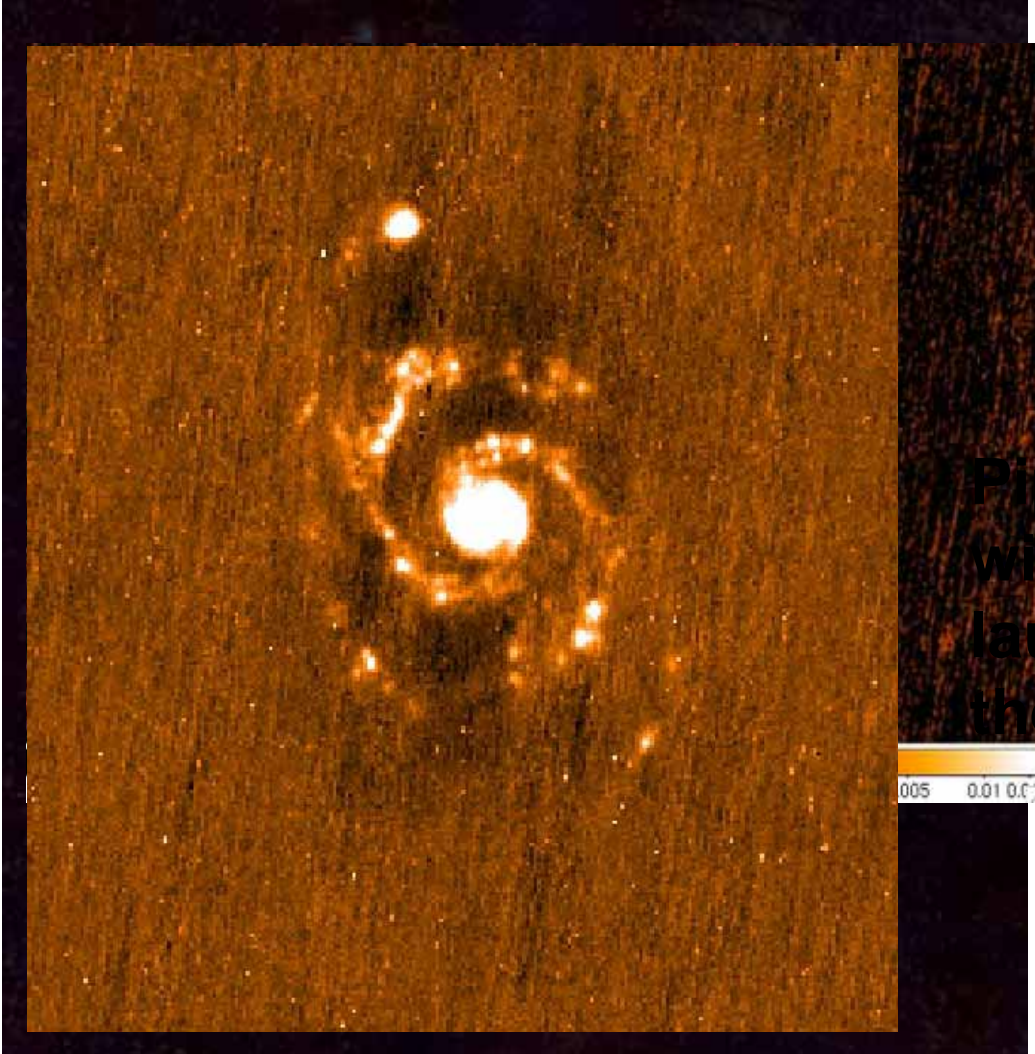
HIPE source code is freely available under the GNU lesser general public license





**What can HIPE do
with Herschel data?**

PACS 'sneak preview' of M51 during OD 32



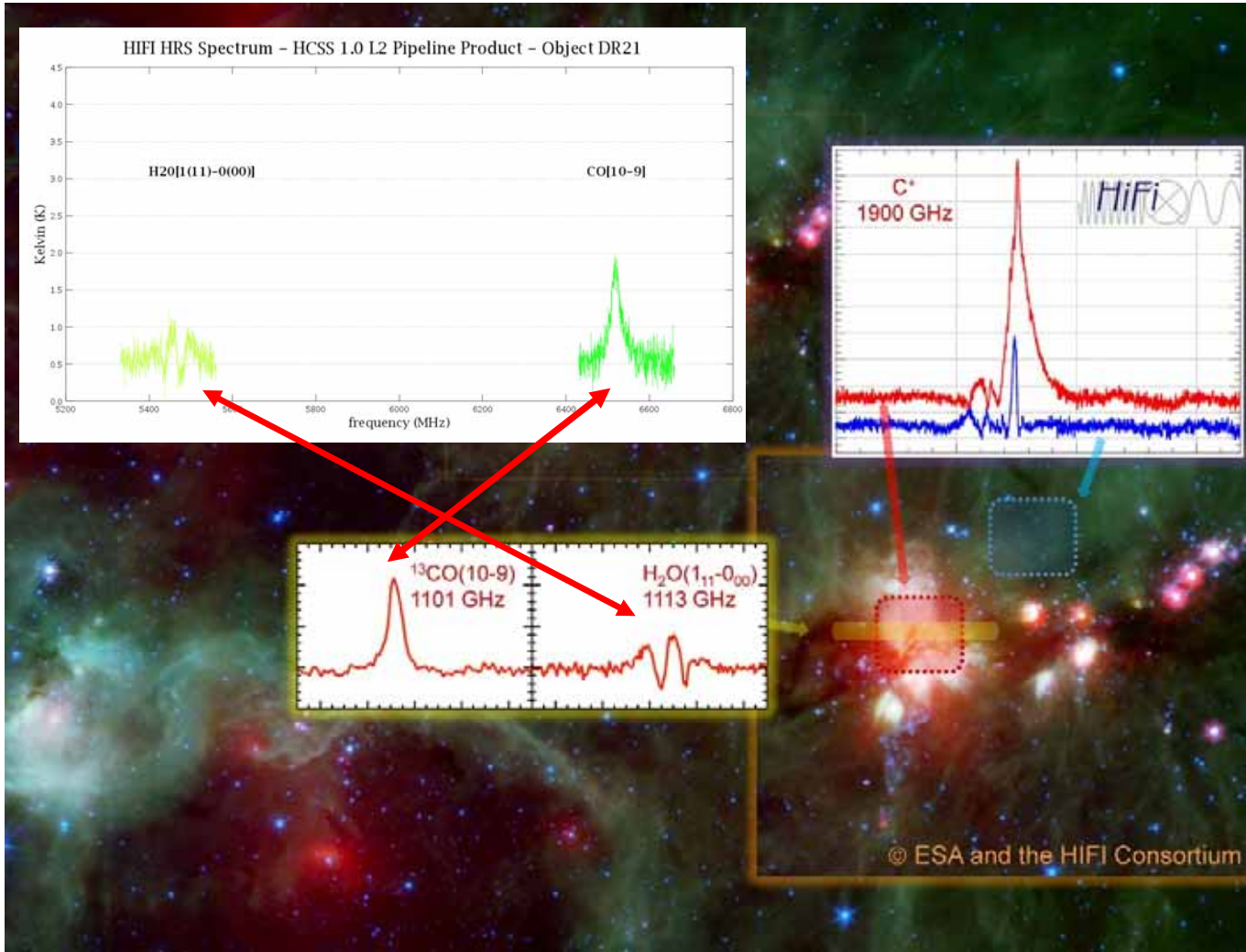
Interactive data processing of the 70 μm channel 30
Elaborate data processing with the 160 μm channel
Three colour
Processing of the
with the 160 μm channel
launch channel
combining several
the 70 μm channel
scans

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HIFI 'first light' of DR21 star forming region during OD 39



Pipeline processing with operational (pre-launch) pipeline

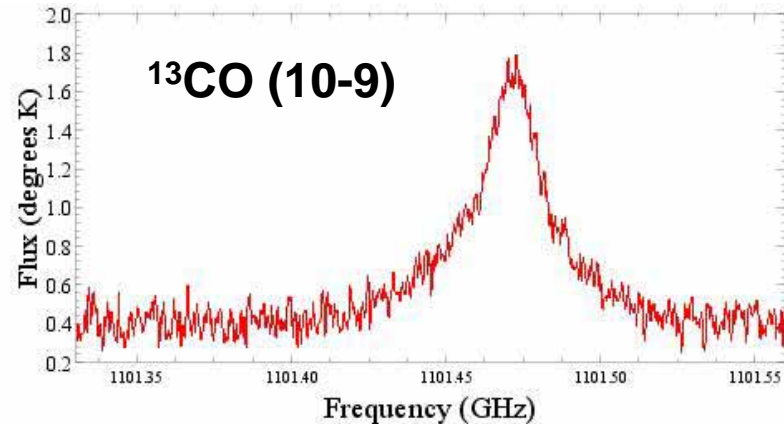
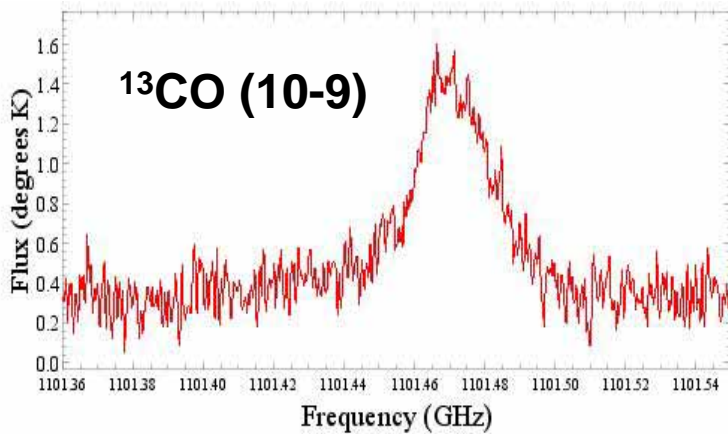
Interactive data processing

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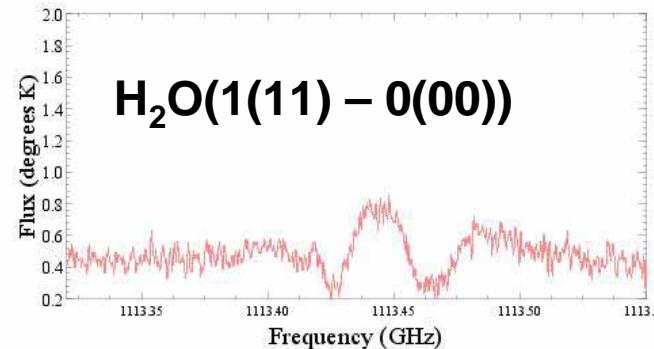
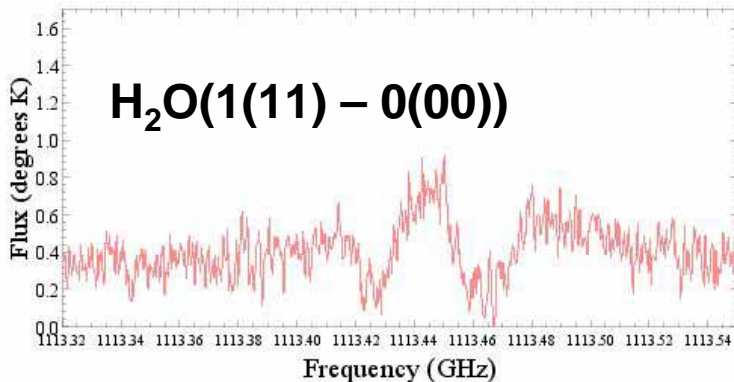




HIFI 'first light' of DR21 star forming region during OD 39 – Final sky spectra

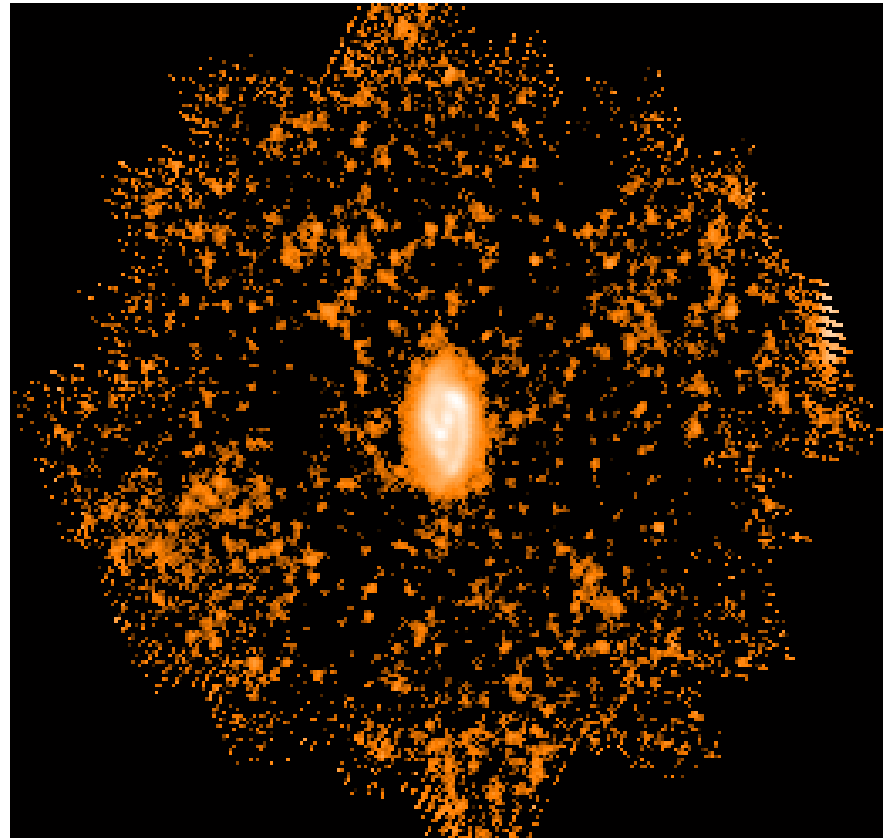
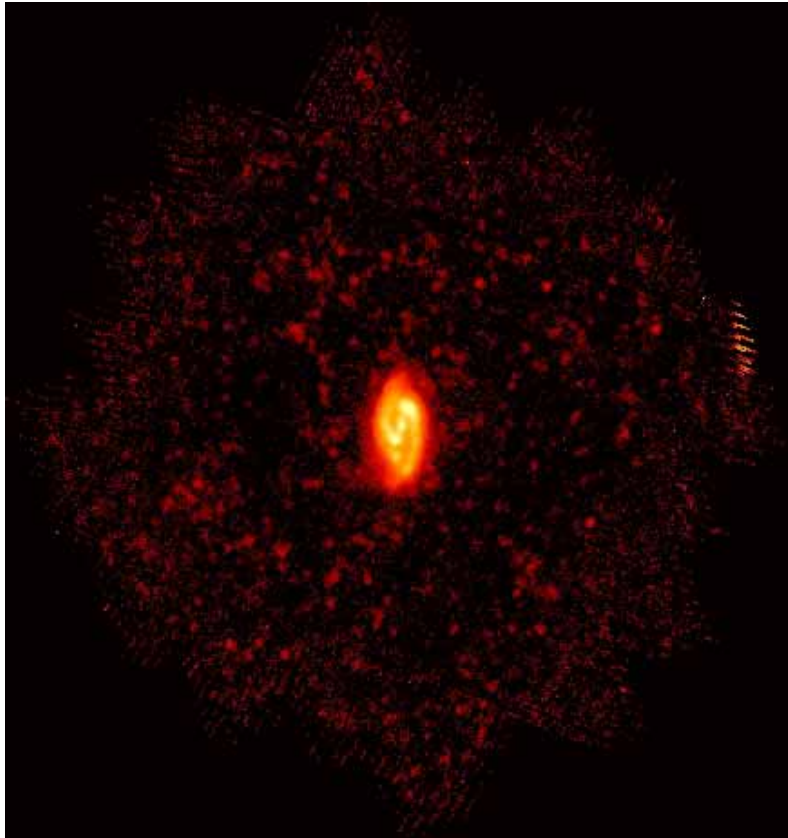


- **Interactive** (left – one mapping element) and **standard pipeline** (right – average of 5 mapping elements) results for HIFI first light using the HRS spectrometer, used simultaneously with the WBS spectrometer.



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SPIRE 'first light' of M66 during OD 42



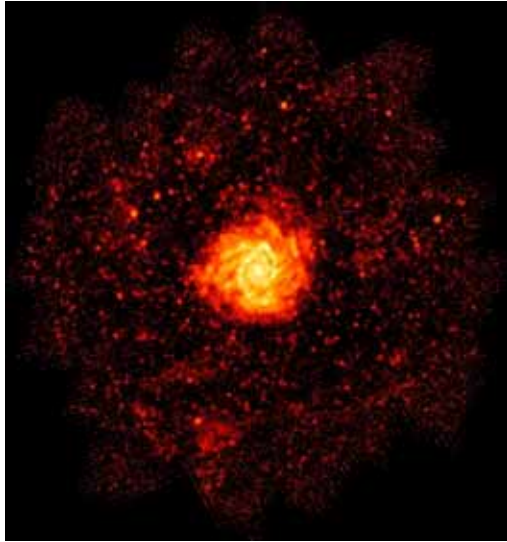
Interactive data reduction

Current pipeline processing

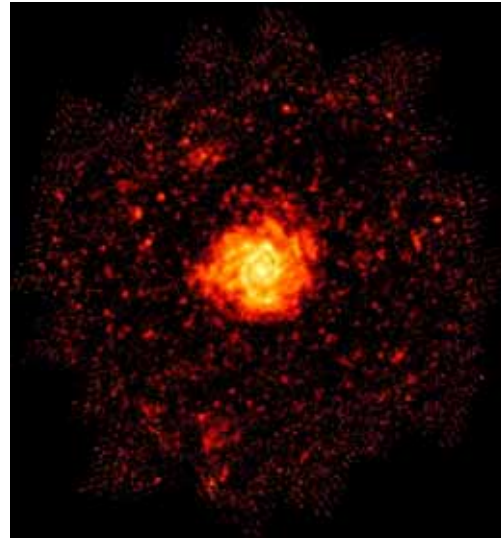
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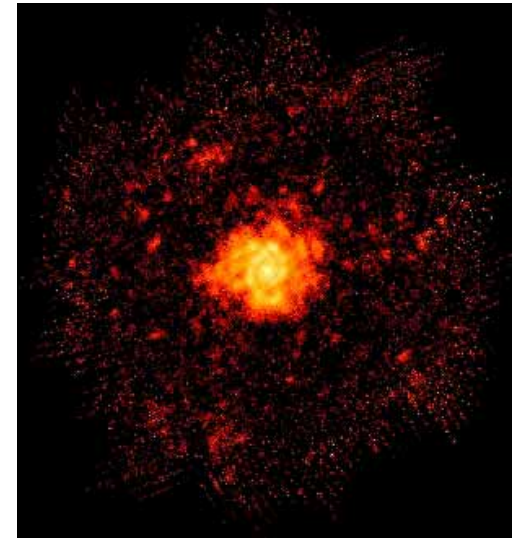
SPIRE 'first light' of M74 during OD 42



250 μm



350 μm



500 μm

Interactive data reduction

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PACS/SPIRE parallel mode observations of the Milky Way



©ESA and the SPIRE & PACS consortia



PACS/SPIRE
5 colour image

©ESA and the SPIRE consortium

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SPIRE 3 colour





Summary



Summary

- **Herschel Data Processing supported Herschel's Commissioning and Performance Verification Phase**
- **Herschel Data Processing was able to support the early delivery of science data to the users community and is ready for Herschel's Science Demonstration and Routine Phase**
- **During the next months hands-on workshops for Herschel Key Program Teams on Science Demonstration Phase data reduction will follow**
- **February 2010 the availability of HIPE 2.0 to the whole Herschel community will be announced together with the opening of the Herschel Science Archive**
- **The Herschel Data Processing System is in a well advanced state, containing an impressive suite of functionality and documentation**

You can follow the Herschel news at

http://herschel.esac.esa.int/Data_Processing.shtml

http://herschel.esac.esa.int/latest_news.shtml





**We are looking forward to demonstrate
this exciting state-of-the-art software
with in-flight Herschel data during
ADASS XX**