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Data Processing Development

Herschel Data Processing – Status and Outlook

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- **Data Processing Overview**
 - **Activities & Events**
 - **Priorities for HCSS 11 and HCSS 12**
- **Post-Operations**
 - **Priorities**
 - **Recommendations**
 - **HCSS schedule**
- **On the way towards the Best Data Products for the Legacy Archive**
- **Scientific productivity of Herschel**
- **Your questions, please**



Herschel observation used as backdrop in the entrance of the new ESAC multipurpose facility showing Álvaro Giménez, ESA's Director of Science and Robotic Exploration and Head of ESAC and ESA's Director General Jean-Jacques Dordain at the opening event



Data Processing Overview: Activities and Events

- **22nd of January 2013** **HCSS 10.0 installed as operational version**
- **28 – 31st January 2013** **Herschel PACS and SPIRE map-making workshop (ESAC)**
<http://herschel.esac.esa.int/2013Mapmaking.shtml>
- **12th of March 2013** **Bulk reprocessing of Herschel observations with HCSS 9.1**
 - **Level 2 generation started November 22nd 2012 and was completed 27th of January 2013**
 - **All 50319 observations reached the expected processing level**
 - **Best sustained system throughput around 40 Operational Days/day**
 - **Level 2.5 generation started February 6th and finished February 27th**
 - **99.99% of 10516 PACS maps were processed successfully in 12 days**
 - **90.3% of 670 PACS spectra were processed successfully in 1 hour**
 - **All 1229 SPIRE maps were processed successfully in one day**



Data Processing Overview: Activities and Events

- **14th of February 2013** **Branch-off point for HCSS 10.1. HCSS 10 bulk reprocessing will be performed with this version**
- **24 – 27th June 2013** **Herschel Data Processing Workshop for Newcomers (ESAC)**
- **Summer 2013** **Herschel Data Processing Workshop for Archive users (NHSC)**
- **Autumn 2013** **HIPE Forum 2013: Expanding the Herschel community (ESAC)**



Data Processing Overview: Priorities for HCSS 11 (Framework & system)

- 1. Improvements of calibration, pointing reconstruction and data reduction pipelines**
 - **Startracker pointing derivation**
 - **Restructuring of ACMS to support improved pointing reconstruction**
 - **Adding the Solar Aspect Angle to the pointing product**
- 2. Migration to Java 7**
- 3. Framework to generate level 2.5 and level 3 products**
- 4. Start-up time for HIPE**
- 5. Improvement of documentation search**
- 6. Improvements to ASCII tables reading and writing**



Data Processing Overview: Priorities for HCSS 11 (Framework & system)

- 7. Batch mode for HIPE (instead of jylaunch)**
- 8. Removal of ia_toolbox_spectrum_gui (old spectrum explorer)**
- 9. Replacement of HSA perspective by data access perspective**
- 10. Improvements in user-friendliness (GUI layout, tooltips, harmonisation of Python syntax in HIPE)**
- 11. Pagination of HSA query results to improve response time for users (avoiding a long response time for HIPE)**
- 12. Improvements to task registration and management**



Data Processing Overview: Priorities for HCSS 11 (Framework & system)

- 13. Editing functionality of table and array datasets, including insertion of changed product into observation context and history recording of the changes**
- 14. Completion of CalSDB interface into HIPE**
- 15. Irregular grid 2-d interpolation**
- 16. Display**
 - **aperture photometry improvements**
 - **WCS matching of images**
 - **source fitting errors**
 - **import of RGB images**



Data Processing Overview: Priorities for HCSS 11 (Framework & system)

17. Cube Spectrum Analysis Toolbox

- **improvement of the moment algorithm for computeVelocityMap**
- **support for the new ParameterCube product (viewer)**
- **rectangular selection is added**

18. Improvements to PAL performance

19. Support to stabilise system for future reprocessing exercises

20. Improvement of SPG interface for DP TAs to ease future reprocessing exercises



Data Processing Overview: Priorities for HCSS 11 (HIFI)

- 1. Investigation of performance issues for HIFI pipeline**
- 2. HIFI uplink product**
- 3. Update of spur-finder to improve data quality**
- 4. Update of calibration table**
- 5. Improvements to HEB standing wave mitigation prototype tool**
- 6. Improvements to sideband ratio**



Data Processing Overview: Priorities for HCSS 11 (PACS)

System

- 1. Search for further memory leaks / reduction/optimisation of memory use**
- 2. Package / code clean-up**
- 3. Test harness coverage improvements**

Photometer

- 1. Improvements in baseline drift correction**
- 2. Scanamorphos HIPE implementation**
- 3. Level 3 products**
- 4. Improved error calculation for level 2.5 products**
- 5. Improved calblock filtering**



Data Processing Overview: Priorities for HCSS 11 (PACS)

Spectrometer

- 1. Flatfielding improvements**
- 2. Calibration improvements**
- 3. Background subtraction improvements**
- 4. specProject/drizzle improvements**
- 5. Product improvements**
- 6. Ipipe script for high flux pointing loss correction**
- 7. User scripts: mapping of line fit parameters and more improvements**



Data Processing Overview: Priorities for HCSS 11 (SPIRE)

Photometer

- 1. New definition of Level 2.5 and Level 3 products**
 - Level 2.5 contains single pairs of nominal and orthogonal SPIRE destriped parallel maps
 - Level 3 will be any overlapping region from a given program using the absolute calibrated maps from the Planck zero point
- 2. New extended calibration framework**
 - improved calibration scheme for extended sources
 - correction coefficients in the form of a Calibration table
- 3. Improved cross-calibration with Planck (TBC)**



Data Processing Overview: Priorities for HCSS 11 (SPIRE)

Photometer

- 4. Map Projections for Naïve Mapper: Implementation of different WCS and pixel minimization into map maker**
- 5. Source subtractor within Source Extraction task**
- 6. Interactive Level-2 deglitcher tool**
- 7. Documentation how to perform source extraction for extended emission (TBC)**



Data Processing Overview: Priorities for HCSS 11 (SPIRE)

Spectrometer

- 1. Bright mode processing to be done in voltage pipeline**
- 2. Updates to the telescope model calibration product**
- 3. Improvement of pipeline for H+L - LR processing**
- 4. Updated instrument and telescopeRsrf calibration products**
- 5. Level-1 spectral products to be averaged**
- 6. Tuning of spectrometer parameters for wavelet deglitcher**
- 7. Update MAD deglitching (2nd level deglitching) parameters for obs. with >30 repetitions**
- 8. Improvement of memory usage when threading**



Data Processing Overview: Priorities for HCSS 11 (SPIRE)

Spectrometer

- 9. Improvements for semi-extended tool**
- 10. Sinc-Gauss function for the fitter**
- 11. Convolution Mapper**
- 12. Updates for WCS handling**
- 13. Updated error propagation for naive mapper algorithm**



Data Processing Overview: Priorities for HCSS 12 (Framework & system)

- 1. Gyro-propagation for pointing products**
- 2. List-return syntax for tasks (reduction of memory leaks)**
- 3. Improvements in user-friendliness (GUI layout, tooltips, harmonisation of Python syntax in HIPE)**
- 4. Improvement of SPG interface for DP TAs to ease future reprocessing exercises**
- 5. Creation of a multi-observation context to reduce download time for users**



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Data Processing Overview: Priorities for HCSS 12 (HIFI and PACS)

HIFI

- 1. Performance issues for HIFI pipeline**
- 2. HEB standing wave mitigation**

PACS

- 1. Tailored level 2.5 products (extended vs. pointsource)**



Data Processing Overview: Priorities for HCSS 12 (SPIRE)

- 1. Alternative Error maps for naïve mapper: Provide the user with a set of alternative error maps including standard (no weighting), bolometer noise weighted and hybrid cases for low coverage maps**
- 2. Destriper improvements**
 - improved Level 2 deglitching algorithms**
 - destriper working on entire timelines**
 - implementation of weighting into destripping**
 - detection of bolometer jumps**
- 3. Automatic correction of data affected by cooler burps**



Data Processing Overview: Priorities for HCSS 12 (SPIRE)

- 4. Continued improvements on Zero Point Calibration with Planck**
- 5. Flux Calibration: New flux calibration using new Neptune fluxes from (ESA_xx) models**
 - new flux calibration files
 - new Temp Drift Correction calibration files
 - new Relative gain correction
- 6. Super Resolution Maps: Port the HiRES code into HIPE as a task for Super resolution mapping**
- 7. Iterative pipeline models to improve deglitching and jump detection**



Data Processing Overview: Priorities for HCSS 12 (SPIRE)

- 8. Quick pipeline without FFT modules up to the Level 2 deglitcher in the destriper that flags glitches in the Level 0.5 timelines, using these results when the full pipeline is run again**



Post-Operations readiness review: Development priorities for Data Processing @ HSC

- **Most important are the archive products that come from standard pipeline processing of the science and calibration observations that were made throughout the mission lifetime. Therefore the support to the pipeline processing environment and the generation and quality control of products has the highest priority**
- **The second highest priority is the maintenance of the interactive data processing system so that the astronomical community has the best means to exploit Herschel data in detail, and the experts from the HSC, ICCs and NHSC can continue to improve algorithms and calibration**
- **Documentation is the third highest priority as the analysis software and data products need to be well described so that the best science results can be extracted**



Post-Operations readiness review: Board recommendations

- **Review board emphasised importance of products as lasting legacy of Herschel. All ICC managers confirmed this as in line with ICC priorities**
- **Review board emphasised importance of prioritisation as we are resource limited and key personnel might leave the project earlier than envisaged**
- **Review board urged to develop the Herschel Legacy in conjunction with the emergence of other major facilities (ALMA, SOFIA)**
- **Review board asked to raise the awareness of the community to the resource limited character what might be achieved in post-operations**



Future HCSS Releases

HCSS version	Branch-off Point	Installation	Rationale
11.0	11 April 2013	June 2013	Full staff complement still available
12.0	26 Sept. 2013	December 2013	Last bi-annual release
13.0	18 Sept. 2014	December 2014	Annual release
14.0	17 Sept. 2015	December 2015	Annual release
14.1	February 2016	March 2016	End of HIFI POPs
14.2	June 2016	July 2016	End of SPIRE POPs
15.0	15 Sept. 2016	December 2016	End of PACS POPs; Legacy version for Herschel Science Archive

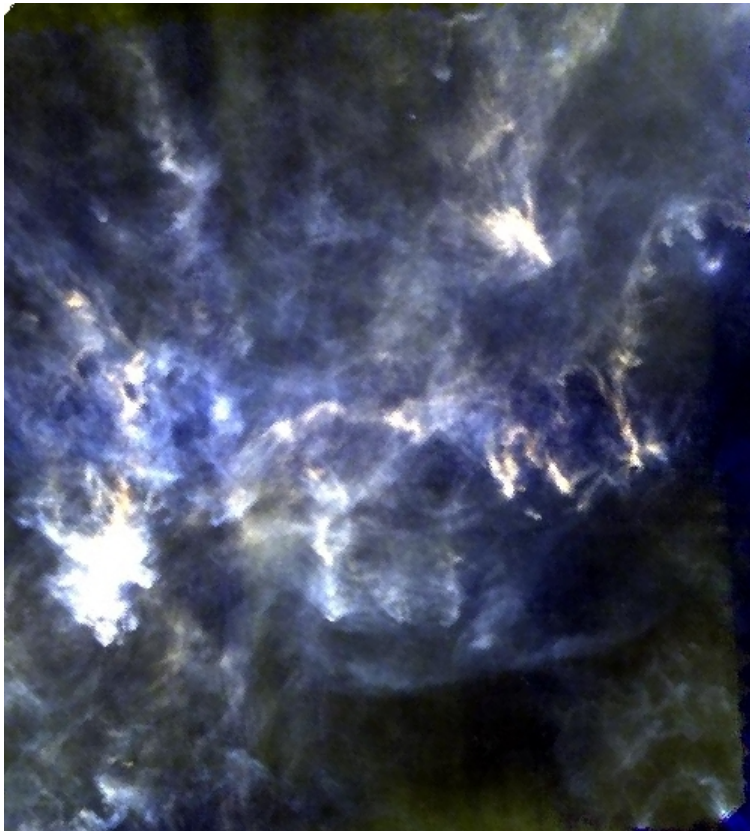
Bulk reprocessing of all Herschel observations will be performed with each of these versions



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On the way towards the Best Data Products for the Legacy Archive



**3 Colour RGB
Composite of
Orion belt
created from
Standard
Pipeline Level
2.5 Products**

PACS 160 μm

SPIRE 250 μm

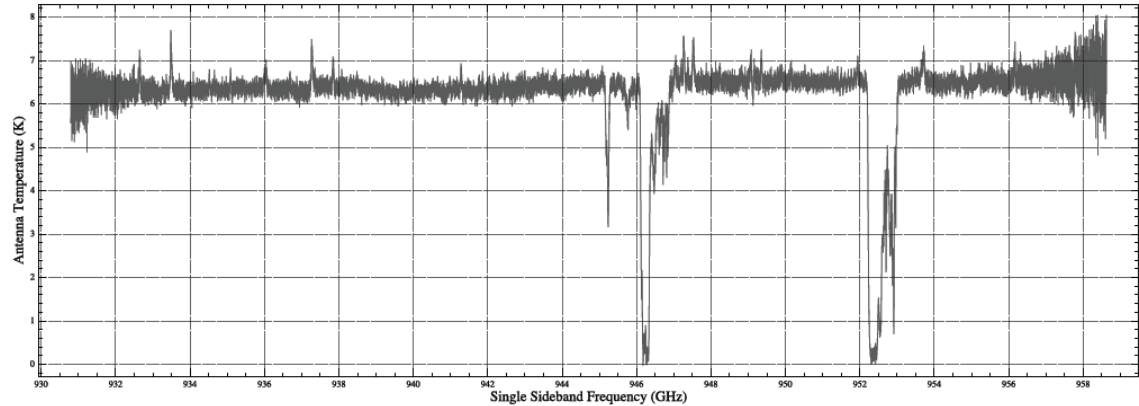
SPIRE 350 μm



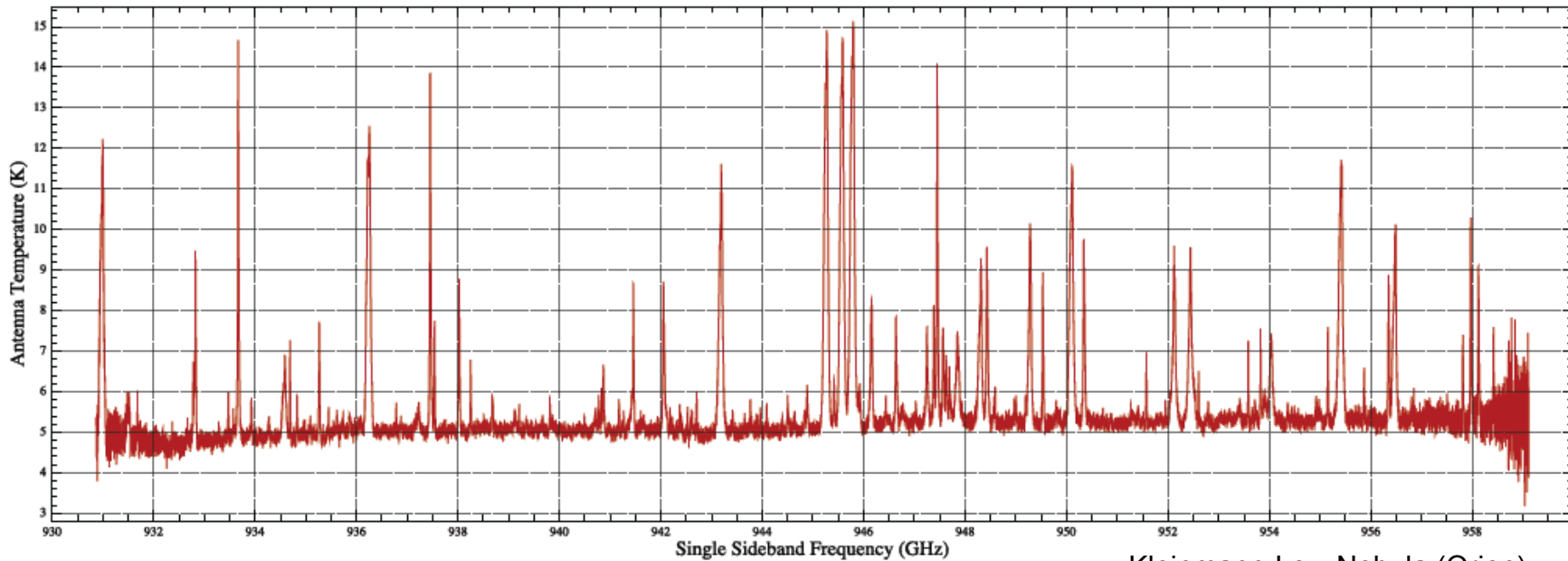
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HIFI Level 2.5 deconvolved spectra



Sagittarius B2



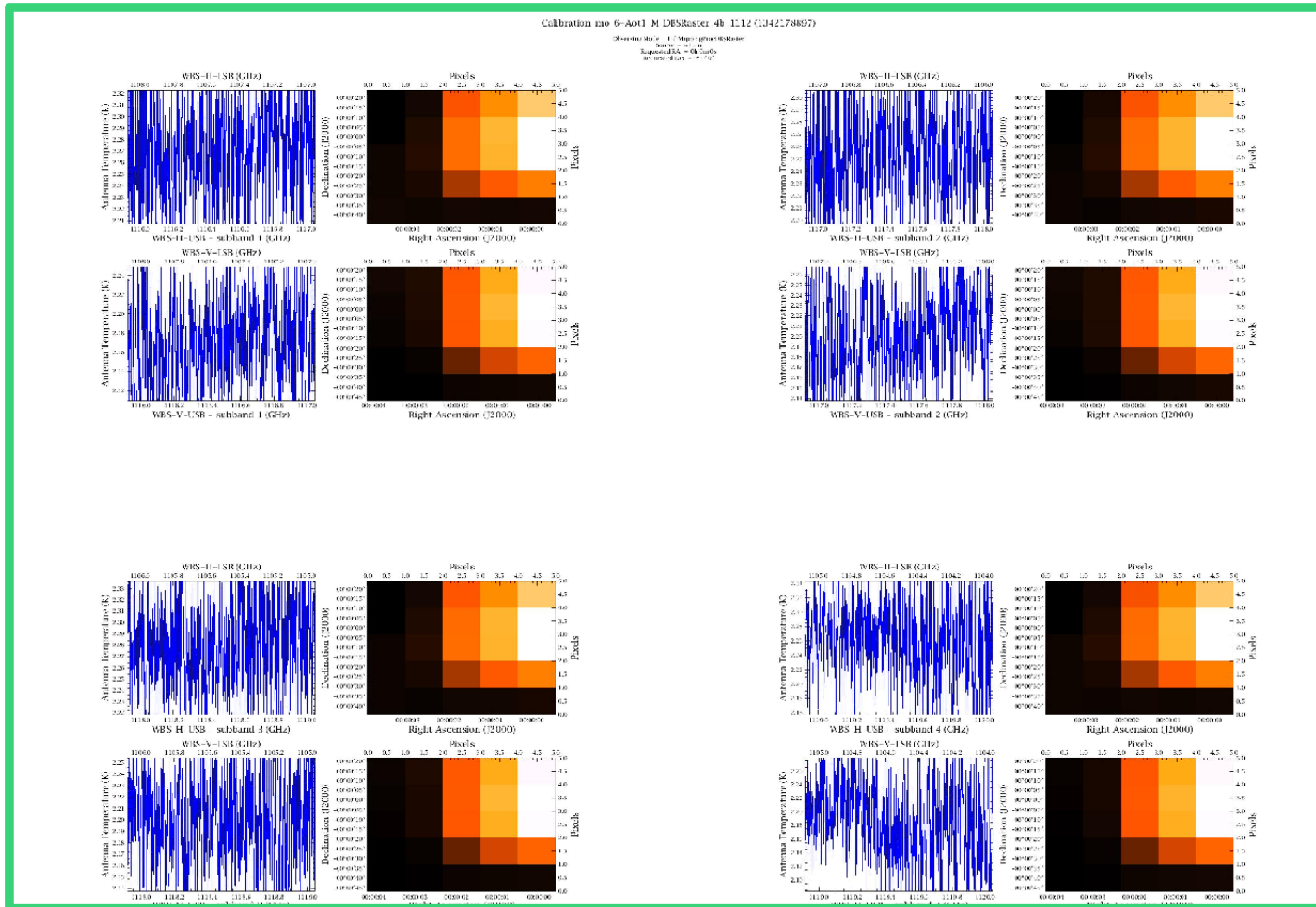
Kleinmann-Low Nebula (Orion)



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HIFI browse products

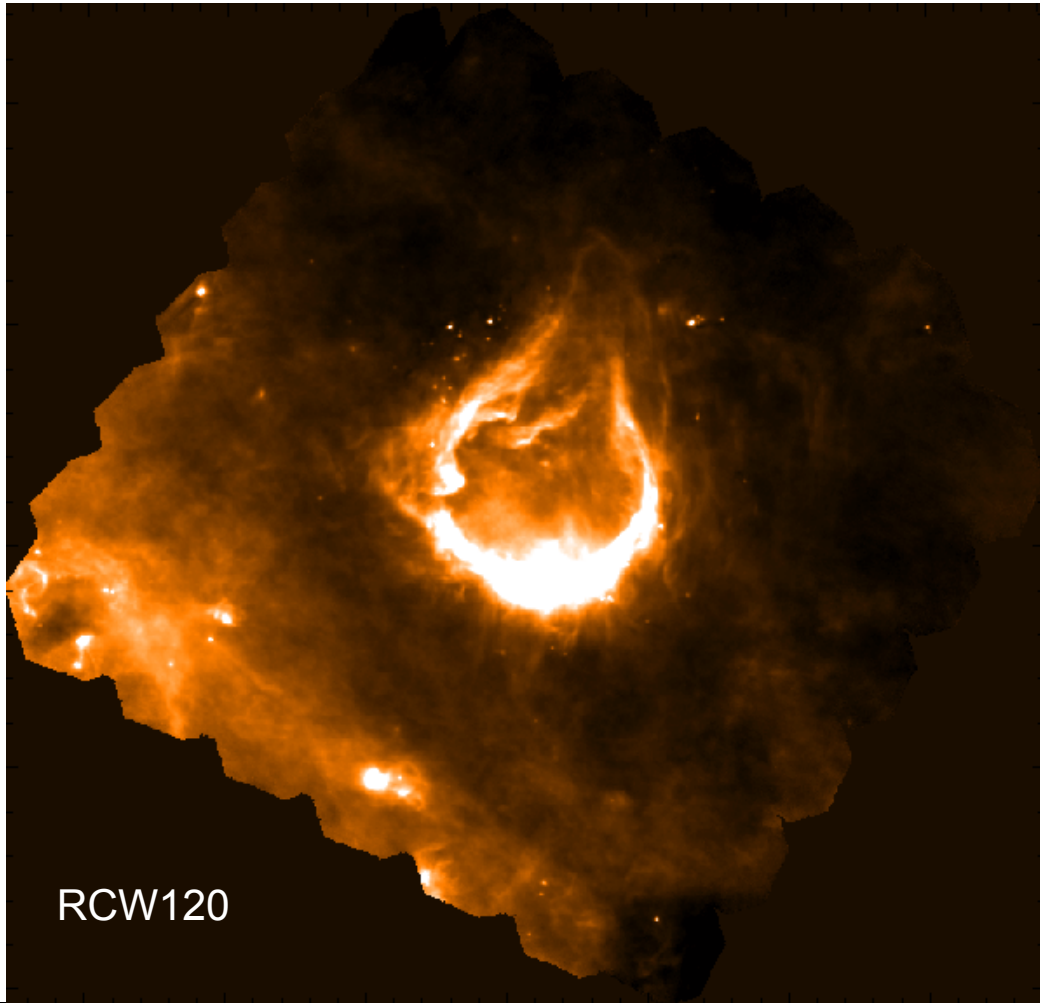




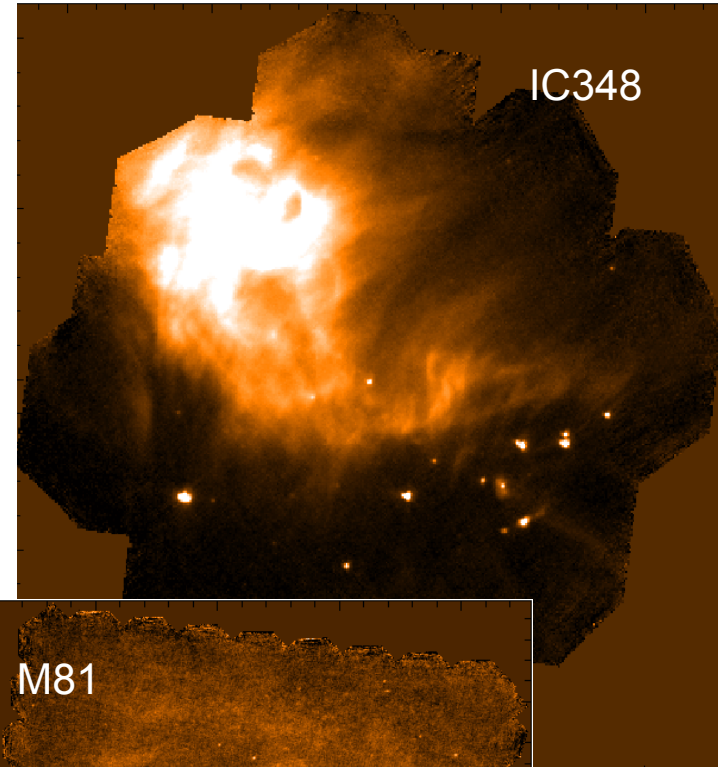
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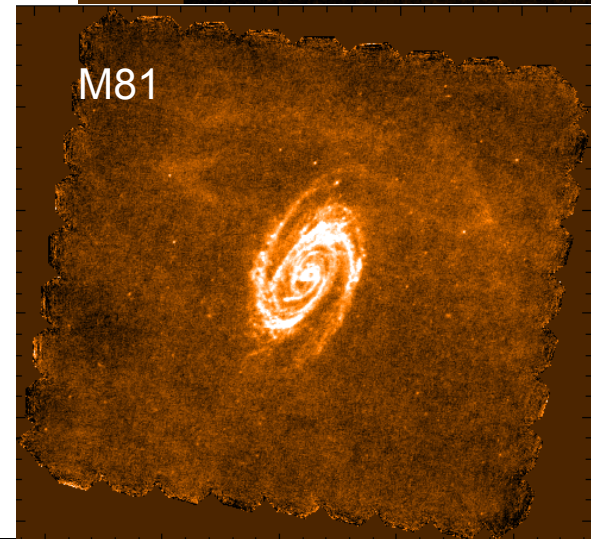
PACS SPG maps



RCW120



IC348

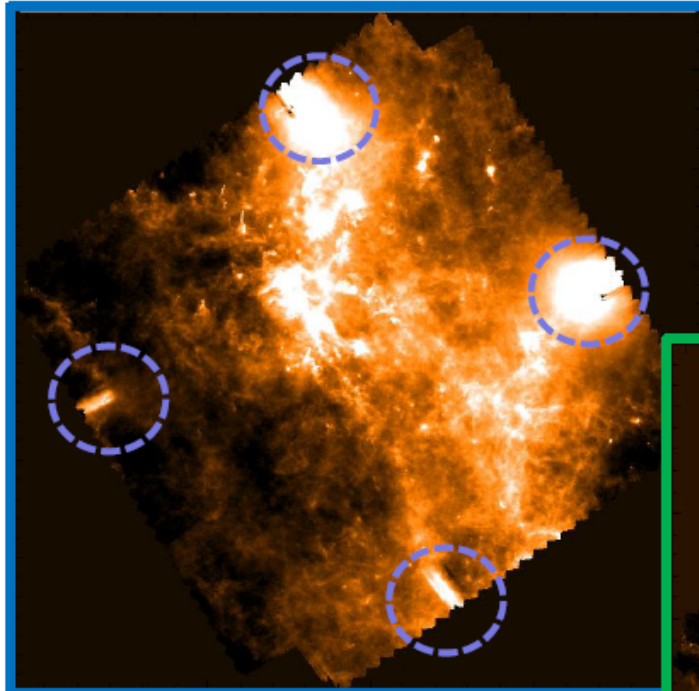


M81



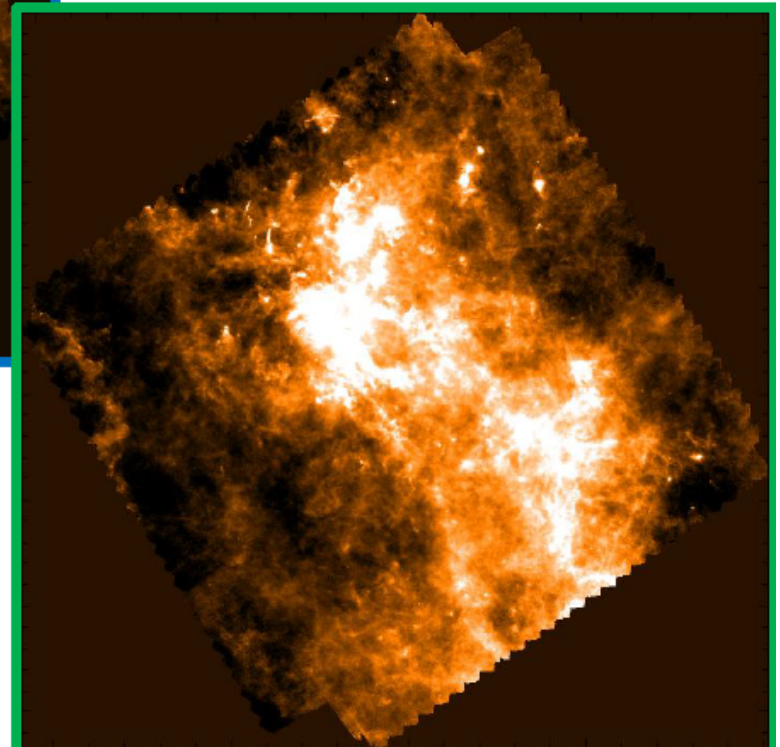
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Hcss 9.1 L2.5 SPG
red corrected map

Removal of remaining
calibration blocks at
red band



Hcss 10.1 L2.5 SPG
red corrected map

PACS SPG maps



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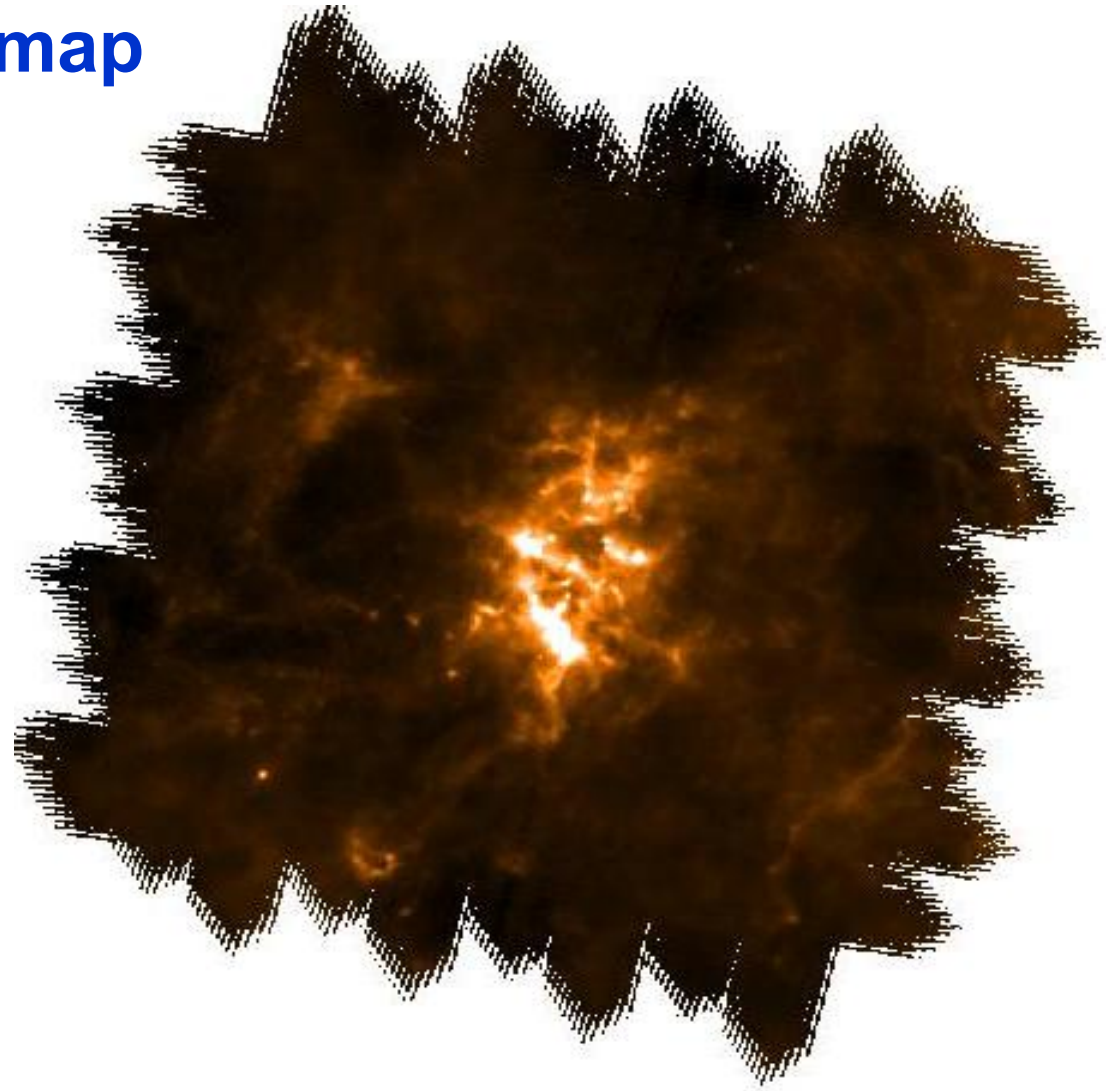


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SPIRE SPG map

RCW49
PSW map
Level 2
(PI R. Paladini)



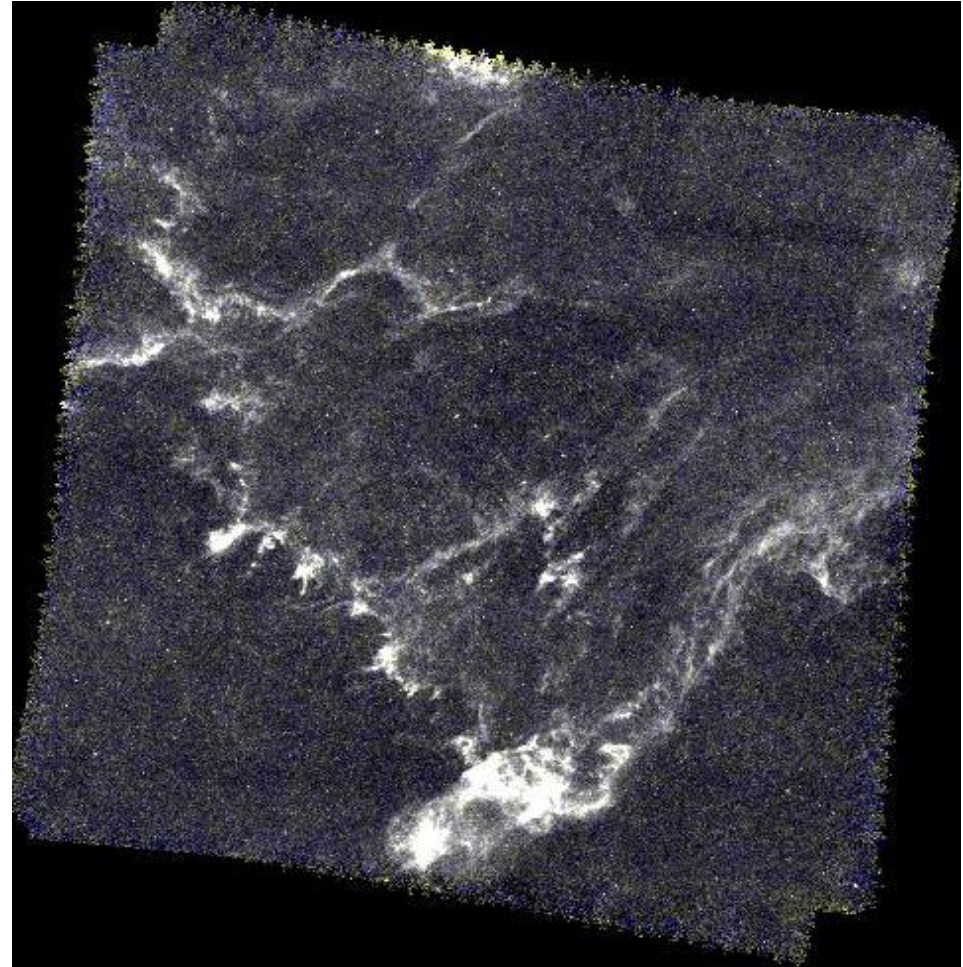


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SPIRE Browse Image

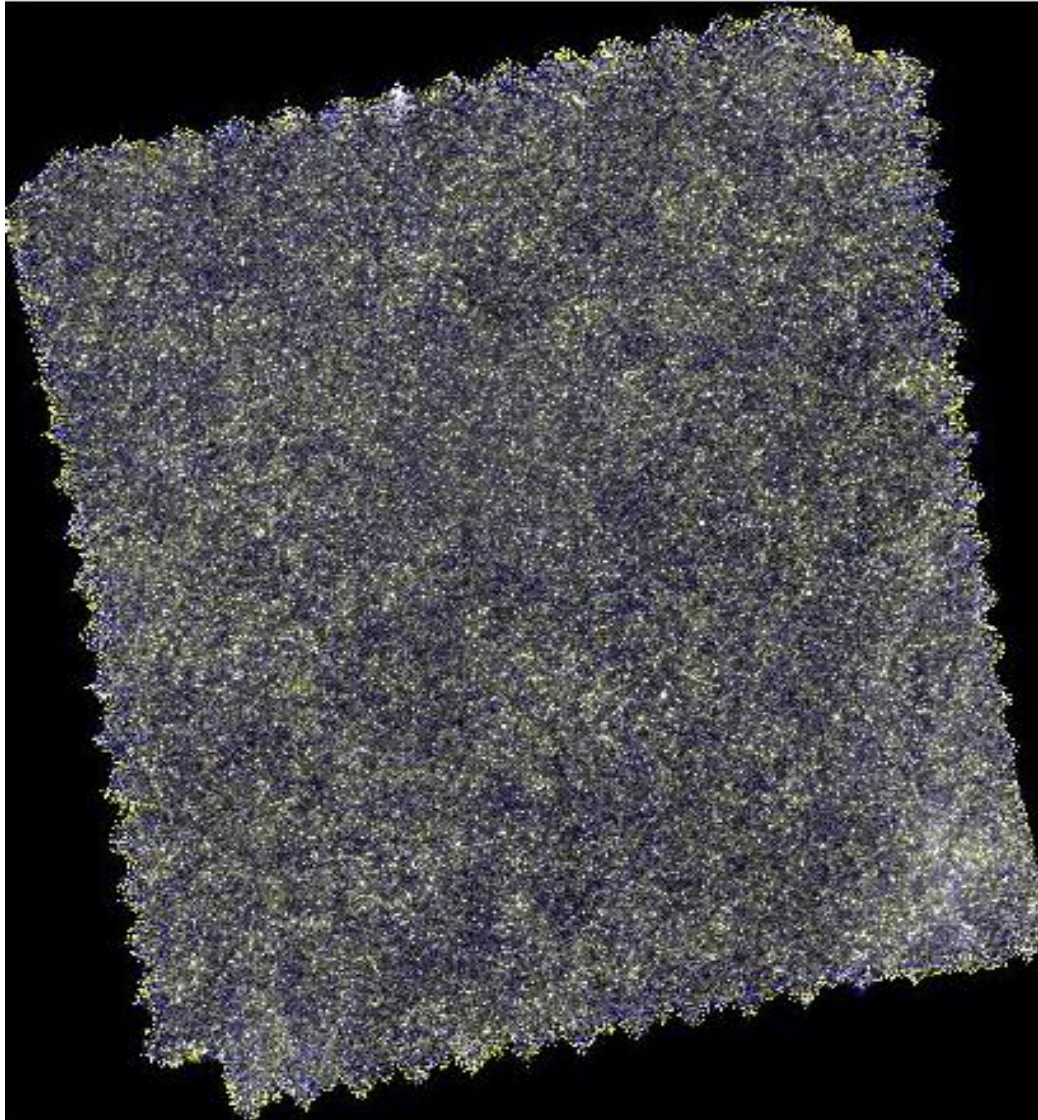
Draco
Level 2.5
(PI M-A Miville-Deschenes)





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SPIRE SPG map

ECDFS
Level 2.5
(PI S. Oliver)

Composite of **105** single
observations



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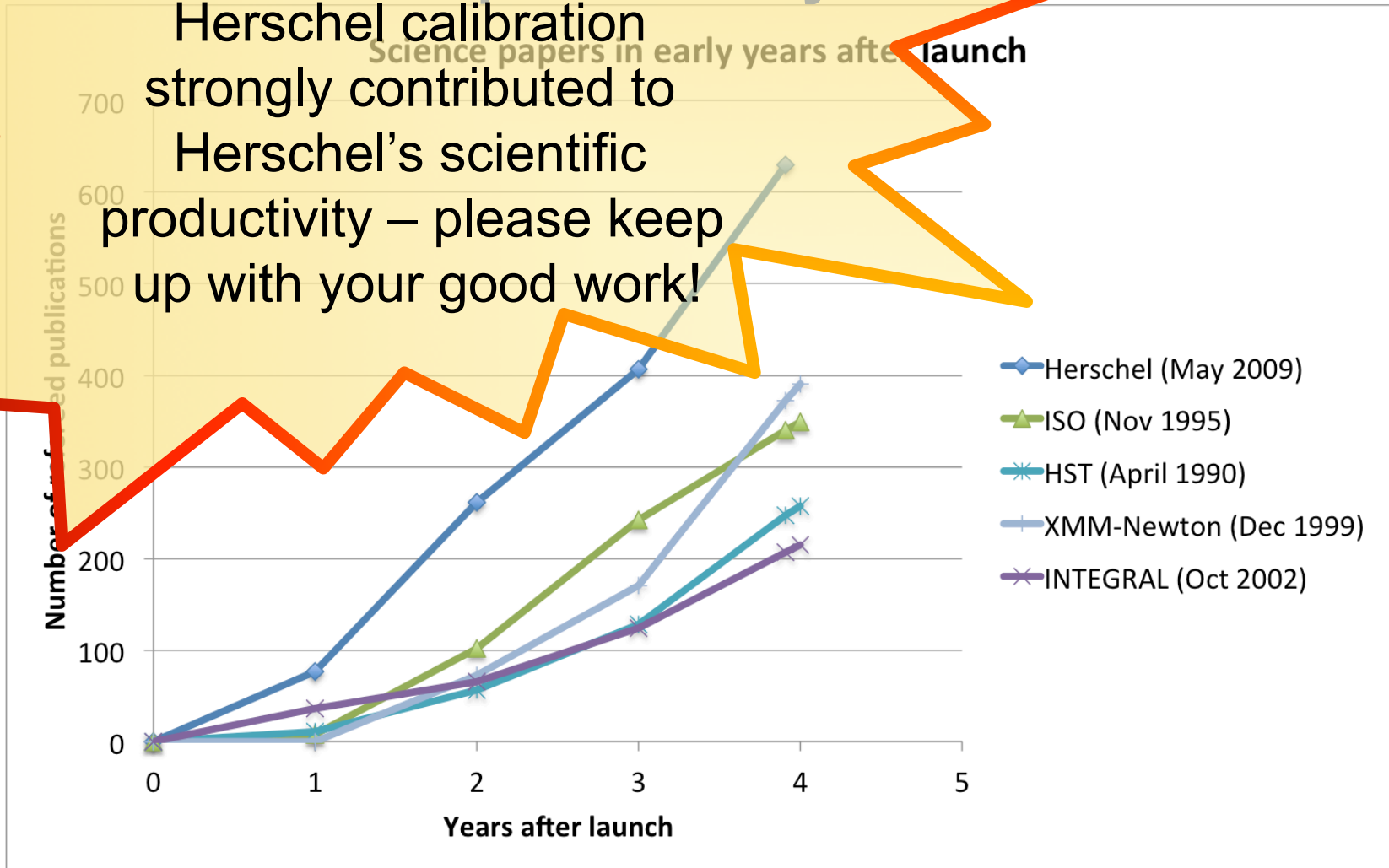


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Scientific productivity of Herschel

The high quality of Herschel calibration strongly contributed to Herschel's scientific productivity – please keep up with your good work!

Science papers in early years after launch





Please consider to contribute to HIPE acceptance testing. This will help the community and you. If you are interested please contact the test coordinator Bruno Merin

Bruno.Merin@sciops.esa.int

Ho'omau maika'i loa 'Oihana