



Using the Herschel Science Archive

2015 SOFIA Observers' Workshop

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The Herschel Space Observatory

- 3.5-m cryogenically cooled telescope, located in L2 – Range: 55 – 650 mic
- Telescope launched in May 2009. Cryogenic exhaustion in April 2013. **No warm mission.**
- European Space Agency-led mission with major contributions by many countries including the US.



PACS

PACS – Photodetector Array Camera and Spectrometer

- PI: Albrecht Poglitsch, MPE, Garching, Germany
- Co-PI: Christoffel Waelkens, KU Leuven, Belgium
- Imaging photometry and spectroscopy over 55-210 μm
- 2 bolometer arrays for photometry, 2 Ge:Ga arrays for spectroscopy



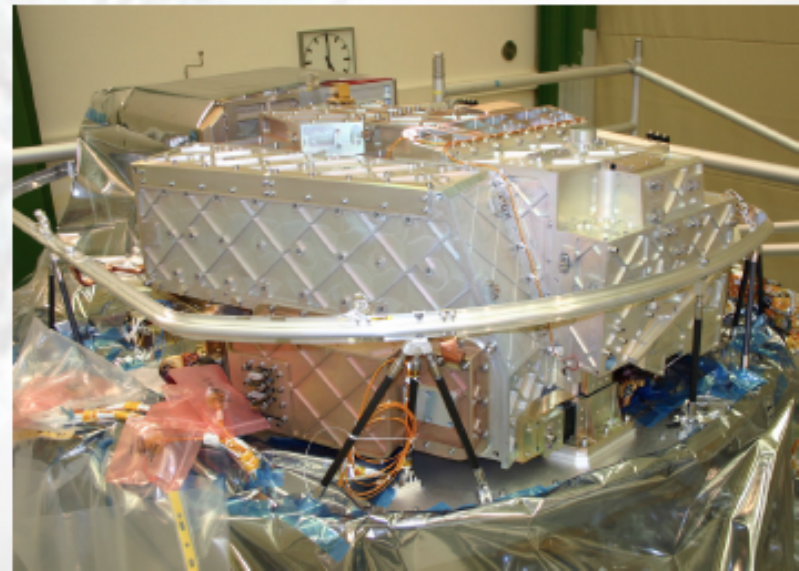
3-band imaging photometer

| | | | |
|-----------------------------|-----|-----|-----|
| λ (μm) | 70 | 100 | 160 |
| FWHM (arcsec) | 6 | 8 | 12 |
| $\lambda/\Delta\lambda$ | 2.5 | 2.8 | 2.1 |

- Simultaneous obs at 70/100 & 160 μm
- 3.5 x 1.75 arcmin fully sampled FOV

Imaging line grating spectrometer

- FOV (arcmin) fully sampled 0.8'x 0.8'
- λ order 1,2,3 102-210, 71-98, 55-73 μm
- $\lambda/\Delta\lambda = 1500-4000$



SPIRE

SPIRE – Spectral and Photometric Imaging Receiver

- PI: Matt Griffin, U Cardiff, Cardiff, United Kingdom
- Co-PI: Laurent Vigroux, CEA, Saclay, France
- Imaging photometry and spectro-photometry/-scopy over 194-672 μm
- 3 bolometer arrays for photometry, 2 bolometer arrays for spectroscopy

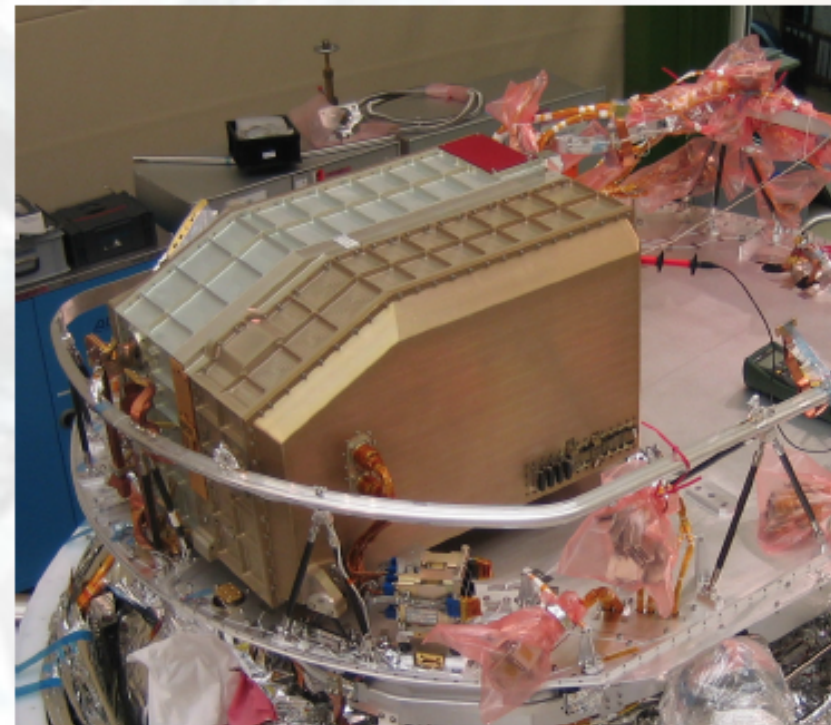


3-band imaging photometer

- 250, 350, 500 μm (simultaneous)
- $\lambda/\Delta\lambda \sim 3$
- 4 x 8 arcminute field of view
- Diffraction limited beams
(17, 24, 35")

Imaging Fourier Transf Spectrom

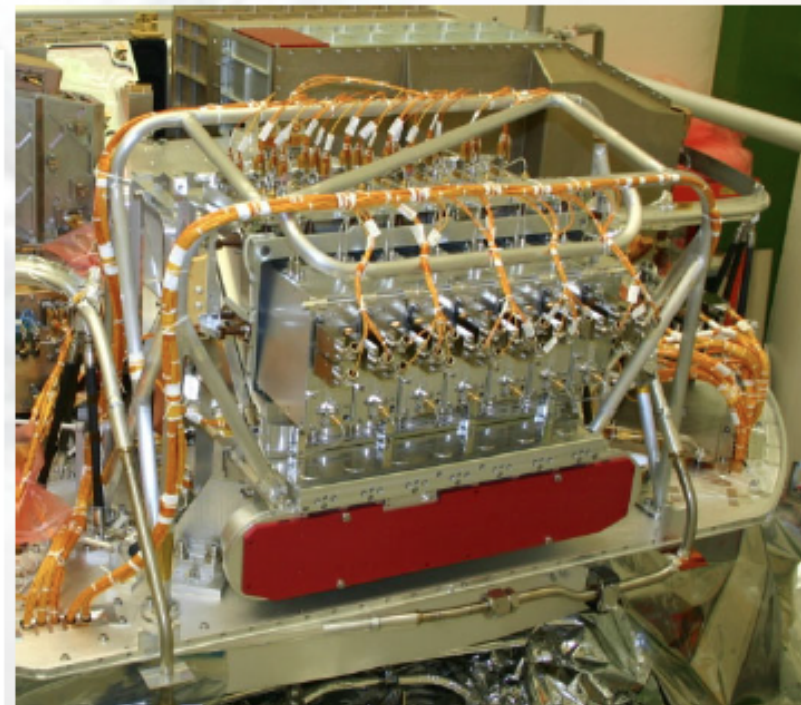
- 194 - 324, 316 - 672 μm
- 2.6 arcminute field of view
- $\Delta\sigma = 0.04 - 2 \text{ cm}^{-1}$
($\lambda/\Delta\lambda \sim 20 - 1000$ at 250 μm)



HIFI

HIFI – Heterodyne Instrument for the Far Infrared

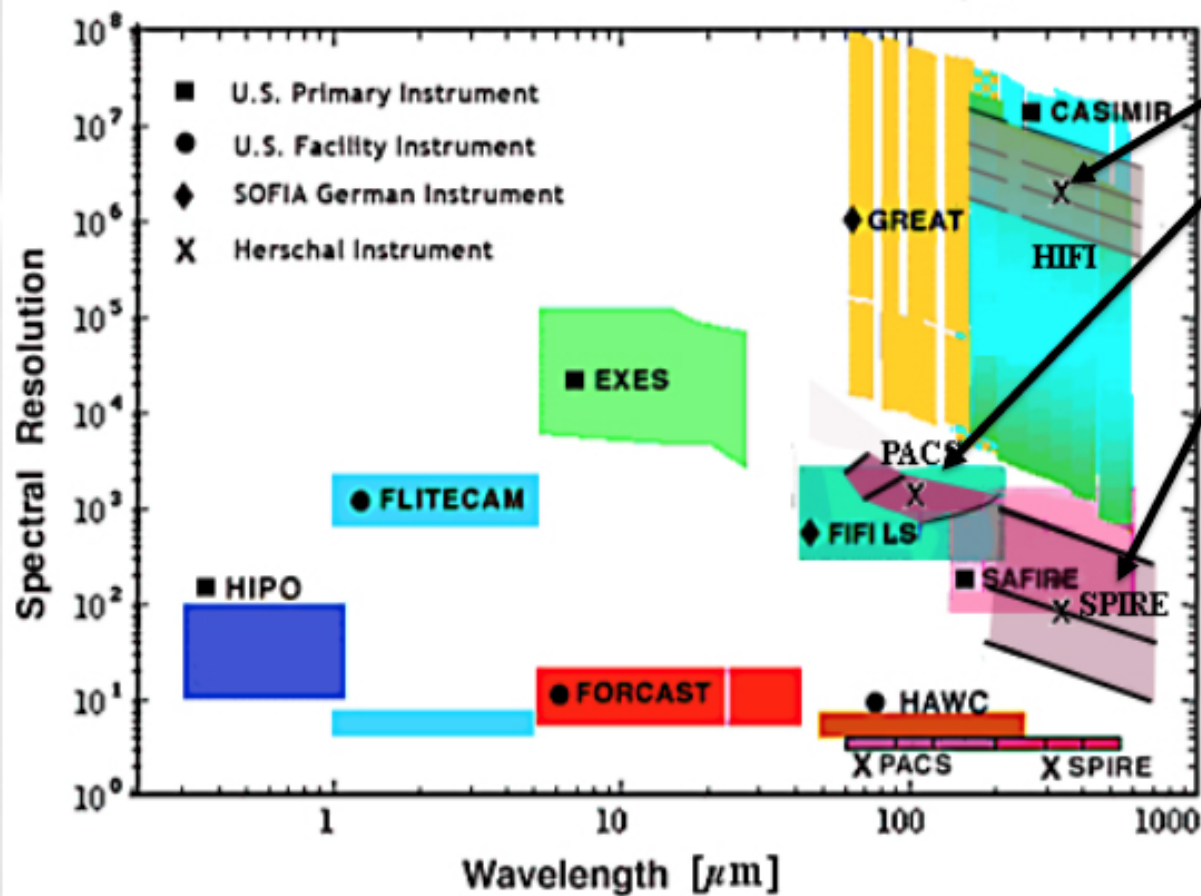
- PI: Frank Helmich, SRON, Groningen, The Netherlands
- Co-PIs: Tom Phillips, Caltech, USA; Jürgen Stutzki, U Köln, Germany; Emmanuel Caux, CESR, France; and Thijs de Graauw, ALMA
- Very high resolution spectroscopy over 480-1250 and 1410-1910 GHz ($<0.1\text{km/s}$)
- SIS and HEB mixers, auto-correlator and AOS spectrometers



SOFIA and Herschel



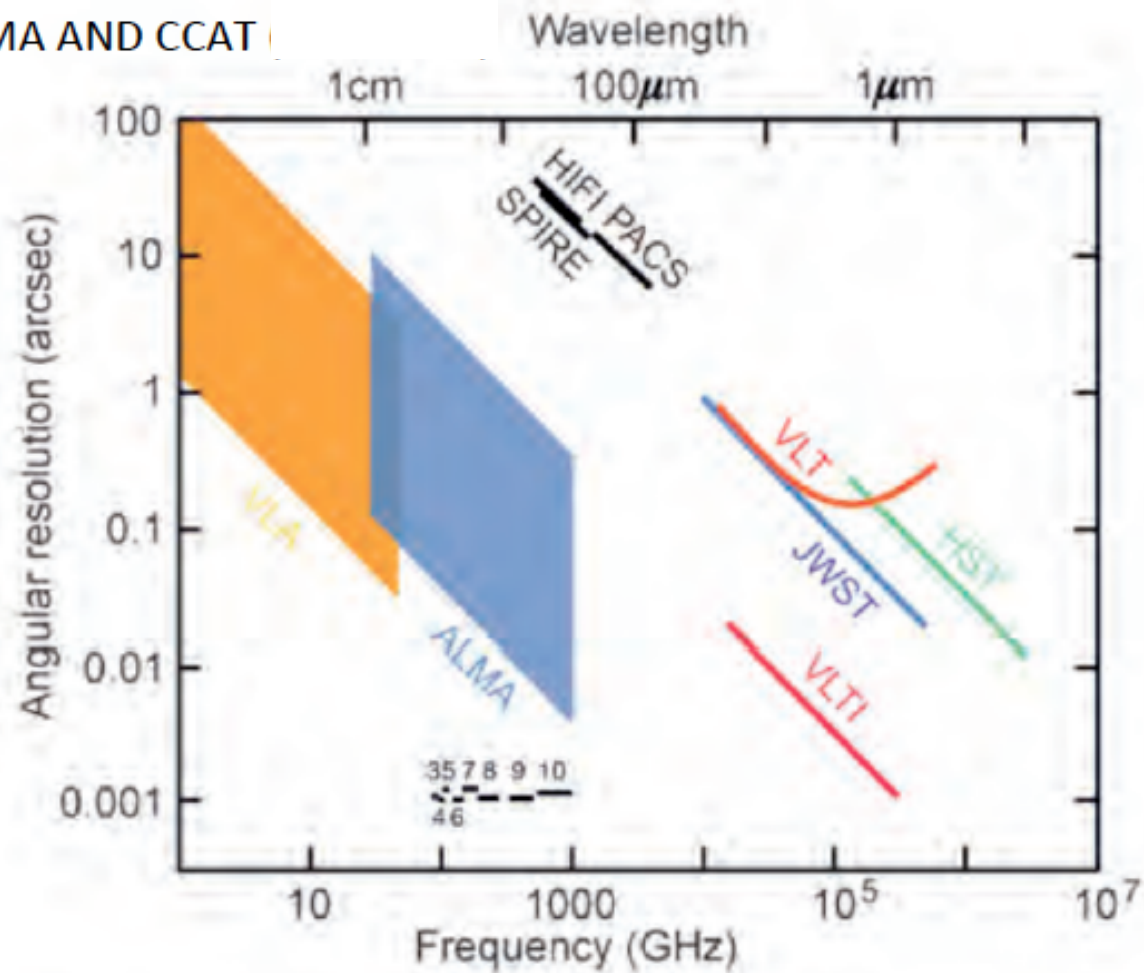
Wavelength Coverage
and Spectral Resolution



Spectrometers

Herschel and ALMA

ALMA AND CCAT





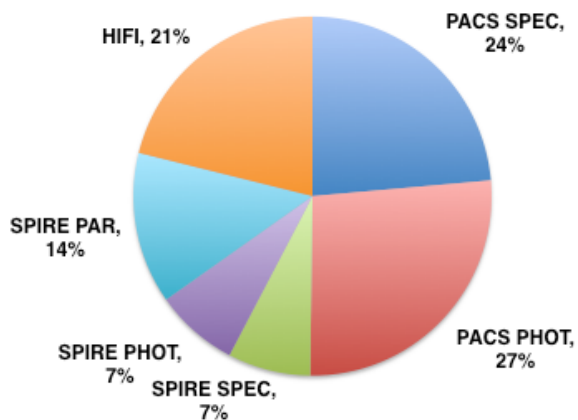
Program Calls (5/2009 – 4/2013)

- One Open Time Key Program call (KPOT)
- One Guaranteed Time Key Program call (KPGT)
- Two regular Open Time calls (OT1, OT2)
- Two regular Guaranteed Time calls (GT1, GT2)
- One Science demonstration phase program call, to produce early results (SDP)
- A “must-do” program call to fill potential science gaps (DDT_mustdo)
- A filler program to observe where nothing else is available (OBS)
- Other: DDT programs, ToO programs, Calibration programs, validation programs, etc

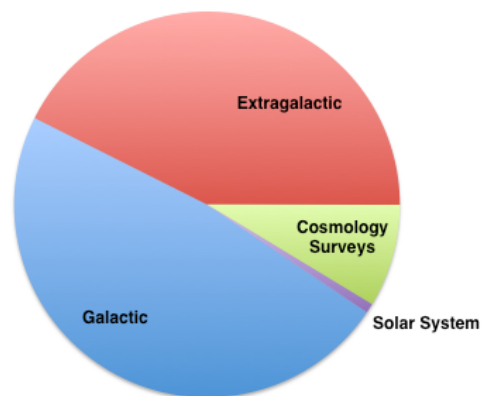


The Archive

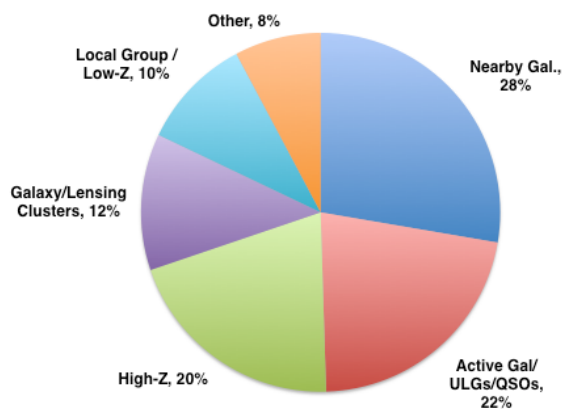
Instrument Distribution: 22694 hrs



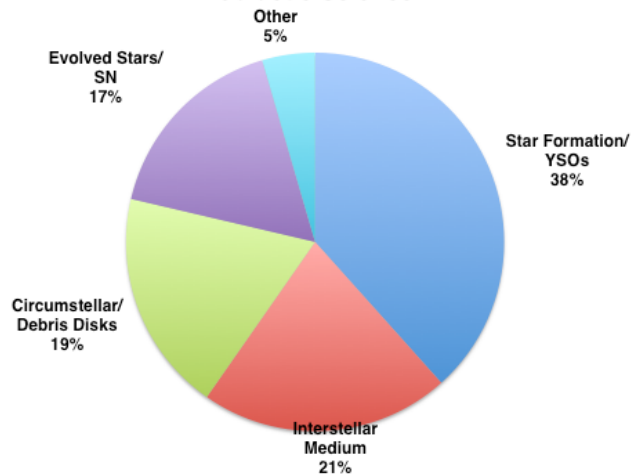
Science Distribution (by hour)



Extragalactic Science



Galactic Science





Using the Herschel Archive User Interface – HUI

<http://www.cosmos.esa.int/web/herschel/science-archive>

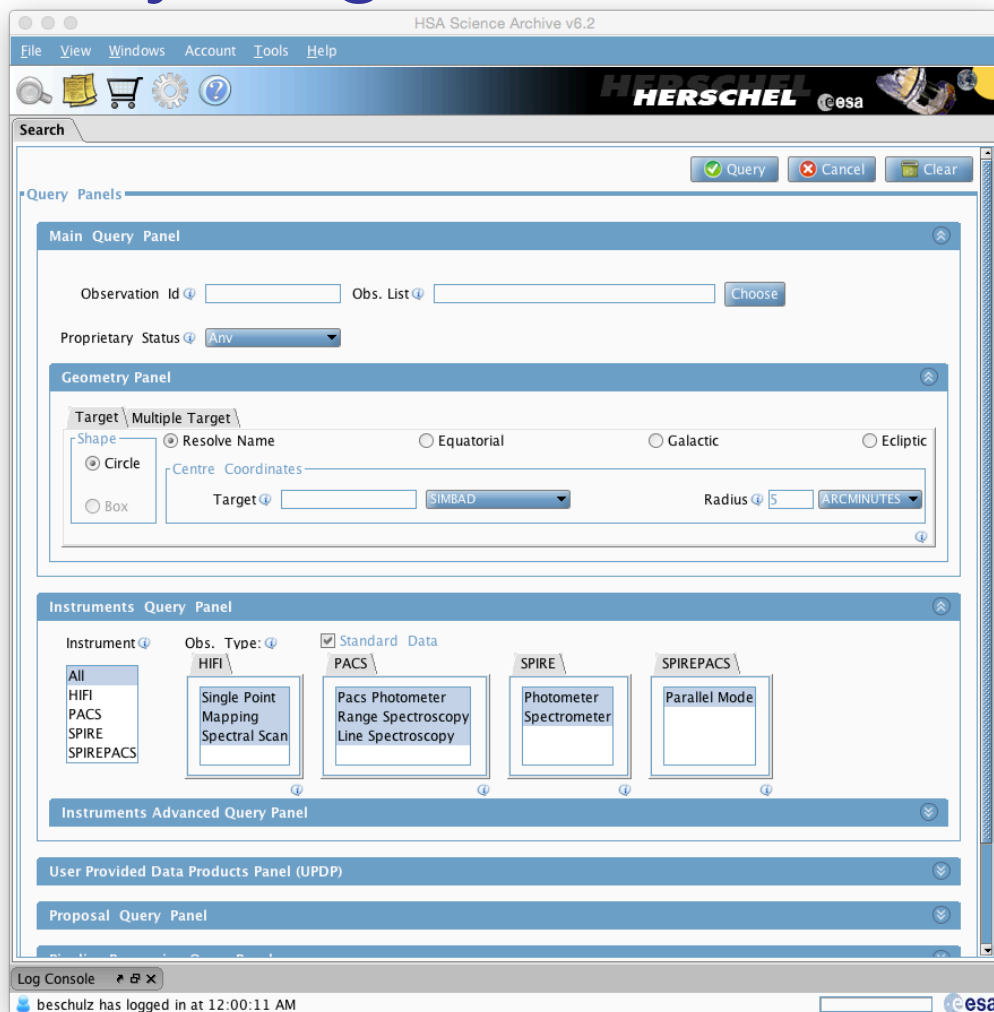
Double-Click the Archive link:
[Start the HSA User Interface \(HUI\) using Java Web Start](http://archives.esac.esa.int/hsa/ui/hui.jnlp)

<http://archives.esac.esa.int/hsa/ui/hui.jnlp>



HUI Query Page

- Can also be launched from Herschel Interactive Processing Environment (HIPE)
- Identify observations or objects by obsID, name or sky position.
 - Multiple objects can be selected with a “Targets File”.
- Select further by instrument, sub-mode, and configuration parameters.
- Additional qualifiers include parameters regarding:
 - User Provided Data Products (UPDP)
 - Proposal
 - Pipeline Processing
 - Timing Constraints





HUI Result List

- Show Postcard results for quick inspection.
- Retrieve Standard Browse Products for closer inspection.
- Retrieve partial or full tree of archival products for scientific analysis.
- Send products to shopping cart for ftp retrieval of larger data volumes.
- Send data directly to applications like HIPE.

The screenshot displays the HSA Science Archive v6.2 web interface. The main window shows a table of observations with columns for Observation ID, Postcards, Target, RA/DEC, Instrument, Observing Mode, OD, and Propos. A context menu is open over the table, showing options like 'Retrieve Products' and 'Send to External Application'. A 'Postcard' window is also open, displaying three astronomical images of the m81 galaxy with associated metadata.

| Observation ID | Postcards | Target | RA/DEC | Instrument | Observing Mode | OD | Propos. |
|----------------|-----------|-----------------|--------|------------|----------------|----|---------|
| 1342183986 | N/A | m81 | | | | | |
| 1342183987 | N/A | m81 | | | | | |
| 1342183988 | | m81 | | | | | |
| 1342186 | | | | | | | |
| 1342186 | | | | | | | |
| 1342209 | | | | | | | |
| 1342220 | | | | | | | |
| 1342220975 | | m81 arm strip-1 | | | | | |



Herschel Interactive Processing Environment (HIPE)

- Send observation to HIPE by choosing “Send to External Application”.
- Many tools to readily inspect and visualize contents.
- More tools to perform full scientific analysis.
- Products of an observation are only transferred from HSA if they are actually required for visualization or processing.

The screenshot shows the HIPE software interface with several key components labeled:

- Start HUI**: Points to the top menu bar (File, Edit, Run, Pipelines, Scripts, Window, Tools, Help).
- Analysis tasks**: Points to the 'Tasks' panel on the right, which lists tasks like 'histogram', 'imageContourSaver', 'metaDataSorter', 'openSE', 'saveProduct', and 'simpleFitsWriter'.
- Summary**: Points to the 'Summary' section of the 'PSW map' panel, displaying observation details such as AOR label (SPhoto-m81), Instrument (SPIRE), Object (m81), and RA/Dec coordinates.
- Metadata**: Points to the 'Meta Data' section of the 'PSW map' panel.
- Visualization**: Points to the central image viewer showing a color-coded astronomical image of a spiral galaxy.
- Product Tree**: Points to the 'Data' panel on the left, which shows a hierarchical tree of products like 'auxiliary', 'browseImageProduct', 'level0', 'level1', and 'level2'.
- Interactive scripting in Jython**: Points to the 'Console' panel at the bottom, which displays a Jython script for processing contours.

```

HIPE> del(obsid_v1342185538)
HIPE> contours = automaticContour(image=obsid_v1342185538, min=-16.301680445695915, max=16.301680445695915, ma
HIPE> # displayExplorer.add wcsImageContour(contours, java.util.ArrayList([java.awt.Color(0, 0, 255), java.awt.Color(0, 0, 255), java.awt.Color(0, 0, 255), java.awt.Color(0, 0, 255)]))
HIPE>
    
```



The Herschel Portal at IRSA

- IRSA is the NASA Infrared Science Archive.
- The Herschel portal is available from the IRSA page.
- Searches the Archive.
- Provides an interface for UPDP.
- Direct inspection of data independently of HIPE.
- Cross-mission comparison!
- Currently searches map centers only! This will be improved using map footprints.

The screenshot shows the IRSA website for the Herschel Space Observatory. The page includes a navigation bar with 'IRSA', 'DATA SETS', 'SEARCH', 'TOOLS', and 'HELP'. Below the navigation bar, there are three main sections: 'Herschel Data Search', 'Catalog Search', and 'Herschel Documentation'. The 'Mission Characteristics' section is expanded, showing a table with the following information:

| | |
|-----------------------------|---|
| Description: | The Herschel Space Observatory is a 3.5 meter telescope observing the Far-Infrared and Submillimeter Universe. |
| Lifetime: | 14 May 2009 - 29 April 2013 |
| Wavelength: | 55 μm - 671 μm |
| Area Coverage: | Targeted observations |
| Instruments: | <ul style="list-style-type: none">• Photodetector Array Camera and Spectrometer (PACS) Imaging bands centered at 70, 100, and 160 μm Spectroscopy: 55-210 μm, R=1000-5000• Spectral and Photometric Imaging Receiver (SPIRE) Imaging: 250, 350, 500 μm Spectrometer: 194-671 μm, R=20-1000• Heterodyne Instrument for the Far Infrared (HIFI) 1.9-0.49THz (157 - 625 μm); R=1e6-1e7 |
| Science Products Generated: | <ul style="list-style-type: none">• Raw and calibrated data from PACS, SPIRE, and HIFI• Herschel User-provided data (Key Program and Open Time) |
| Funding Agency: | Herschel is an ESA mission with participation from NASA |
| Canonical Paper: | <p>Herschel Mission - Pilbratt et al. (2010) PACS - Poglitsch et al. (2010) SPIRE - Griffin et al. (2010) HIFI - de Graauw et al. (2010)</p> <p>Please include the following standard acknowledgment in any published material that makes use of Herschel data products: "Herschel is an ESA space observatory with science instruments provided by</p> |

<http://irsa.ipac.caltech.edu/Missions/herschel.html>





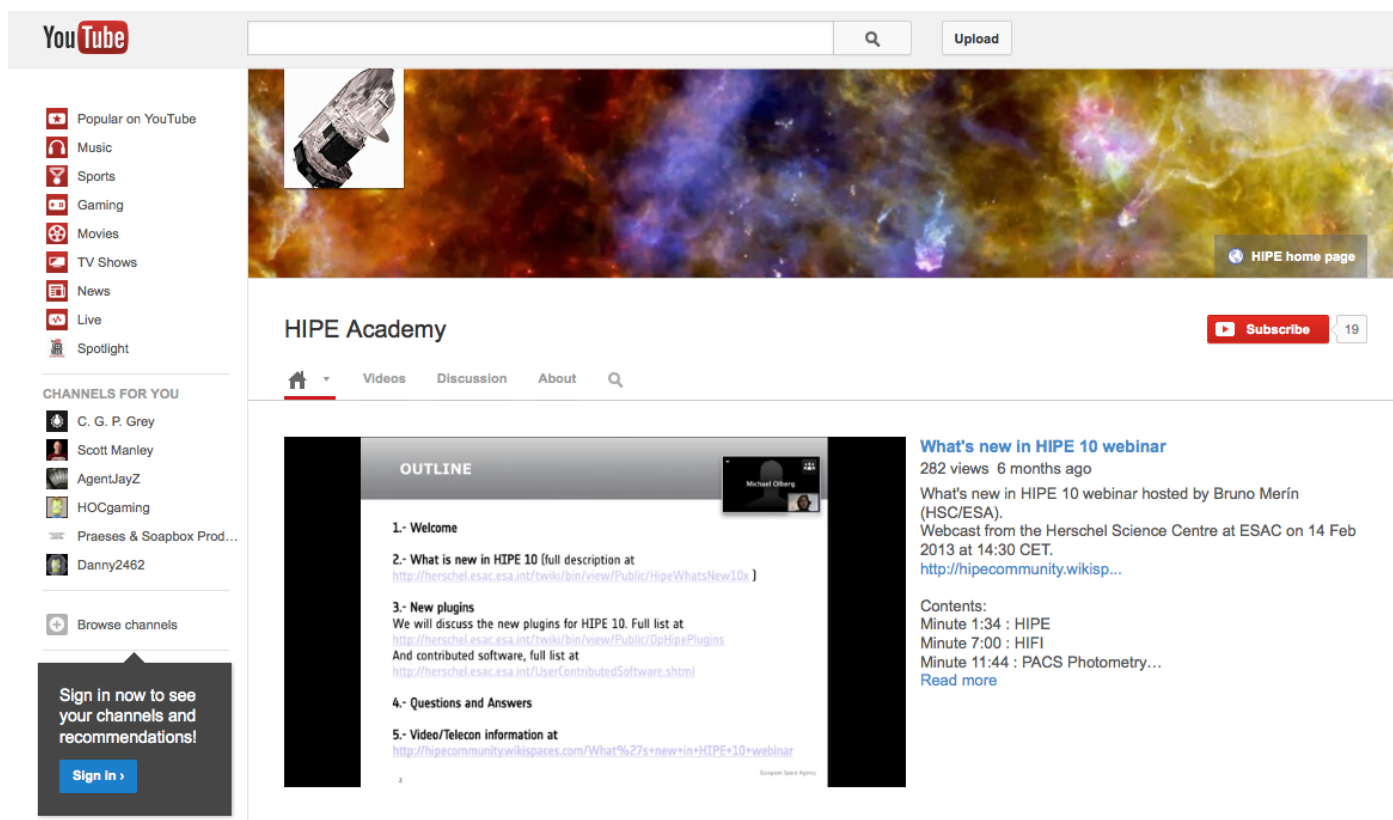
What NHSC can do for you:

- We organize webinars. In the past we also did in-person workshops.
- The Herschel Science Center in Madrid, Spain is organizing a beginner's workshop in June 2015.
- We provide technical support on instruments, data reduction, documentation, via the helpdesk: <http://nhsc.ipac.caltech.edu/helpdesk/index.php>.
- We can host members of your team in Pasadena for intensive data reduction sessions.
- We produce a monthly newsletter: <http://www.herschel.caltech.edu/newsletters>.

| NHSC Resources | New User? | Expert User? | Comments |
|----------------------------|-----------|--------------|--------------------------------------|
| NHSC Helpdesk | Y | Y | nhsc.ipac.caltech.edu/helpdesk |
| NHSC Wiki pages | Y | Y | nhscsci.ipac.caltech.edu |
| NHSC Newsletter | Y | Y | www.herschel.caltech.edu/newsletters |
| Webinars | Y | Y | On-line topical discussion groups |
| Online videos and tutorial | Y | Y | Step by step guides |
| Introductory Workshops | Y | N | Best for new users |
| NHSC in-person visits | N | Y | Subject to staff availability |
| Remote access computers | N | Y | Requested via the helpdesk |

Learn more!

- Lots of videos on YouTube! “HIPE Academy”



The screenshot shows the YouTube channel page for HIPE Academy. The channel name is "HIPE Academy" with a "Subscribe" button and a subscriber count of 19. The video player displays a video titled "What's new in HIPE 10 webinar" with 282 views, posted 6 months ago. The video description includes details about the webinar hosted by Bruno Merin (HSC/ESA) on 14 Feb 2013 at 14:30 CET, and provides a link to the HIPE community wiki page. The video outline is visible, listing five sections: 1- Welcome, 2- What is new in HIPE 10 (full description at <http://herschel.esac.esa.int/twiki/bin/view/Public/HipeWhatsNew10x>), 3- New plugins (We will discuss the new plugins for HIPE 10. Full list at <http://herschel.esac.esa.int/twiki/bin/view/Public/DotHipePlugins> And contributed software, full list at <http://herschel.esac.esa.int/User/ContributedSoftware.shtml>), 4- Questions and Answers, and 5- Video/Telecon information at <http://hipecommunity.wikispaces.com/What%27s+new+in+HIPE+10+webinar>). The left sidebar shows "Channels for you" with recommendations like C. G. P. Grey, Scott Manley, AgentJayZ, HOCgaming, Praeses & Soapbox Prod..., and Danny2462. There is also a "Sign in now to see your channels and recommendations!" prompt.



Instrument Manuals

- All about Herschel:
<http://herschel.esac.esa.int/twiki/bin/view/Public/SpacecraftObservatoryWeb?template=viewprint>
- All about PACS:
<http://herschel.esac.esa.int/twiki/bin/view/Public/PacsCalibrationWeb?template=viewprint>
- All about SPIRE:
<http://herschel.esac.esa.int/twiki/bin/view/Public/SpireCalibrationWeb?template=viewprint>
- All about Parallel Mode:
http://herschel.esac.esa.int/Docs/PMODE/html/parallel_om.html
- All about HIFI:
<http://herschel.esac.esa.int/twiki/bin/view/Public/HifiCalibrationWeb?template=viewprint>



Data Manuals

- All about HIPE, PACS, SPIRE, HIFI data reduction guides:

[http://www.cosmos.esa.int/web/herschel/
data-processing-overview](http://www.cosmos.esa.int/web/herschel/data-processing-overview)

- Scripting help:

<http://herschel.esac.esa.int/hcss-doc-13.0/>