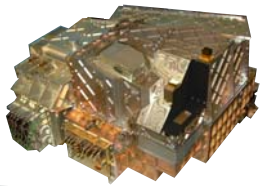
PACS – Photodetector Array Camera and Spectrometer

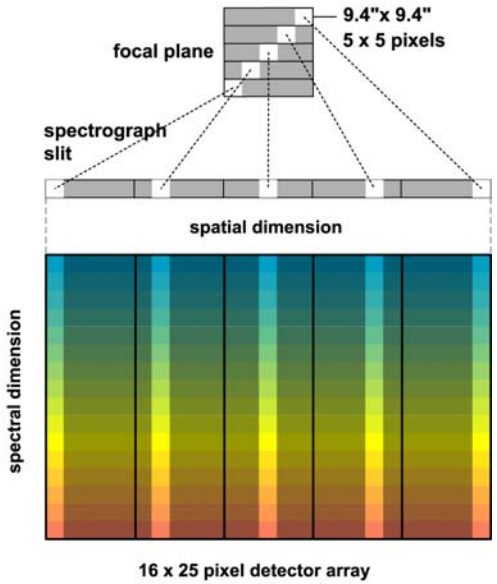
One of the three science instruments on the ESA Herschel Space Observatory

Instrument



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 51 to 220 μm.

Projection of focal plane onto spectrometer arrays



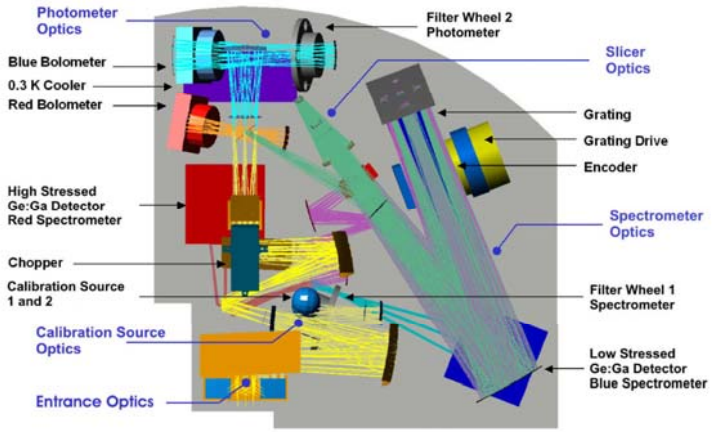
Integral Field Spectrometer

Simultaneous 51-105 & 103-220 μm spectroscopy.

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

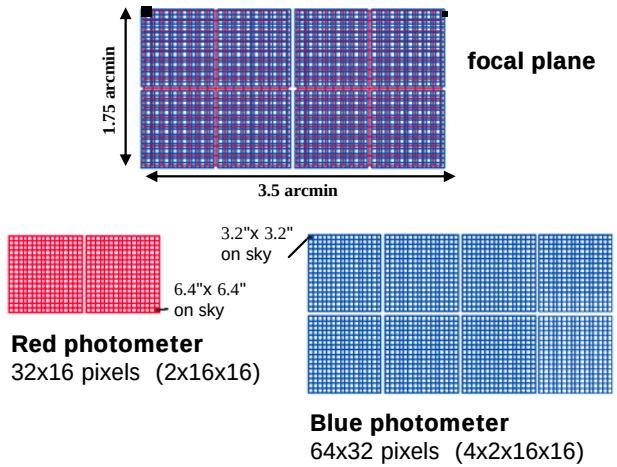
$\lambda/\Delta\lambda$ ~ 1000-5000

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



Optical layout of the PACS instrument

Projection of focal plane onto bolometer arrays



Imaging Photometer

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

Two filled bolometer arrays:
64x32 (blue channel) and 32x16 pixels (red)

Point source detection limit:
~ 5 mJy (5σ, 1h) @ 70 & 100μm
~10 mJy (5σ, 1h) @ 160μm

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 see : http://herschel.esac.esa.int/ or http://www.herschel.caltech.edu/ and additional links provided therein (version May 2010)

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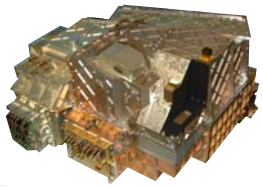
Science



The opening of the 55-210µm window by PACS to sensitive photometry and spectroscopy at high spatial resolution will address a wide range of key questions of current astrophysics concerning the ***origins of stars, planetary systems, galaxies, and the evolution of the Universe.***

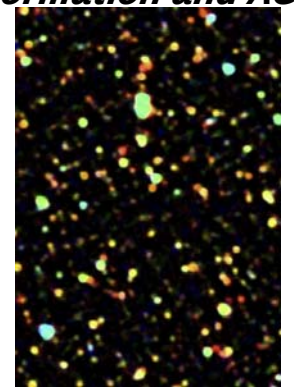
-Most of the energy released e.g. in starbursts or AGNs is absorbed by interstellar dust (which prevents observation at shorter wavelengths) and re-emitted in the far infrared and sub-mm domain.

-Cool, dusty and/or distant objects have their emission peak in the far-IR.

-The far-IR also contains many spectral lines from atoms, ions and molecules. Largely unaffected by extinction they provide detailed information on UV radiation, density, temperature, velocities and abundances of ionised and neutral components of interstellar and circumstellar gas.

Some examples:

What is the cosmic history of star formation and AGN activity?

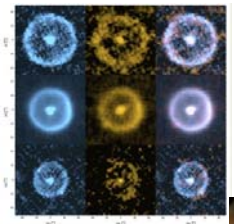


GOODS-South zoomed image from PACS Extragalactic Probe Key Programme 70+100+160µm composite colour image (226 hours)

- Deep multi-band photometric surveys and spectroscopy at the peak of cosmic star formation (up to z~3)

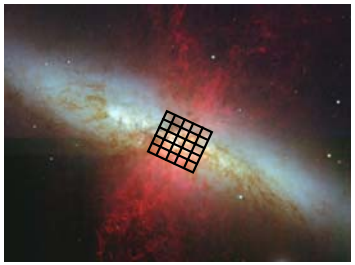
How does stellar mass loss influence the ISM chemistry?

Herschel-PACS scan maps (left to right: at 70 µm, 160 µm, two colour composite) of AQ And, U Ant, and TT Cyg (Kerschbaum et al. 2010)



- Photometric mapping and spectroscopy (e.g. CO, H_2O, OI) of the circumstellar matter in evolved objects

How do stars form out of the interstellar medium?



M82 (Subaru/FOCAS) with the PACS spectroscopy FOV overlayed

- Local galaxies: photometric and spectral line mapping for detailed, spatially resolved studies of star formation on galactic scales

RCW 120 PACS100+160µm + SPIRE250µm colour composite image (Zavagno et al., 2010)

- Photometric surveys of nearby molecular clouds and HII regions: search for protostars

PACS is also intended to be an important driver for other projects which will explore adjacent spectral regions, such as JWST in the near/mid IR and ALMA in the mm domain.

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