Status of Herschel Data Processing/HIPE

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Outline

- ➤ **General Data Processing Status**
- ➤ **Status of reactions regarding HUG's recommendations; priorities of DP development**
- ➤ **Project development statistics**
- ➤ **Additional points**
- ➤ **Questions?**

Eagle constellation observed by Herschel

ESA / PACS & SPIRE Consortium,
Sergio Molinari, Hi-GAL Project

Data Processing Status

➢ **HCSS 6.0 was released 2nd of March 2011**

  ➢ **The modifications of the HCSS validation procedure to speed up the validation process were successful, reducing the test period to 7 weeks, 3 weeks shorter compared to HCSS 5**

  ➢ **For the first time we had co-location of astronomers and key developers at ESAC during the acceptance test period. This worked very well**

➢ **HCSS 6.1 was released 12th April. This version will be used for bulk reprocessing (started 26th of April). Bulk reprocessing for level 2.5 products will be done with HCSS 6.1.1**

➢ **HCSS 7.0 was branched off 7th of April. The release of HCSS 7.0 is forecast for the end of May**

➢ **We will continue to have a co-location of astronomers and key developers during the acceptance testing period**

  ➢ **NHSC offered to take a stronger role in the acceptance testing. This is very much welcomed**

Highlights of general improvements for HCSS 7 for pipeline system, HIPE, documentation and user tools

➢ **Few highlights of HIPE improvements**

  ➢ **Significant improvement of bulk reprocessing throughput: The system should now be able to process around 20 ODs/day, exceeding the requirement of 12 ODs/day**

  ➢ **Framework for generation of PACS and SPIRE L2.5 photometer mosaics**

  ➢ **Improved integration of Calibration Sources Database: We now have our calibrators database accessible to users with a few clicks**

  ➢ **Nightly tester checks for memory leaks**

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

Highlights of HIFI improvements for HCSS 7

➢ **Browse products for simple spectra**

➢ **The SpectrumFitter has been updated to allow users or ICCs the choice of what models (if any) are initially fitted at start up**

➢ **The SpectrumExplorer has introduced a prototype datamanager. The purpose of this datamanager is to provide better support to all instruments by providing a framework that they can use for interactions with instrument specifics in their spectra**

➢ **Continued documentation updates**

➢ **HIFI pipeline task GUI**

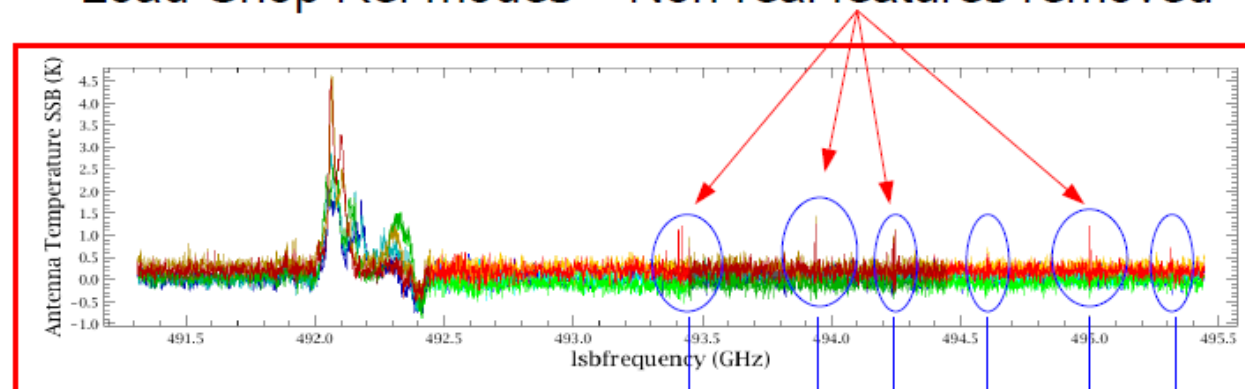➢ **Fuller configurable HIFI pipeline**

HIFI pipeline task GUI

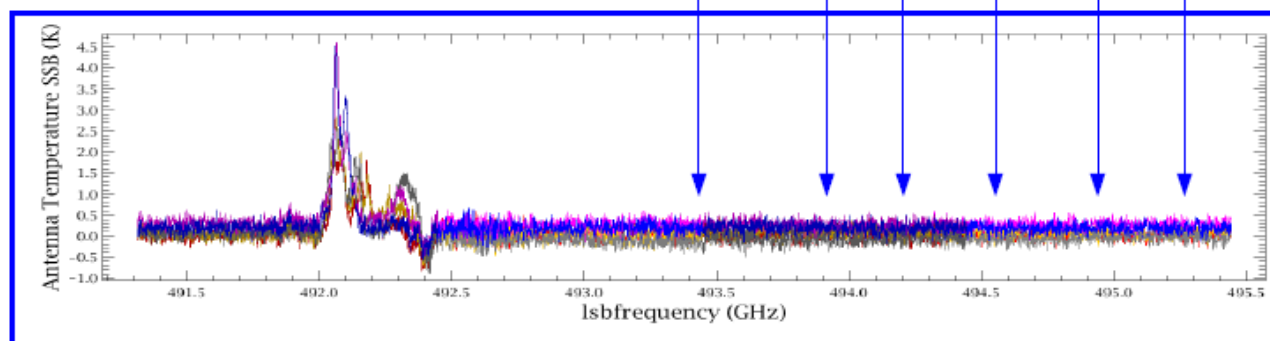**DoPipeline ConfigurationGUI**
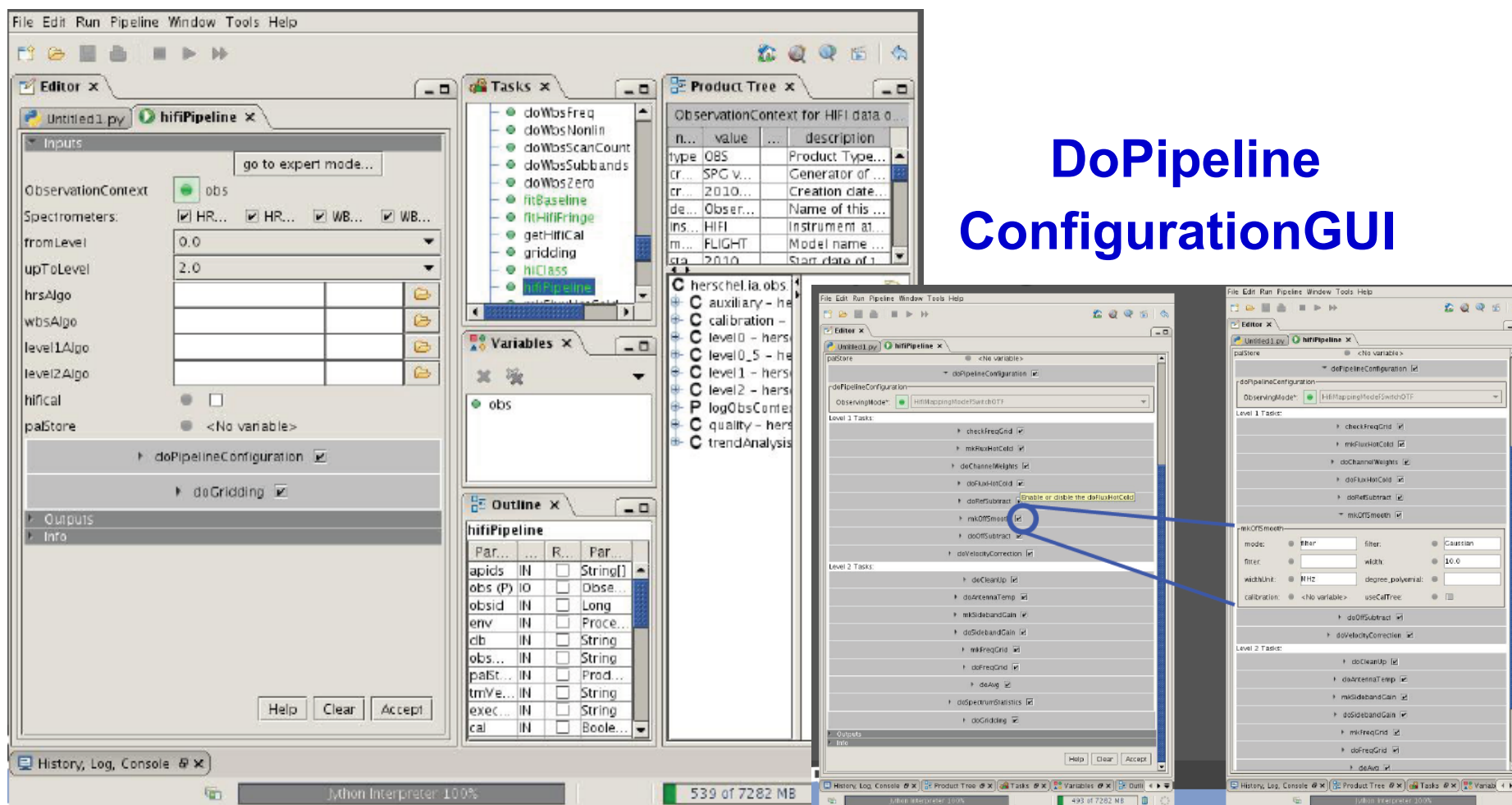
Highlights of HIFI SPG improvements

Improvements for HIFI products
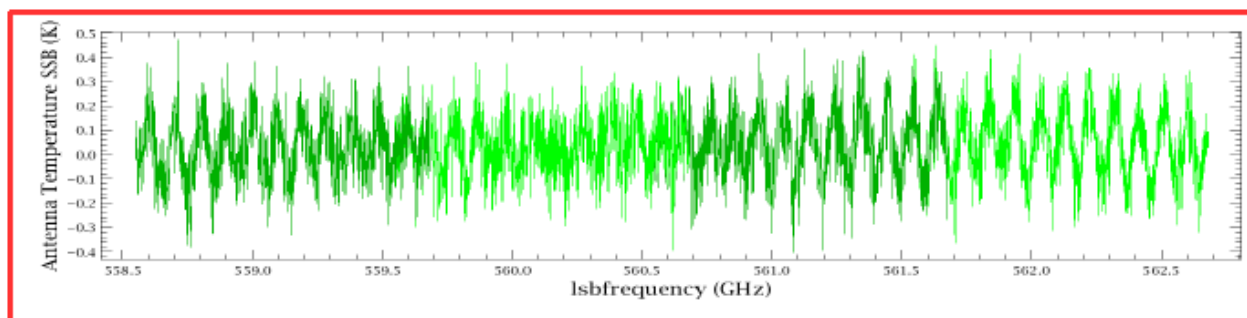Load Chop Ref modes – Non-real features removed
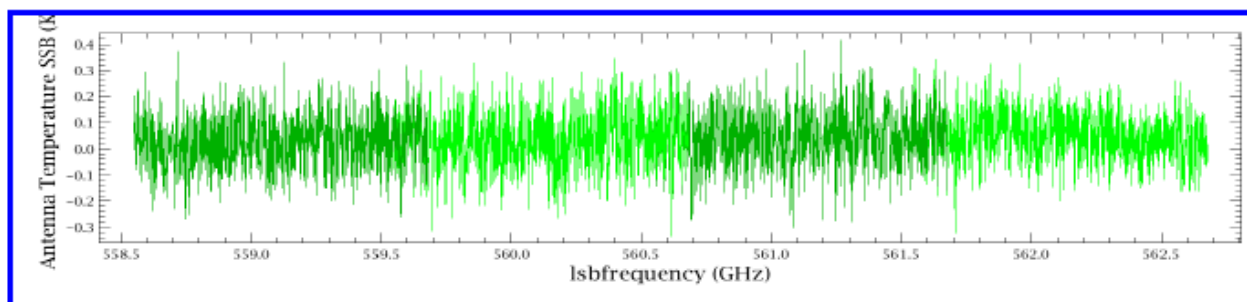
SgrA Observation SPG v5.0

SgrA Observation SPG v6.0

Highlights of HIFI SPG improvements

Improvements for HIFI products
Load Chop/FSwitch Ref modes – Smoothing Applied

SPG HCSS 6.0

SPG HCSS 6.1

No artificial standing waves coming from the OFF calculated baseline

Highlights of PACS improvements for HCSS 7

➢ **General**

  ➢ **Improved viewers for inspecting / masking datapoints**

  ➢ **Improved saving intermediate results on machines with little memory**

  ➢ **Partial implementation of photometer and spectrometer browse products (mostly for testing the process/interfaces/procedures within the operational environment)**

➢ **Spectrometer**

  ➢ **interactive pipeline scripts for unchopped range spectroscopy**

  ➢ **interactive script to separate on/off positions (to verify background line pollution)**

  ➢ **more robust interactive flatfielding**

  ➢ **interactive scripts processing all lines / ranges in an observation**
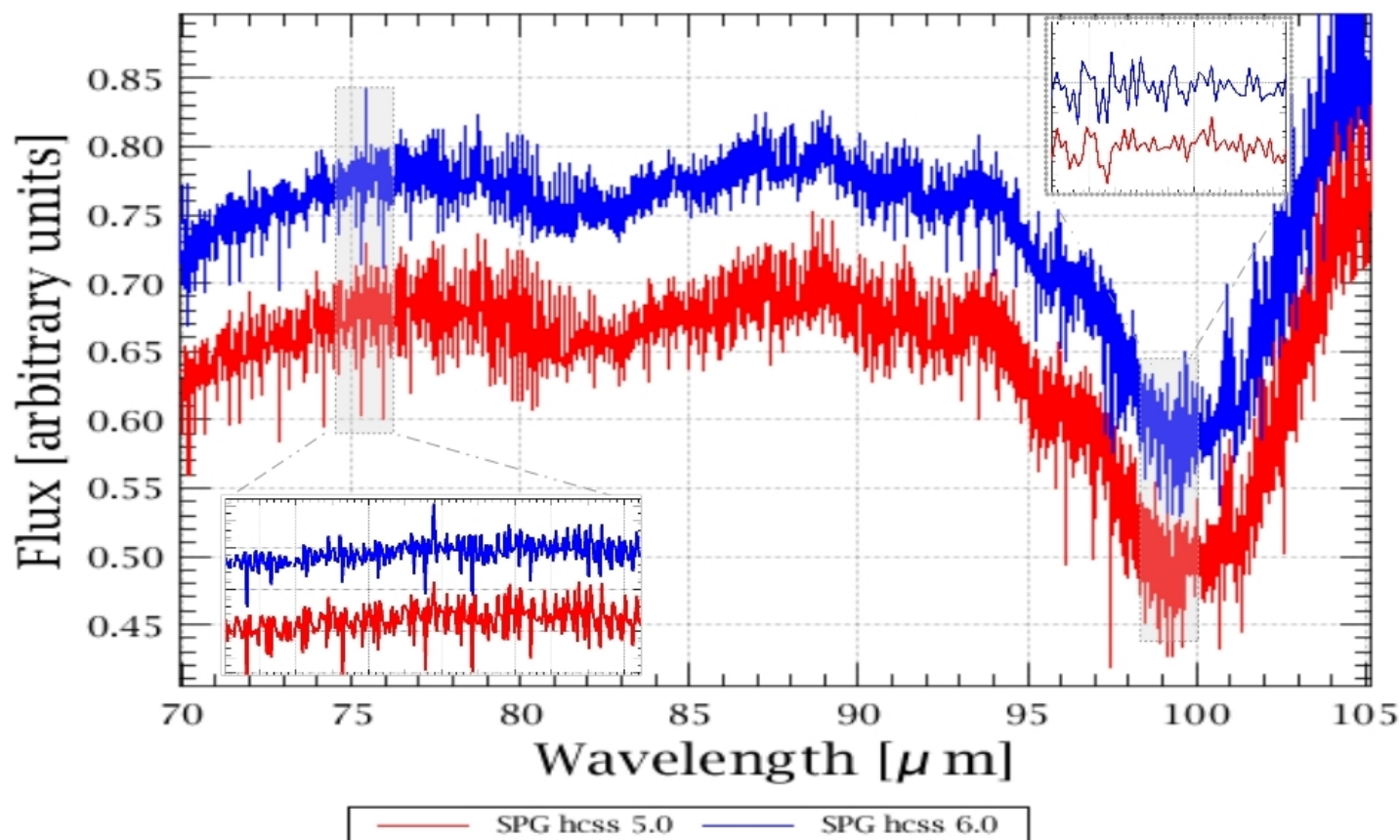
➢ **Photometer**

  ➢ **New response calibration and corresponding aperture corrections**

  ➢ **Improved correction for solar system object movement in the sky**

Highlights of PACS SPG improvements

Range Spectroscopy, pointed Chop/Nod

PACS band B2B SED Spectrum
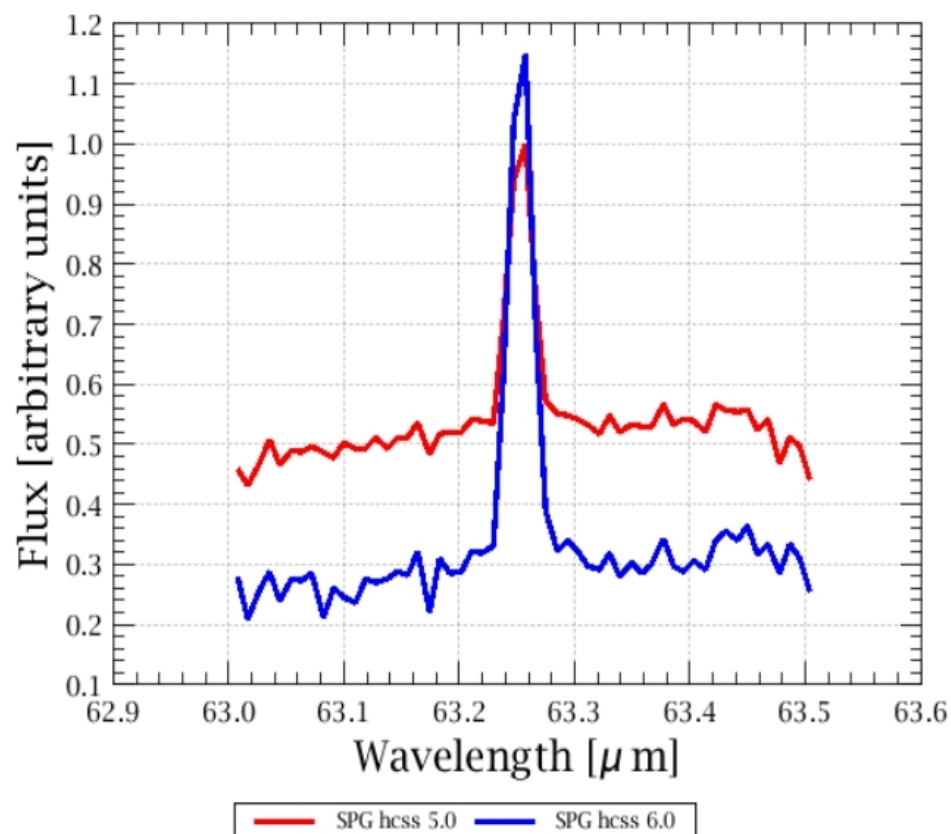
SPG hcss 5.0   SPG hcss 6.0

Spectra have been shifted on purpose to improve visibility

Highlights of PACS SPG improvements
Line Spectroscopy, pointed Chop/Nod

PACS band B3A [OI 3P1–3P2] line
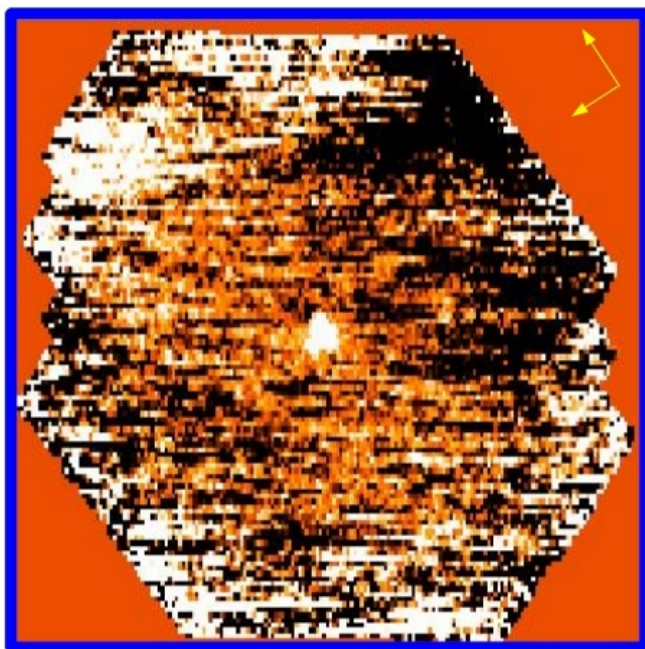
SPG hcss 5.0 — SPG hcss 6.0

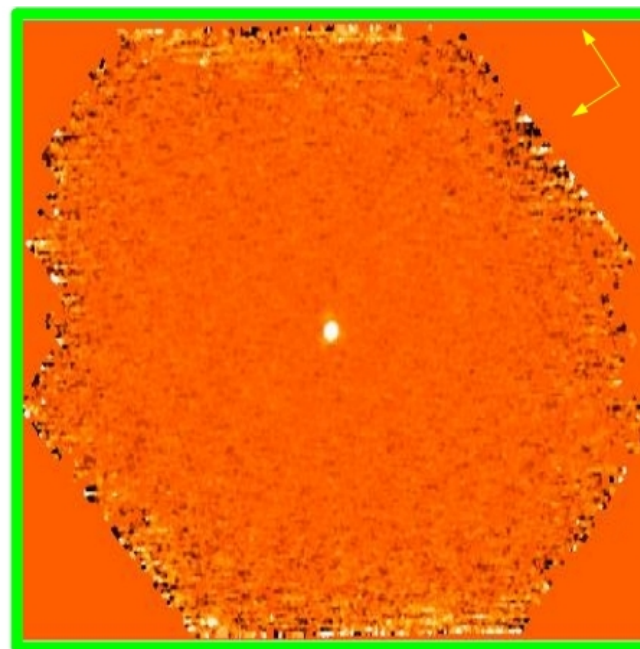Spectra have been shifted on purpose to improve visibility
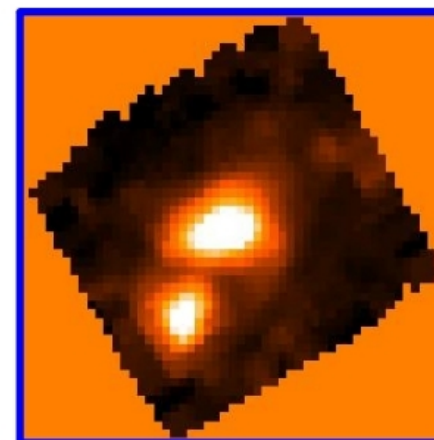
HCSS 6.1: Highlights of PACS SPG improvements
Photometry

Level 2
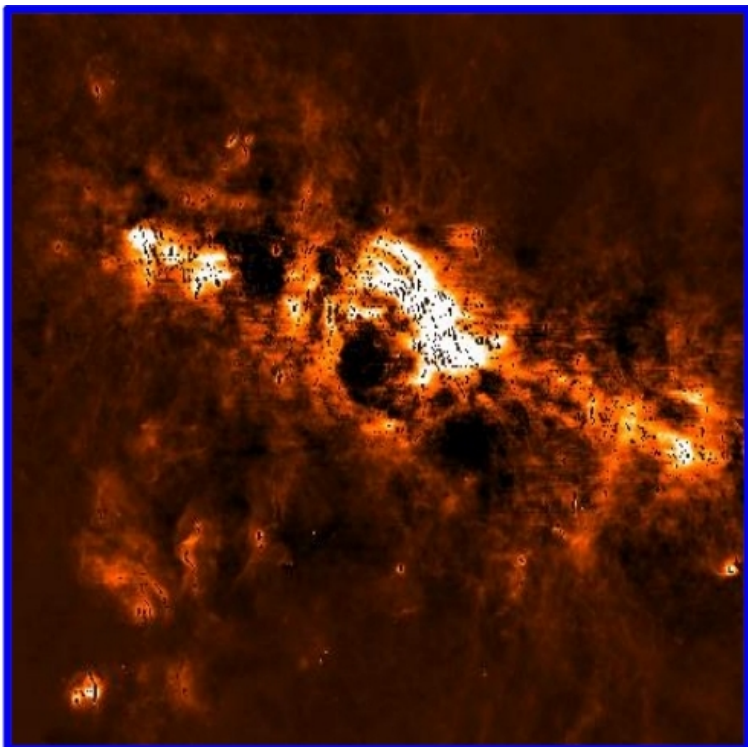
Level 2
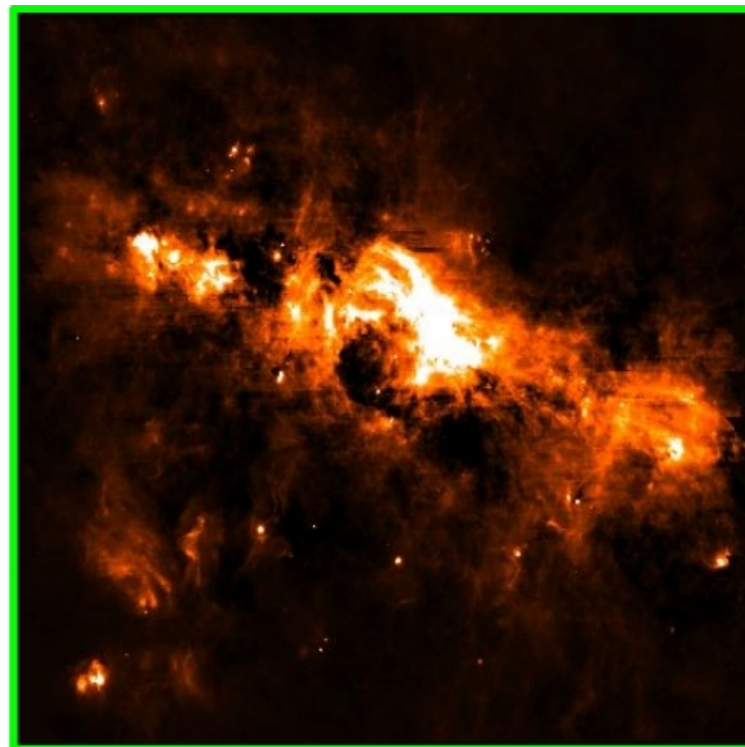
- *projection on smaller map pixels*
- *better masking.*

——— SPG hcss 6.0   ——— SPG hcss 6.1

HCSS 6.1: Highlights of PACS SPG improvements

Level 2
MMT deglitching

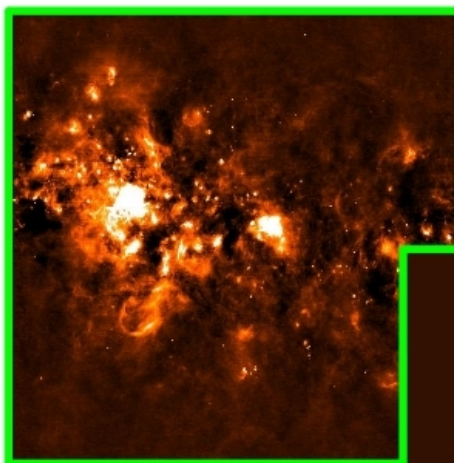**Level 2**
II level deglitching

SPG hcss 6.0   SPG hcss 6.1

HCSS 6.1: Highlights of PACS SPG improvements
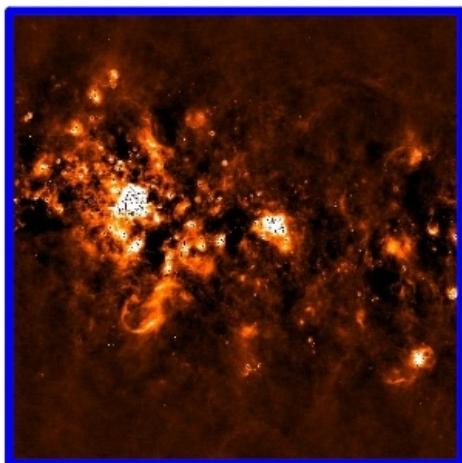
Level 2
@scan

Level 2
@scan

With HCSS 6.1 it is possible to combine multiple observations into level 2.5 products →
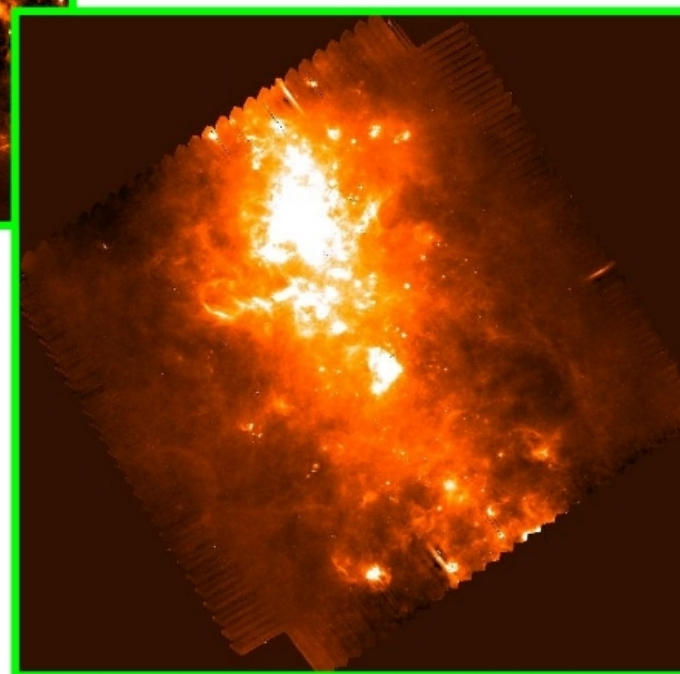
Level 2.5
@scan&cross-scan

──── SPG HCSS 6.0   ──── SPG HCSS 6.1*

* PACS CalTree working properly

PACS SPG: HCSS 6.1 shows great improvements

Photometry
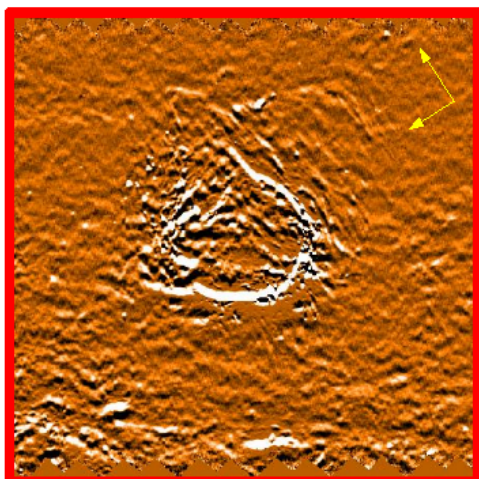
Level 2
PhotProject
@scan

With HCSS 6.1 it is possible to combine multiple observations into level 2.5 products →

Level 2.5
MadMap
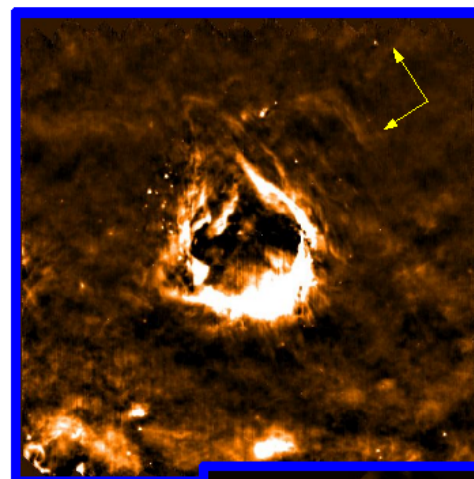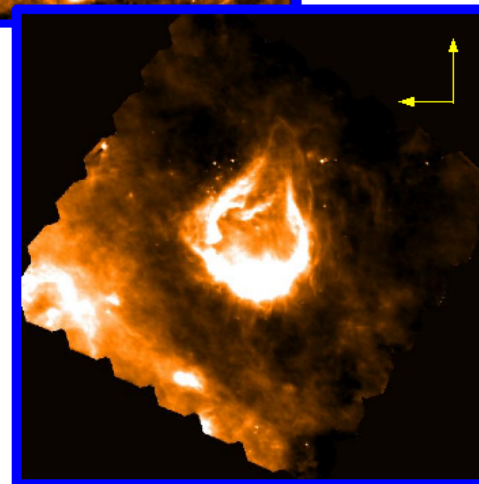*@scan&cross-scan*

SPG HCSS 6.1*	SPG HCSS 3.0

* PACS CalTree working properly

PACS SPG: HCSS 6.1 shows great improvements
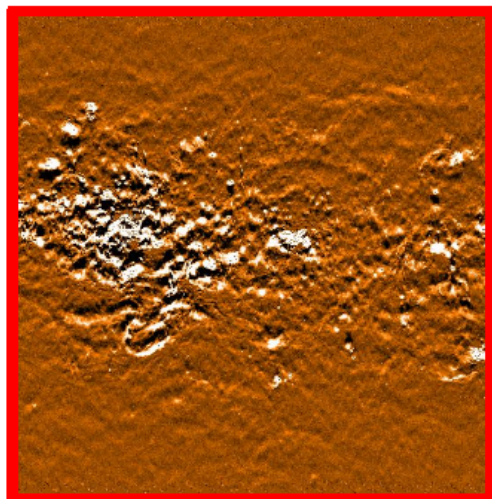
Photometry

SPG HCSS 3.0
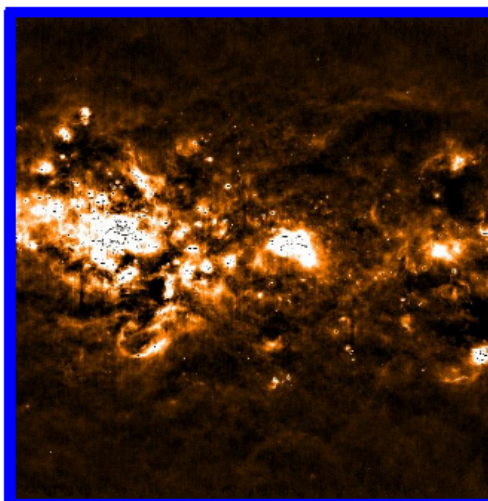
SPG HCSS 6.0
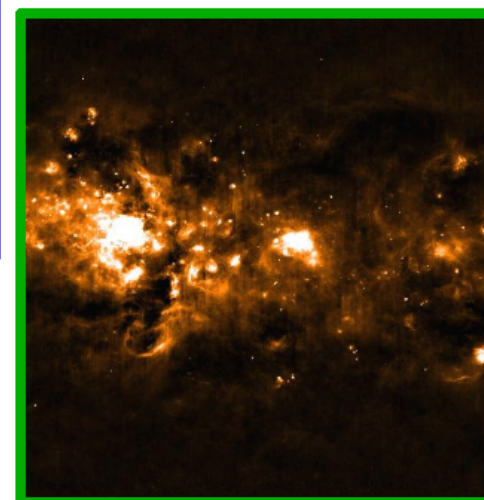
SPG HCSS 6.1

Level 2
PhotProject
@scan

Highlights of SPIRE improvements for HCSS 7

➢ **General**

   ➢ **Signal jump detector now handles "cooler burps"**

   ➢ **Masking of data at non-nominal s/c velocities**

➢ **Photometer:**

   ➢ **Baseline removal and destriper tasks now fully available**

   ➢ **Creation of Level 2.5 products, combining several observations into one mosaic**

➢ **Spectrometer**

   ➢ **New order for modules**

   ➢ **no telescope RSRF for telescope subtraction**

   ➢ **Wavelet deglitcher upgraded to work better with large glitches**

   ➢ **Gridding projection now a SPIRE task giving access to HIFI's task consistent with other projection tasks**

Highlights of SPIRE SPG improvements
Photometry

HCSS 5.1
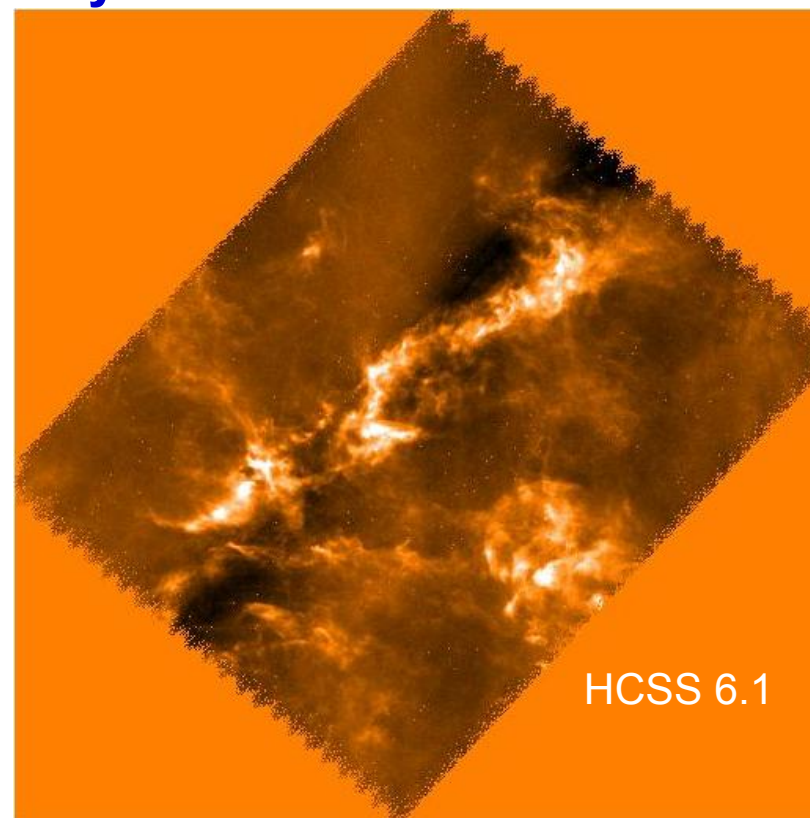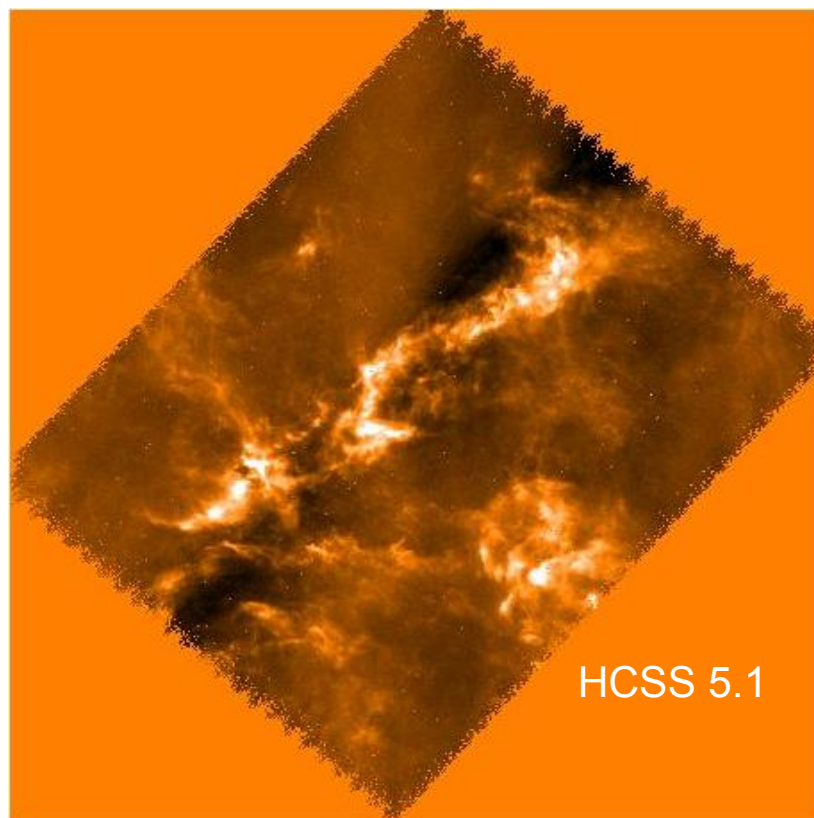
HCSS 6.1

With HCSS 6.1 it is possible to combine multiple observations into level 2.5 products

Highlights of SPIRE SPG improvements
Photometry
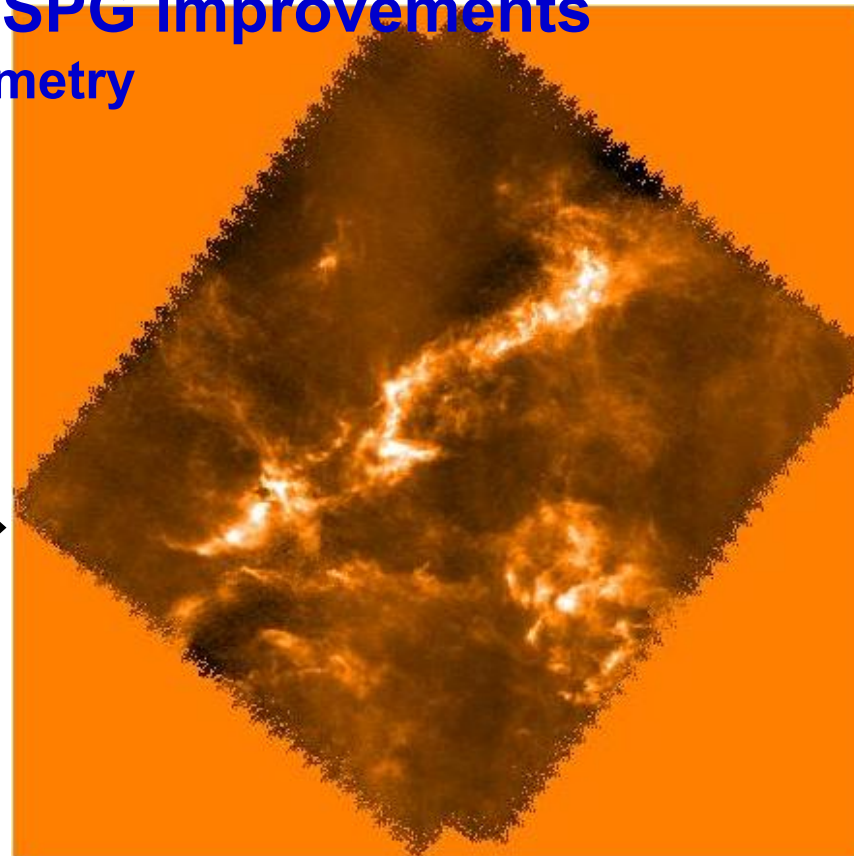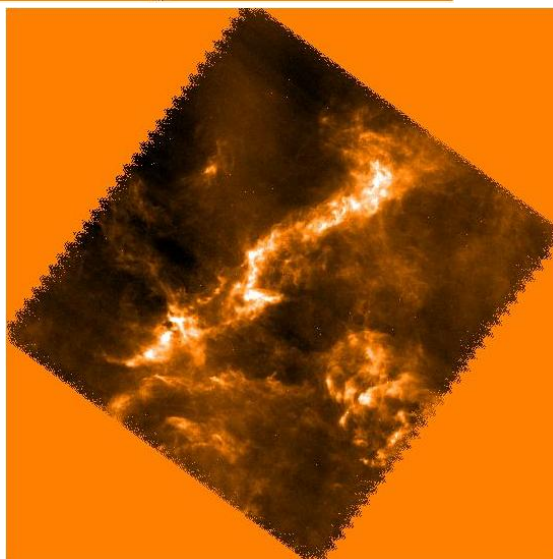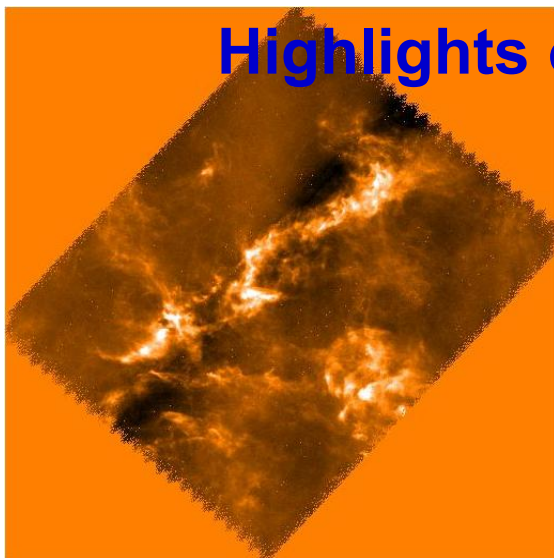
By combining several observations some artefacts are eliminated (details on next slide)

Highlights of SPIRE SPG improvements
Photometry
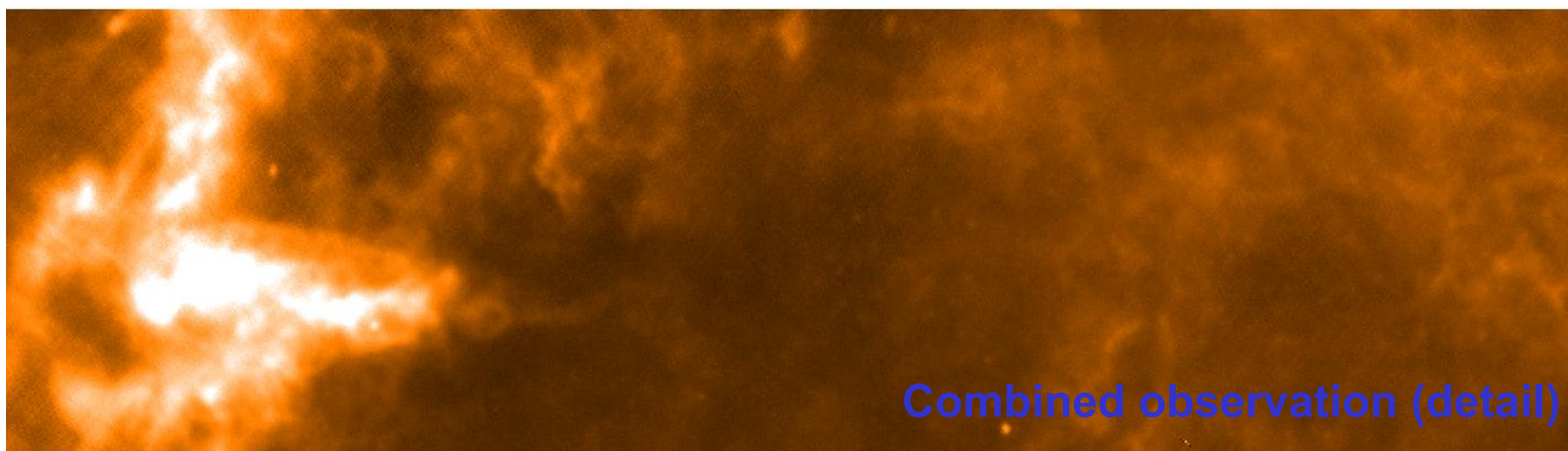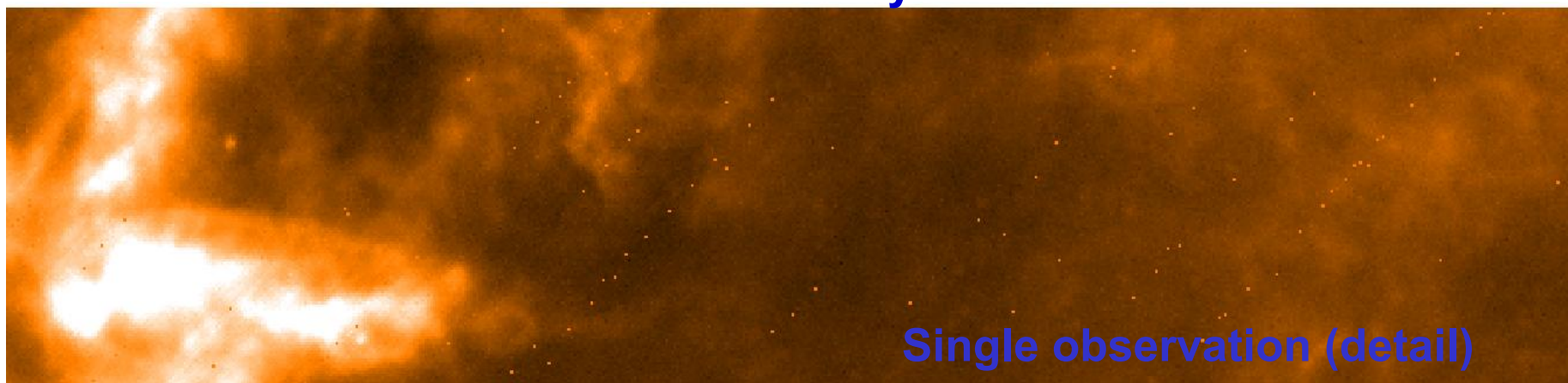
Single observation (detail)

Combined observation (detail)
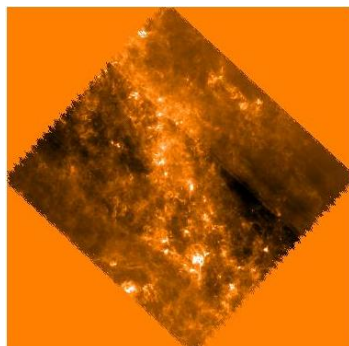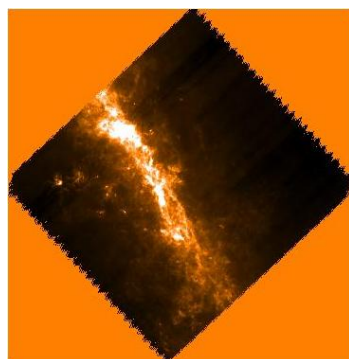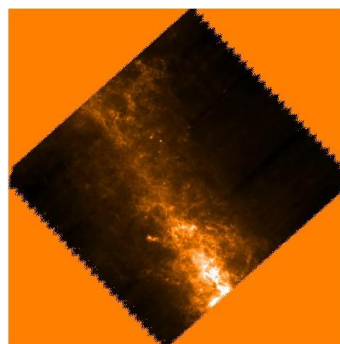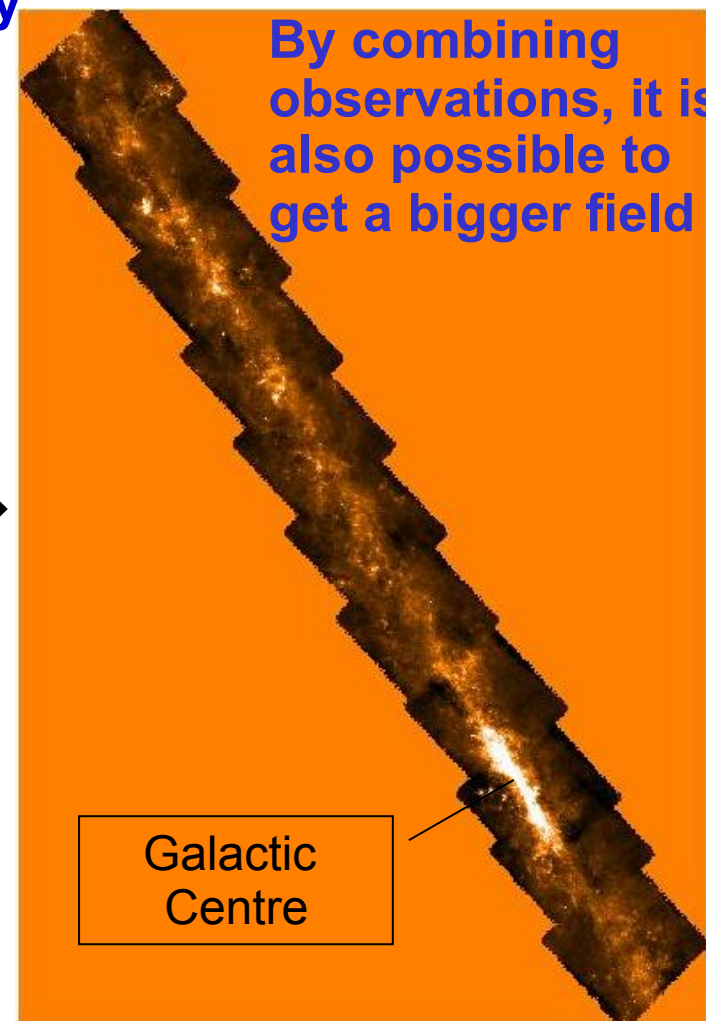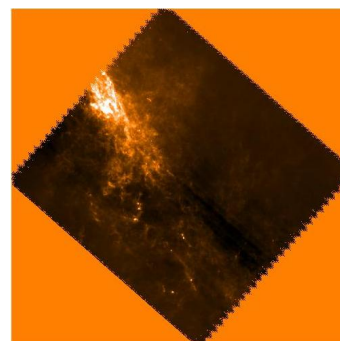
Highlights of SPIRE SPG improvements
Photometry
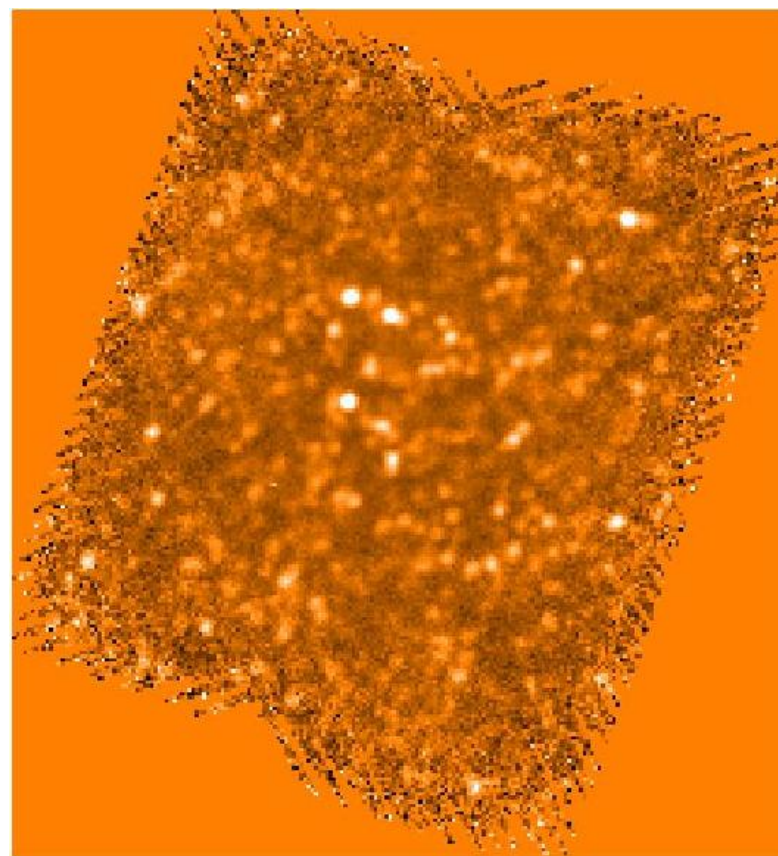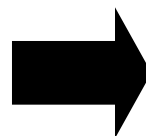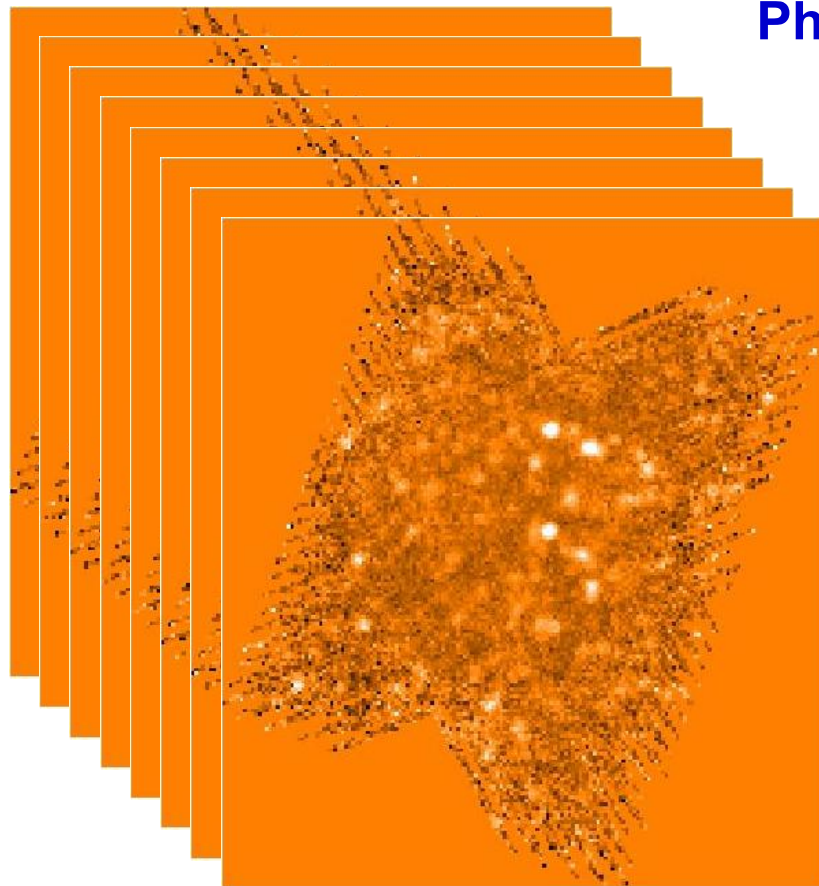
**Combination of 8 observations into
one mosaic increases s/n ratio**

Highlights of SPIRE SPG improvements
Spectroscopy

Calibration star (CRL 618) — **Faint Galaxy**

Version 4

Version 5

Version 6
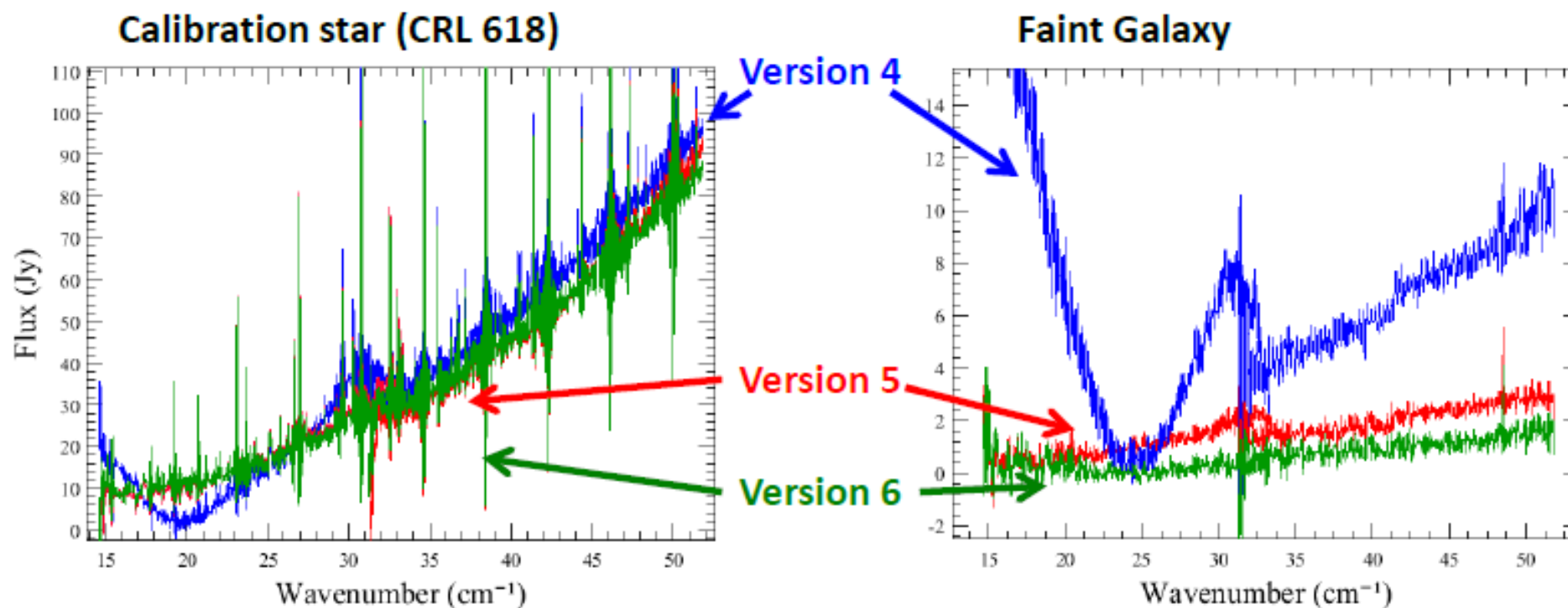
- Subtle improvements to normal sources
- Much improved spectral shape for weak sources

HIFI Data Processing Status for HCSS 6.1

AOT	Observing Mode	L2 Product Science useful	QC Avail (Flags/Docs)	HSA Browse Product	HIPE scripts Usable	Planned/needed improvements
Single Point	DBS	Yes	Yes	No	Yes	QC Area: spur flagging Browse Product: expected in v7.0
Single Point	Freq./Pos Switch	Yes	Yes	No	Yes	QC Area: spur flagging Browse Product: expected in v7.0
Single Point	Load Chop	Yes	Yes	No	Yes	QC Area: spur flagging Browse Product: expected in v7.0
Spectral Scan	DBS	Yes	Yes	No	Yes	QC Area: spur flagging Browse Product
Spectral Scan	Freq./Pos Switch	Yes	Yes	No	Yes	QC Area: spur flagging Browse Product
Spectral Scan	Load Chop	Yes	Yes	No	Yes	QC Area: spur flagging Browse Product
Mapping	DBS Cross/Raster	Yes	Yes	No	Yes	QC Area: spur flagging Browse Product
Mapping	OTF Freq./Pos Switch	Yes	Yes	No	Yes	QC Area: spur flagging Browse Product
Mapping	OTF Load Chop	Yes	Yes	No	Yes	QC Area: spur flagging Browse Product

green : OK (for current state of the mission) orange: limited shortcomings red: not available/not useful

PACS Data Processing Status for HCSS 6.1

AOT	Observing Mode	L2 Product Science useful	QC Avail (Flags/Docs)	HSA Browse Product	HIPE scripts Usable	Planned/needed improvements
Photometer	Scan Map	Yes L2.5 under test.	No	No	Yes	Calibration access for L2.5 products Speed bump flag Browse Product: expected in v7.0
Photometer	Point Source (not recommended observing mode)	Yes L2.5 under test.	No	No	Yes	Calibration access for L2.5 products Speed bump flag Browse Product: expected in v7.0
Photometer	Parallel	Yes L2.5 under test.	No	No	Yes	Calibration access for L2.5 products Speed bump flag Browse Product: expected in v7.0
Line Spec	Pointed Mapping	No	Yes	No	Yes	broadband correction for flux loss due to pointing, RSRF, reliability of broad features, flatfielding Browse Product: expected in v7.0
Range Spec	Pointed Mapping	No	Yes	No	Yes	broadband correction for flux loss due to pointing RSRF, reliability of broad features, flatfielding Browse Product: expected in v7.0
Unchopped	Pointed Mapping	No	Yes	No	Yes	broadband correction for flux loss due to pointing RSRF, reliability of broad features, flatfielding Browse Product: expected in v7.0

green : OK (for current state of the mission) orange: limited shortcomings red: not available/not useful

SPIRE Data Processing Status for HCSS 6.1

AOT	Observing Mode	L2 Product Science useful	QC Avail (Flags/Docs)	HSA Browse Product	HIPE scripts Usable	Planned/needed improvements
Photometer	Point Source (POF2)	Yes	Yes	Yes	Yes	Calibration of extended sources (baseline removal) QC flag thresholds under revision
Photometer	Large Map (POF5)	Yes	Yes	Yes	Yes	Calibration of extended sources (baseline removal) QC flag thresholds under revision
Photometer	Parallel (POF9)	Yes	Yes	Yes	Yes	Calibration of extended sources (baseline removal) QC flag thresholds under revision
Photometer	Small Map (POF10)	Yes	Yes	Yes	Yes	Calibration of extended sources (baseline removal) QC flag thresholds under revision
Spectrometer	SOF1	Yes	Yes	Yes	Yes	Bright source mode pipeline QC flag thresholds under revision
Spectrometer	SOF2	Yes	Yes	Yes	Yes	Bright source mode pipeline QC flag thresholds under revision

green : OK (for current state of the mission) orange: limited shortcomings red: not available/not useful

Miscellaneous

➢ **NHSC Workshop "An introduction to Herschel Data Processing for new users" was held during end of February. It went very well**

➢ **ESAC "OT1 Data Processing Workshop" took place mid March. It was well received by the participants**

➢ **A Spectral Mapping workshop to address astronomers needs to make fully calibrated spectral maps with Herschel data will take place May 26th to May 27th. Around 25 persons are expected to attend**

➢ **A Herschel Science Ground Segment user/developer meeting "HIPE Forum 2011" (successor of the developer oriented CSDT meetings) will take place 28th to 30th of June in Garmisch-Partenkirchen (Germany).**

Status of reactions on HUG #1 recommendations: DP general

4.1	Facilitating a small number of working groups to solve specific data processing and/or calibration problems	Calibration steering group will follow this important issue up
4.2	Improvement of release notes for user releases	Ongoing work
4.3	Expansion of web pages to include data processing manuals for all of the instruments and cookbooks	Ongoing work
4.4	Expansion of the DPUG to include outside Herschel users and execution and evaluation of user survey	Ongoing work
4.5	Establishment of regular communication between the DPUG and the HUG	Ongoing work
4.6	Reinvigorate or disband Data Processing Interest Lists. Continue with Data Processing workshops	Ongoing work

Status of reactions on HUG #1 recommendations: HIFI

5.1	Export of deconvolved HIFI spectrum to CLASS; goal is HCSS 7	Ongoing work, expected for HCSS 8
5.2	Removing baseline ripples for high-continuum, line-rich sources in Level 1 products.	Challenging and long-term task. Draft report on alternative calibration schemes available
5.3	Improvement of in-flight sideband gain calibration; goal for sideband ratios to go in the HIFI calibration tree is HCSS 8	Ground-based investigations needed. Challenging and long-term task. Advancement of the knowledge of the side band ratio will come as results of an ongoing PhD project.

Status of reactions on HUG #1 recommendations: SPIRE

6.1	Improved calibrations and data processing for FTS spectroscopy; goal is HCSS 8	Ongoing work, targeted for HCSS 8
6.2	Improved calibrations (with uncertainties) and tests of mapping of extended diffuse emission for SPIRE scan maps	Ongoing work that might well continue into the post-operational phase. Work on zero point calibration of scan maps started

Status of reactions on HUG #1 recommendations: PACS

7.1	Calibration and external validation of mapping of extended emission	Issues understood. Documents posted on the WWW
7.2	Scripts, PSF and software for the end-to-end processing of spectra	Fulfilled by HCSS 7
7.3	Removal of artefacts including striping from scan maps and astrometric issues for moving target observations	Tools to remove striping artefacts and to correct astrometric issues for SSOs included in 7.0
7.4	End-to-end processing of calibrated full-range spectra with both instruments; goal is HCSS 7	HCSS-12100 targeted for HCSS 8

Status of reactions on HUG #2 recommendations

Addressing the HUG top-level recommendations

1. PACS Spectroscopy Calibration

While recognising that significant progress has been made recently, the need to be to be able to obtain fully calibrated range spectra which are published (with known errors) remains as a high priority. Algorithms for the de-fringing of the full-range spectra would be very much appreciated.

http://herschel.esac.esa.int/twiki/bin/view/HSC/Hug2Response

[From Roland V.] Fully-calibrated long-range spectra can be produced with the available interactive pipeline scripts in HIPE 6.0 and later versions. The interactive flat-field task is doing most of the "de-fringing" work on the data but it was (so far) decided that this task should be kept out from the standard (SPG) pipeline. Task documentation is available in the PACS Data Reduction Guide.

Edit response

Detailed reactions to HUG #2 recommendations are work in progress

2. PACS and SPIRE Spectral Mapping

Although significant has been made in recent months in processing of point source spectroscopy with PACS and SPIRE, spectral mapping remains beyond the reach of all but the most expert user. Committed to implementing the these challenging tasks, we give this a high priority, especially a faculty a level of the PACS pipeline for the unchopped line scan mode. These capabilities are needed to allow observers to validate their data and the efficacy of their observing strategies before the Cycle 2 deadline (Section 3.2).

[From Roland V. regarding PACS spectral mapping] The current 7.0 pipeline provides a simplistic but robust solution to finite element discretization, i.e. the individual IFU cubes can be projected onto a spatially and spectrally resampled cube. We realize this is just the first step of creating reliable spectral maps of physical measures in the interest of the observer. The instrument team is working on advanced spectral cube reconstruction algorithms what aim to offer users the ability to

- project all spectral slices to the same spatial grid
- project fitted line parameters and derived physical measures - such as line flux - to a common spatial grid

Many thanks for your feedback, specially for the detailed feedback on documentation.

Herschel Data Processing Management group will address the HUG #2 recommendations in detail during its next in persona meeting mid May

Envisaged improvements for pipeline system, HIPE, documentation and user tools

➢ **Reduce HIPE freezes and hangs**

➢ **Improvement of calibration and data reduction pipelines**

➢ **Improvement of user friendliness**

➢ **Data manager for Herschel spectra to improve the robustness of spectrum explorer interface**

➢ **Applicability of Tasks**

➢ **Improvement of tools**

➢ **Simplified data input/output. Access to reprocessed data.**

➢ **Addition of useful example scripts to the build**

Envisaged improvements for pipeline system, HIPE , documentation and user tools

➢ **Combination of data from the different instruments**

➢ **Harmonization of final spectra and VO. Workflow between Herschel products/HIPE and VO**

➢ **Upgrade to Jython 2.5**

➢ **Removal of JIDE**

➢ **Improved automatic testing to increase confidence in developer builds and speed-up delivery cycle for releases to the community**

➢ **Improvement of code quality so the system will be maintainable with the reduced manpower we can expect during post-operations**

➢ **Documentation**

Envisaged improvements for HIFI

- ➢ **Spectral maps (OTF and DBS Raster)**

- ➢ **Exporting the deconvolved HIFI spectrum to CLASS**

- ➢ **Inclusion of uplink information how the map has been carried out on the sky**

- ➢ **Implementation of rotated maps (non-square RA / Dec grid)**

- ➢ **Upgrading Jython tasks written by key program users which were heavily used during HIFI's PV phase to tools within the SpectrumToolbox**

- ➢ **Implementation of browse products and postcards for the Herschel Science Archive**

Envisaged improvements for PACS

➢ **Spectrometer**

   ➢ **Correction for solar system object movement in the sky (spectral maps)**

   ➢ **Correction for flux losses due to pointing**

➢ **Photometer**

   ➢ **Linearity correction**

Envisaged improvements for SPIRE

➢ **Photometer**
  ➢ **Use of individual detector relative gains (relative beam areas) for better flat fielding in extended emission calibration**
  ➢ **Weighted errors in maps**
  ➢ **2nd level deglitching (photometer)**
  ➢ **Correction of electrical crosstalk**
  ➢ **Zero point calibration of scan maps using Planck data**
  ➢ **Tool to provide bolometer timelines crossing a certain pixel in the map**
  ➢ **Timeline-based source fitter**
  ➢ **Timeline-based source subtractor**
  ➢ **Improving pointing registration with repeated map data**

➢ **Spectrometer**
  ➢ **Bright source mode pipeline (for HCSS 8)**
  ➢ **Background subtraction**
  ➢ **Repeatability and accuracy**
  ➢ **Characterisation of the instrument line shape**
  ➢ **Calibration to GHz in spectral axis**
  ➢ **Characterisation of beam shapes and area**

Reply on HUG #2/6 recommendation:
Planning and Prioritization of Data Processing

➢ **There are several drivers in the planning and prioritisation of data processing efforts that need to be balanced**

  ➢ **Operations**

  ➢ **Science**

  ➢ **Usability**

  ➢ **Maintainability**

➢ **There are several sources to collect the requests for improvements**

  ➢ **S/W tickets issued from persons involved in the HSGS**

  ➢ **Feedback from user/developer workshops, converted into s/w tickets**

  ➢ **Feedback from HIPE acceptance campaigns, converted in s/w tickets**

  ➢ **Helpdesk tickets, converted into s/w tickets**

  ➢ **Feedback from DP questionnaire, converted into s/w tickets**

  ➢ **Recommendations from HUG, converted into s/w tickets**
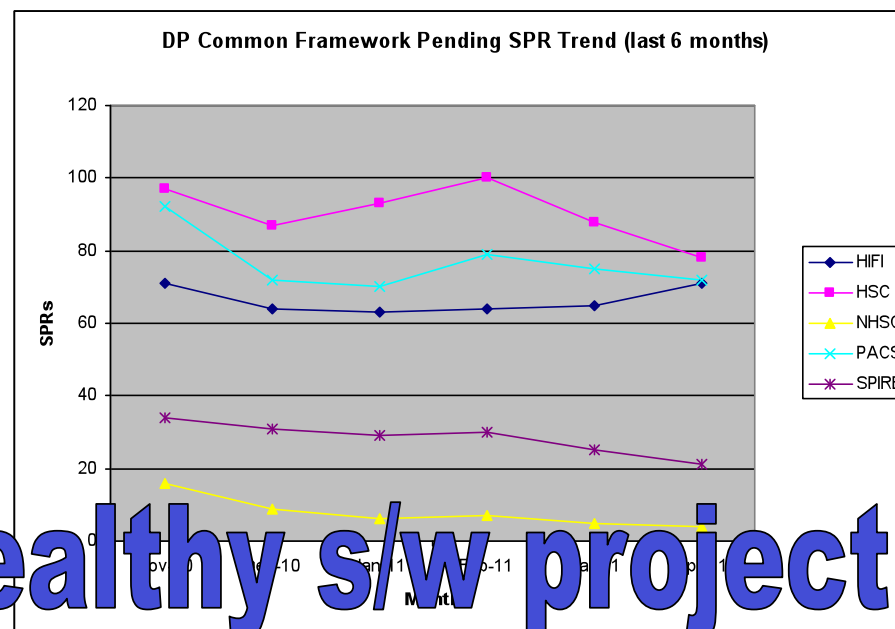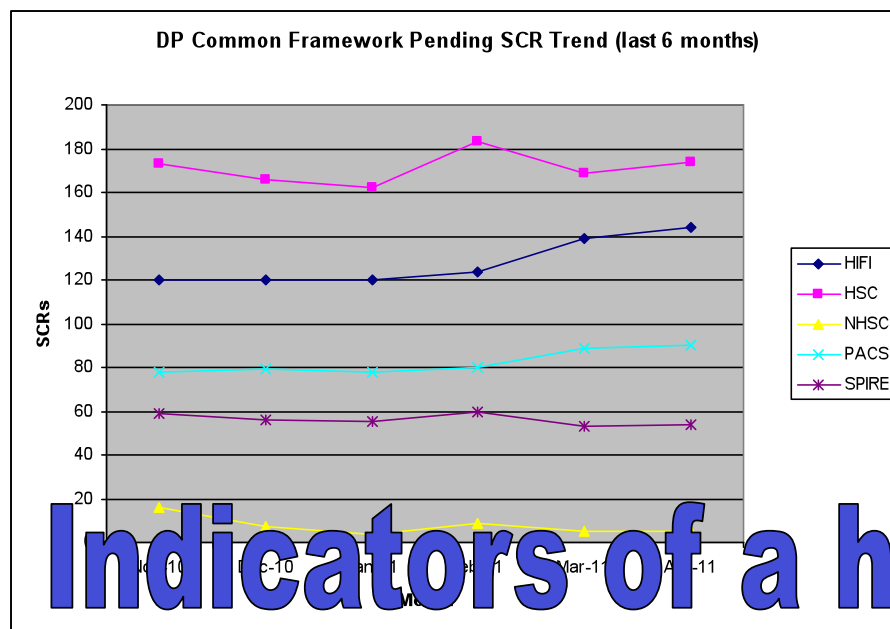
Reaction to HUG #2/6 recommendation: Planning and Prioritization of Data Processing

➢ **These s/w tickets are implemented on the initiative of the relevant implementer or actioned by a group of topical Configuration Control Boards (CCBs)**

➢ **We have quite a number of contributors with specialised areas of expertise, i.e.**

>   ➢ **ICC, HSC and NHSC astronomers who are specialists in algorithmic development and calibration refinement**

>   ➢ **HSC software engineers who are taking care of HIPE and SPG infrastructure**

>   ➢ **ICC, HSC and NHSC software engineers who contribute to other parts of HIPE to support data analysis**

>   ➢ **Software engineers located at FHNW (Switzerland) and NOAC (China) to take care of help and plot functionality**

➢ **E.g.: Staff who work on plot can not contribute to algorithmic development or calibration refinement**

Project development statistics
Trend of s/w tickets for pipeline system, HIPE, documentation and user tools

DP Common Framework Pending SCR Trend (last 6 months)

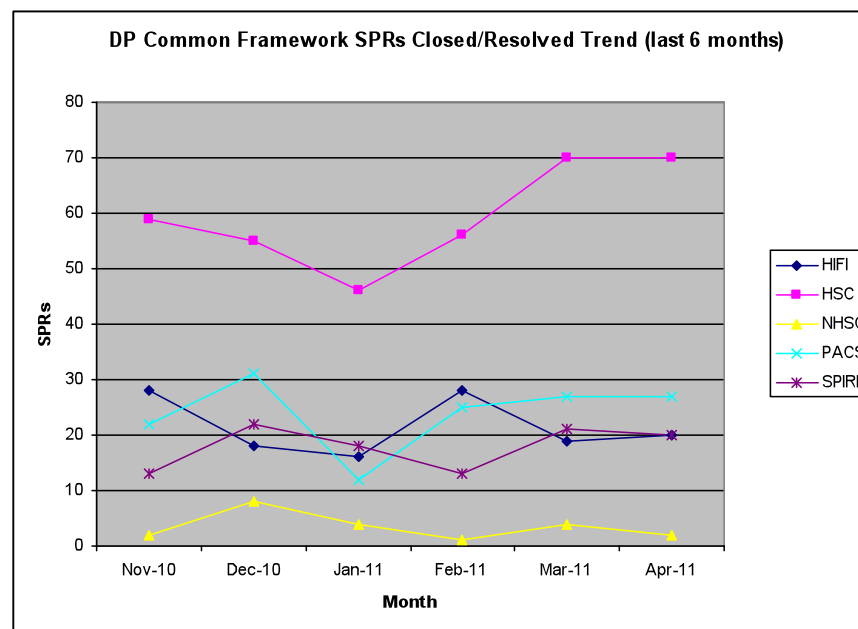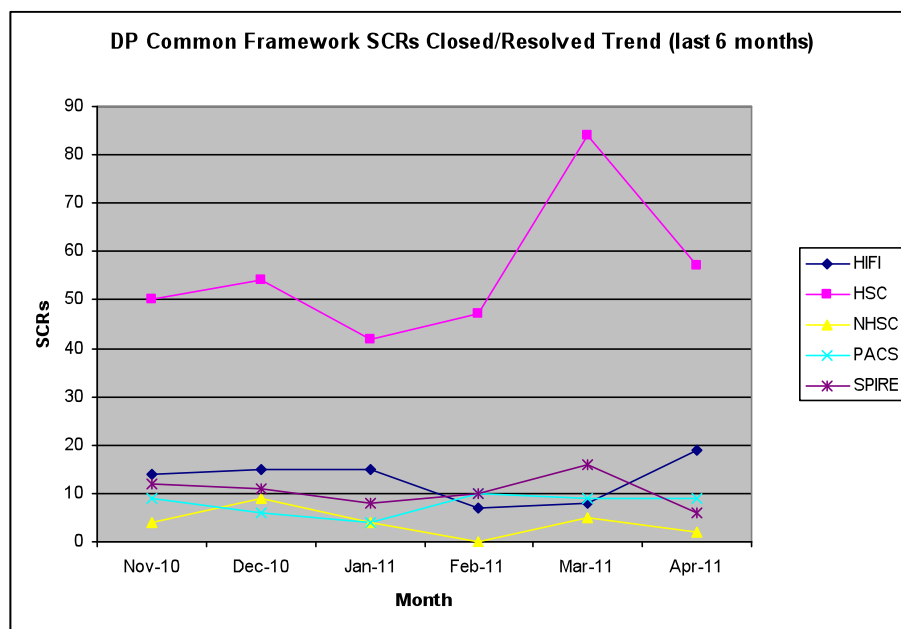**DP Common Framework Pending SPR Trend (last 6 months)**

Indicators of a healthy s/w project

stable number of change requests

number of problem reports reached six months low

Project development statistics:

Closure rate of s/w tickets for Trend of s/w tickets for pipeline system, HIPE, documentation and user tools
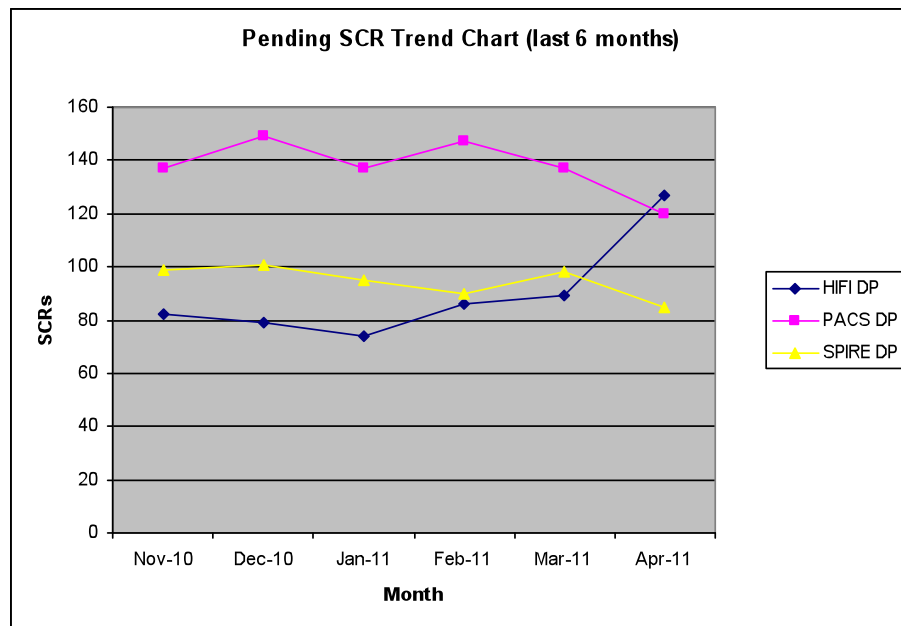

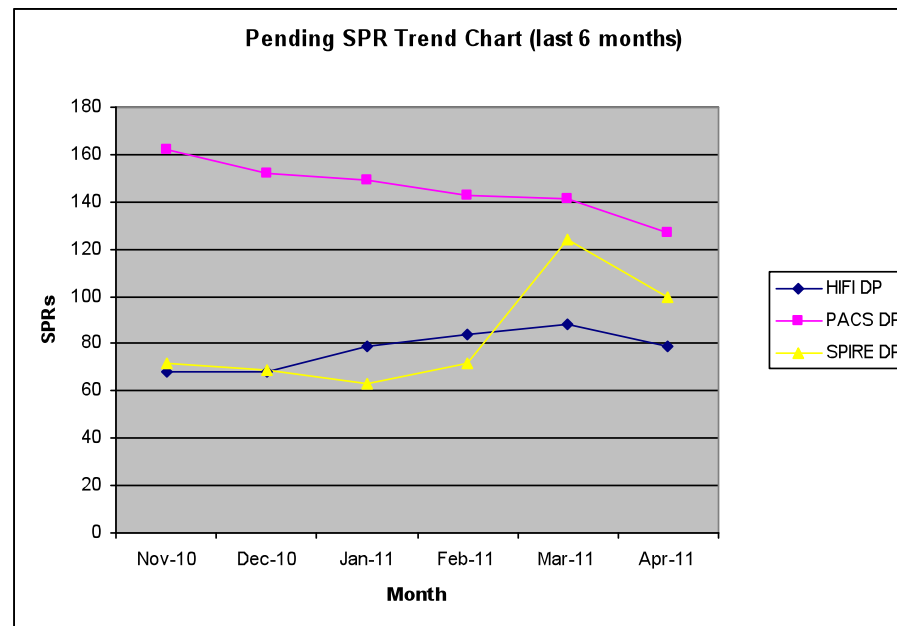**DP Common Framework SCRs Closed/Resolved Trend (last 6 months)**

DP Common Framework SPRs Closed/Resolved Trend (last 6 months)

Change Requests   Problem Reports
230 s/w tickets were implemented last month

Project development statistics:
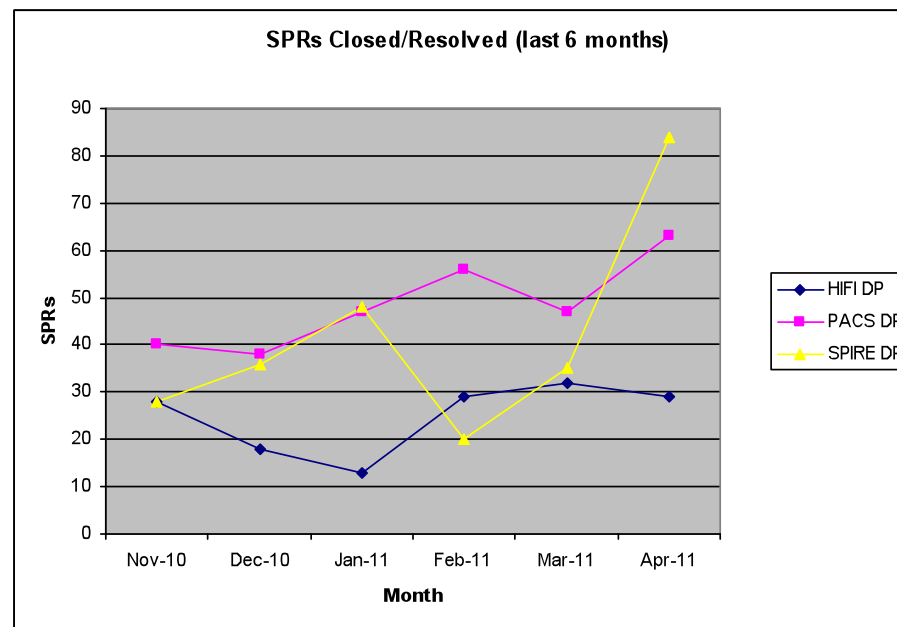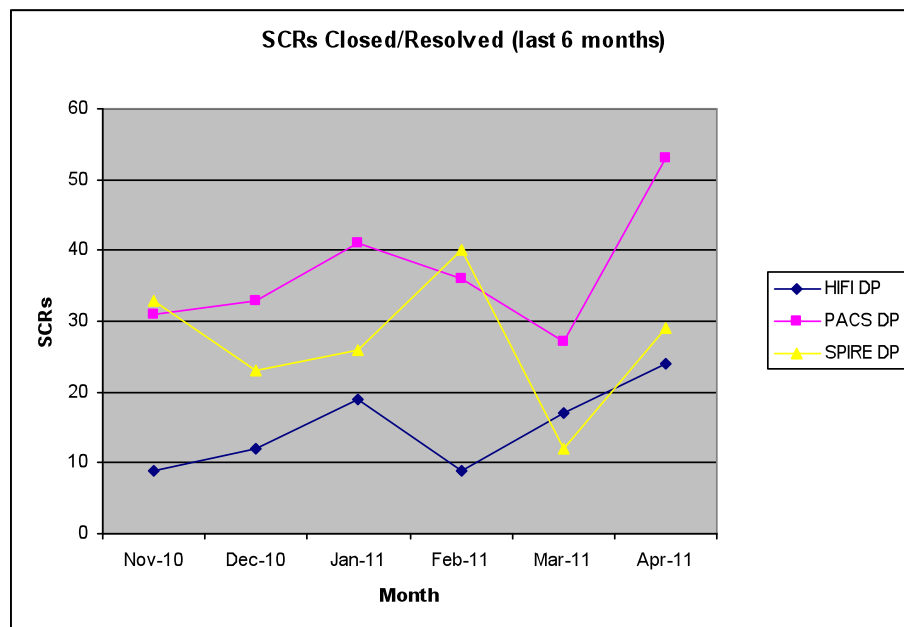## Trend of instrument DP s/w tickets

number of HIFI DP SCRs peaked due to the change requests raised for URM updates

number of SPIRE DP SPRs peaked to the problem reports raised for task compliance and URM updates

Project development statistics:
Closure rate of instrument DP s/w tickets

SCRs Closed/Resolved (last 6 months)

Legend: HIFI DP, PACS DP, SPIRE DP

SPRs Closed/Resolved (last 6 months)

Legend: HIFI DP, PACS DP, SPIRE DP

Change Requests

Problem Reports

280 s/w tickets were implemented last month

Additional points

➢ **HIPE Forum 2011: If you have observers active in HIPE data processing who would like to participate please contact B. Merin**

➢ **Future user/developer workshops: If you are aware of observers active in HIPE data processing who could participate in the potentially planned sessions to address the list of data processing bottle-necks listed in the HUG #2 recommendations please contact B. Merin**

➢ **Future HIPE acceptance test campaigns: If you are aware of observers active in HIPE data processing who could participate in the future sessions please contact B. Merin**

Additional points

➢ **Frequency of HCSS releases: We don't envisage to increase the frequency. As reported during HUG #2 we need to consider to decrease the release frequency as validation of releases takes a serious efforts from the HSGS**

➢ **We welcome HUG's encouragement that DPUG members take a stronger role to identify and prioritise the top-level needs of the observer community relevant to core pipeline processing (i.e., removal of instrumental artifacts and calibrations) As this is mainly done within the instrument CCBs should the instrument DPUG representatives be asked again to become members of their instrument CCBs?**

Your questions to me?