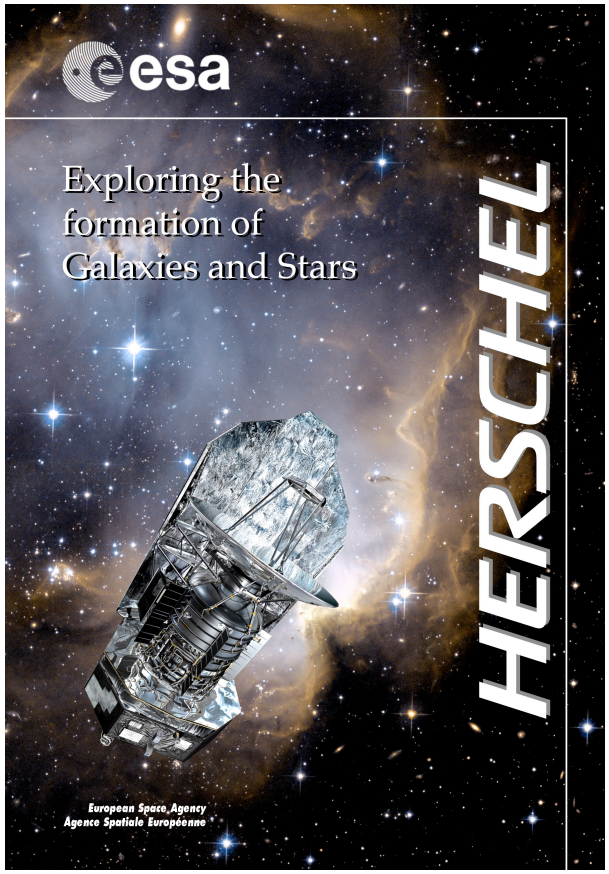
The Herschel Space Observatory

Herschel is the fourth of the European Space Agency's Cornerstone missions and will be open to the international community for proposals for far-infrared and submillimeter astronomical observations.

MAJOR SCIENTIFIC OBJECTIVES:

- Study the formation and evolution of galaxies
- Investigate the creation of stars and their interaction with the interstellar medium
- Observe the chemical composition of the atmospheres and surfaces of comets, planets and satellites
- Examine the molecular chemistry of the Universe



An artist's conception of the Herschel Space Observatory (Copyright: ESA)

BASIC CHARACTERISTICS:

Primary Mirror	3.5 metres
Science Instruments	Heterodyne Instrument for the Far-Infrared (HIFI), P.I. T. de Graauw 157–211 and 240–625 microns / 490–1250 and 1410–1910 GHz Photo-Array Camera and Spectrometer (PACS), P.I. A. Poglitsch 55–210 microns Spectral and Photometric Imaging Receiver (SPIRE), P.I. M. Griffin 200–672 microns
Wavelength Coverage	55 - 672 microns
Lifetime	3 years nominal routine science operations
Orbit	Lissajous about the Earth-Sun L2 point
Launch Vehicle	Ariane 5

Science Operations – The Herschel Science Centre (HSC) will conduct the science operations activities. The HSC is based at the European Space Astronomy Centre (ESAC) near Madrid.

Mission Operations – The Mission Operations Centre (MOC) will conduct mission operations, the prime ground station is in New Norcia, near Perth, Australia. The MOC is based at the European Space Operations Centre (ESOC) in Darmstadt.

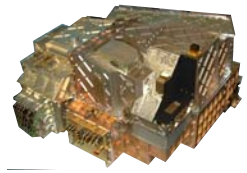
http://herschel.esac.esa.int

esa HIFI ICC nhsc PACS SPIRE

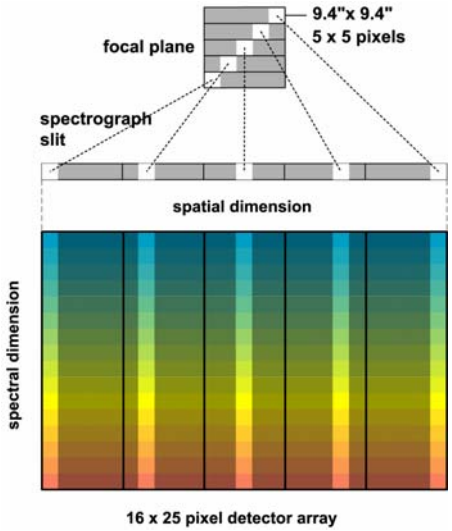
PACS – Photodetector Array Camera and Spectrometer

One of the three science instruments on the ESA Herschel Space Observatory

Instrument



Projection of focal plane onto spectrometer arrays



Integral Field Spectrometer

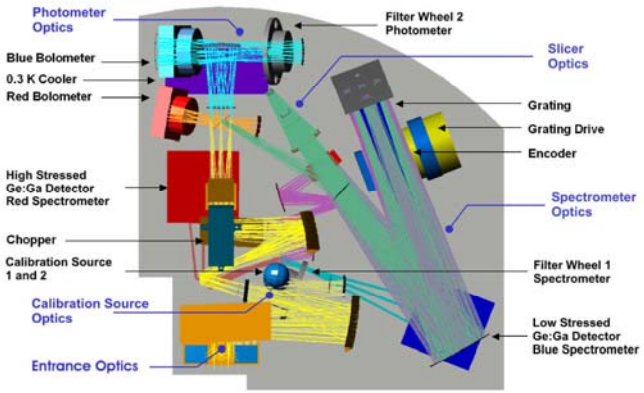
Simultaneous 55-105 & 105-210 μm spectroscopy.

47”x47” (5x5 pixels) FOV rearranged via an image slicer on two 16x25 Ge:Ga detector arrays.

$\lambda/\Delta\lambda$ ~ 1000-5000

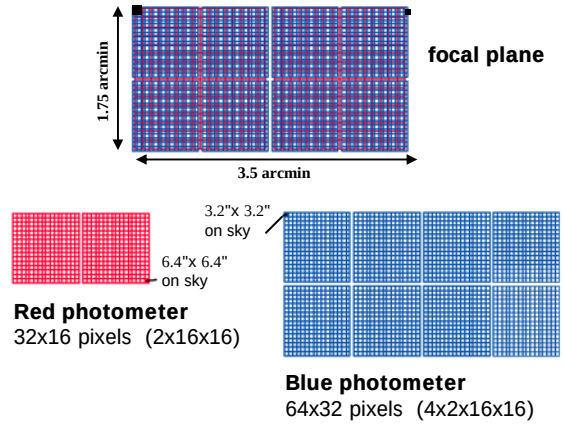
Point source line sensitivity:
~ 4-10x10^{-18} W/m^2 (5σ, 1h)

PACS is one of three science instruments for ESA’s Herschel mission. It operates either as an imaging photometer or an integral field spectrometer over the spectral band from 55 to 210 μm.



Optical layout of the PACS instrument

Projection of focal plane onto bolometer arrays



Imaging Photometer

Simultaneous two-band (same FOV) 60-85 μm *or* 85-130 and 130-210 μm fully sampled imaging.

Two filled bolometer arrays: 32x16 and 64x32 pixels

Point source detection limit:
~ 3-5 mJy (5σ, 1h)

PACS is being designed and built by a consortium of institutes and university departments from across Europe under the leadership of Principal Investigator Albrecht Poglitsch located at Max-Planck-Institute for Extraterrestrial Physics, Garching, Germany. Consortium members are: Austria: UVIE; Belgium: IMEC, KUL, CSL; France: CEA, OAMP; Germany: MPE, MPIA; Italy: IFSI, OAP/OAT, OAA/CAISMI, LENS, SISSA; Spain: IAC.

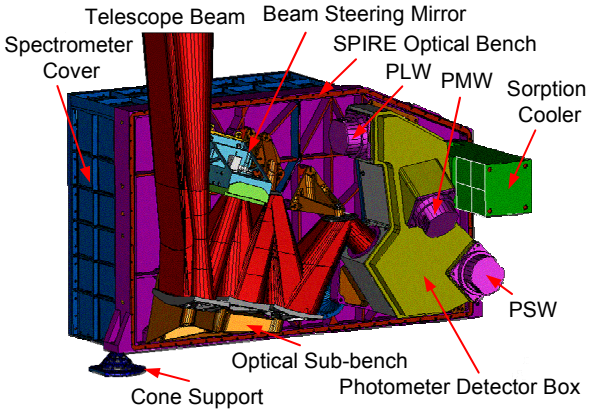
For more information HSC website: http://herschel.esac.esa.int/ and additional links provided therein

(version July 2007)

SPIRE is one of 3 scientific instruments on board of ESA's Herschel Space Observatory, exploring the Universe at infrared wavelengths between 200 and 670 μm.

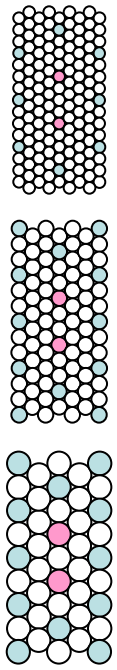
SPIRE

Spectral and **P**hotometric **I**maging **R**eceiver



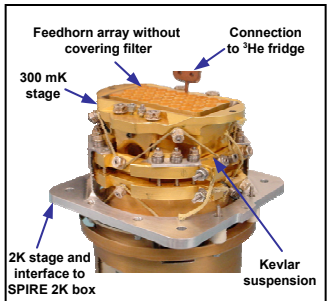
Imaging Photometer

Simultaneous observation in 3 bands
139, 88, and 43 pixels
Wavelengths: 250, 350, 500 μm
$\lambda/\Delta\lambda \sim 3$
FOV 4' x 8', beams (18", 25", 36")

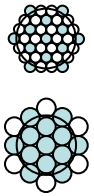


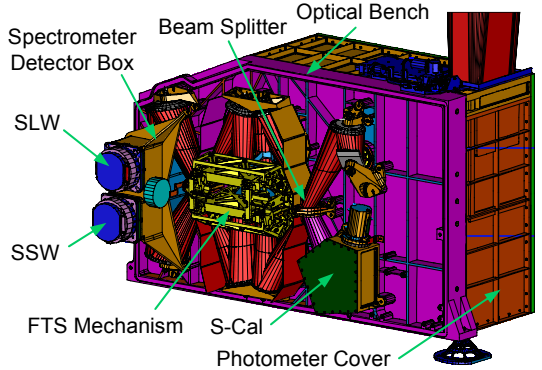
General

Beam Steering Mirror
T= 0.3 K by ^{3}He sorption cooler.
Hexagonally packed Spider-web bolometer arrays.



Detector Assembly





Imaging Fourier Transform Spectrometer

Simultaneous imaging observation of the whole spectral band
37 and 19 pixels
Wavelength Range: 194-672 μm
$\lambda/\Delta\lambda$ = 1289-372 , 206-60, 52-15 (variable)
FOV circular 2.6' diameter, beams 16", 34"

Estimated Photometer Sensitivities*

Wavelengths (μm)		250	350	500
Point Source (7-point jiggle mode, mJy, 5σ, 1hr)		1.8	2.2	1.7
4'x4' jiggle map (mJy, 5σ, 1h)		6.2	8.4	7.1
Large cross linked scan map	Nominal scan (mJy, 5σ)	48	66	56
	Time (h) to map 1deg^2 to 3mJy 1σ	8.5	16	12

Estimated Spectrometer Sensitivities*

λ/Δλ	Wavelengths (μm)	194-324	315-672
1289-372 ≅ 0.04 cm^{-1}	Line flux (10^{-17} Wm^{-2}, 5σ, 1h)	2.5-3.8	2.1-3.9
	cont. flux (mJy, 5σ, 1h)	2075-3125	1750-3250
206-60 ≅ 0.25 cm^{-1}	Line flux (10^{-17} Wm^{-2}, 5σ, 1h)	2.5-3.8	2.1-3.9
	cont. flux (mJy, 5σ, 1h)	332-500	280-520
52-15 ≅ 1 cm^{-1}	Line flux (10^{-17} Wm^{-2}, 5σ, 1h)	2.5-3.8	2.1-3.9
	cont. flux (mJy, 5σ, 1h)	83-125	70-130

* For more information please refer to the Observer's Manual or visit one of these sites:
http://www.rssd.esa.int/Herschel/, http://www.ssd.rl.ac.uk/SPIRE/,
http://www.ipac.caltech.edu/Herschel/

The SPIRE Consortium: SPIRE is being designed and built by a consortium of institutes and university departments from across Europe, Canada and the USA, under the leadership of a Priciple Investigator (Professor M.J. Griffin) located at the University of Wales, Cardiff. The member institutes are: Astronomy Technology Centre (ATC), Edinburgh; Observatoire de Meudon (DESPA), Paris; CEA, Service des Basses Temperatures (SBT), Grenoble; Goddard Space Flight Center (GSFC), Maryland; Instituto de Astrofisica de Canarias (IAC), Tenerife; Insitut d'Astrophysique Spatiale (IAS), Orsay; Imperial College London; Instituto di Fisica dello Spazio Interplanetario (IFSI), Rome; Jet Propulsion Laboratory (JPL), Pasadena; Laboratoire de Marseille (LAM), Marseille; Mullard Space Science Laboratory (MSSL), Holmbury St. Mary; Padova Observatory, Padova; University of Wales, Cardiff; Rutherford Appleton Laboratory (RAL), Chilton; CEA, Service d'Astrophysique (Sap), Saclay; University of Colorado, University of Lethbridge, Canada; Stockholm Observatory, Sweden

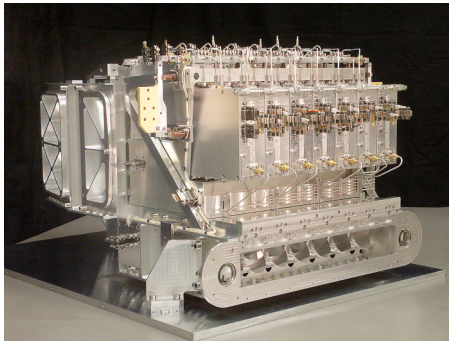
* Quoted figures represent nominal expectations as of Sept 2007

***HIFI* is one of three scientific instruments on board of ESA's Herschel Space Observatory. *HIFI* will conduct high resolution spectroscopic observations over the ranges 480 to 1,250 GHz and 1,440 to 1,916 GHz (625-240 μm and 208-157 μm).**

HIFI

Heterodyne Instrument for the Far-Infrared

Principal Investigator: Thijs de Graauw, SRON, Groningen, The Netherlands
Co-PIs: Tom Phillips, CalTech; Emmanuel Caux, CESR; Jürgen Stutzki, U. Köln



General Features

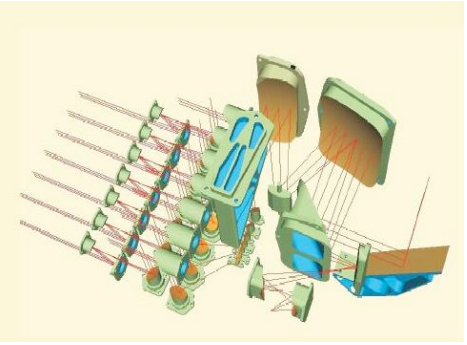
Broad Coverage of the FIR and Sub-mm

Instantaneous IF Bandwidth of 4 GHz in Bands 1-5, and 2.4 GHz in Bands 6 and 7

Resolving Power $\nu/\delta\nu$ up to 10^7, or <0.1 km/s

Diffraction-limited (11 – 42 arcsec) beam

Seven bands utilizing low-noise SIS and HEB Mixers.



Common Optics Light Path

The Common Optics Assembly containing seven mixer bands – five pairs of SIS (Superconductor-Insulator-Superconductor) mixers and two pairs of HEB (Hot Electron Bolometer) mixers, the calibration assembly, and 2 x (14) Local Oscillator inputs.

The Common Optics system combines seven beams and provides a beam chopper for the HIFI Observing Modes which include: Dual Beam Switching, Position Switching, Frequency Switching, and Thermal Load Switching available with the Fixed Position, Mapping, and Spectral Scan Astronomical Observing Templates. Dual acousto-optical spectrometers (wide band) and autocorrelator (high resolution) backends provide frequency resolutions of 140 kHz, 280 kHz, and 1 MHz.

HIFI Sensitivity: Near-quantum noise limit sensitivity (goal < 3 hν/k)
HIFI Calibration Accuracy: 10% baseline requirement; 3% goal

Estimated Spectrometer Sensitivities