

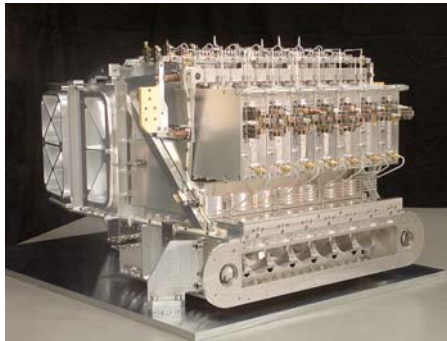


HIFI is one of three scientific instruments on board of ESA's **Herschel Space Observatory**. **HIFI** will conduct high resolution spectroscopic observations over the ranges 490 to 1,250 GHz and 1,440 to 1,910 GHz (612-240 μm and 208-157 μm).

HIFI

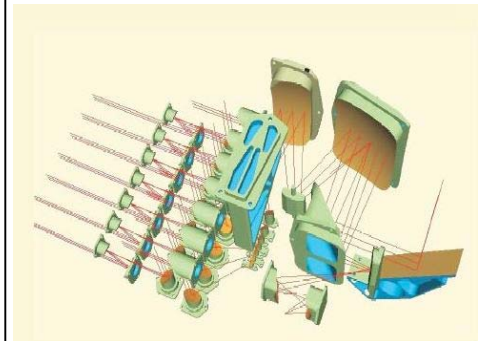
Heterodyne Instrument for the Far-Infrared

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.



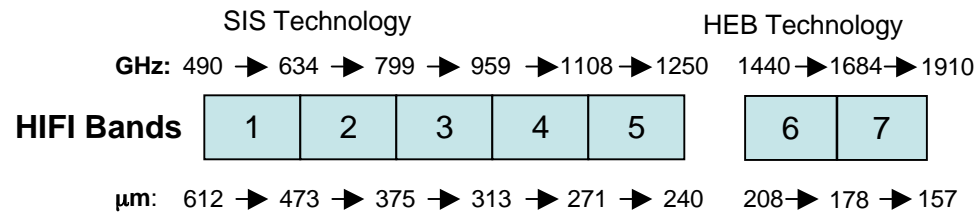
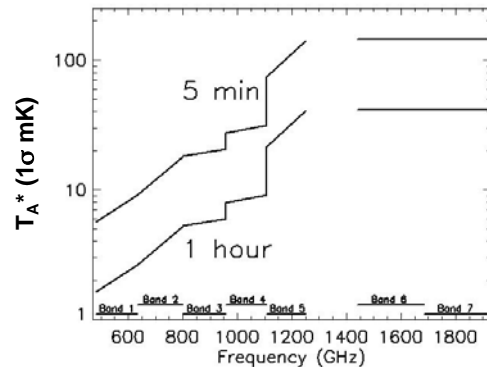
Common Optics Light Path

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 0.125, 0.25, 0.5, and 1 MHz.

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

Estimated Spectrometer Sensitivities





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HIFI
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The **HIFI** Science Objectives center around understanding the interrelation between the stars and the interstellar medium (ISM) in our galaxy and others. Stellar systems return copious amounts of atomic and molecular material enriched by nucleosynthesis to the ISM. Further evolution occurs via gas infall, outflows, and shocks. With HIFI's high spectral resolution, one can observe the material involved in these dynamic processes in the emission of many molecular rotational line transitions (including water) and fine-structure transitions of atoms, their ions, and isotopes.

HIFI is an ideal instrument for:

- Probing the physics, kinematics, and energetics of star forming regions through their atomic and molecular cooling lines.
- Surveying the molecular inventory of such diverse regions as: interstellar shocks, PDRs, diffuse atomic clouds, hot cores, protoplanetary disks, stellar outflows, and the toroids around AGNs.
- Studying the gas components of comets and the giant planets
- Measuring the mass loss regulating post main-sequence stellar evolution and the gas/dust ISM replenishment.
- Identifying galactic [CII] emission in the ionized and neutral ISM.
- Studying the chemistry of water, the prime building block of life: determining the relative importance of photodissociation, freeze-out, and evaporation of water during star and planet formation.
- Observing the water molecule as a tracer of warm dense gas to learn the distribution and kinematics of circumstellar material in the earliest phases of star formation.

For more information please visit:

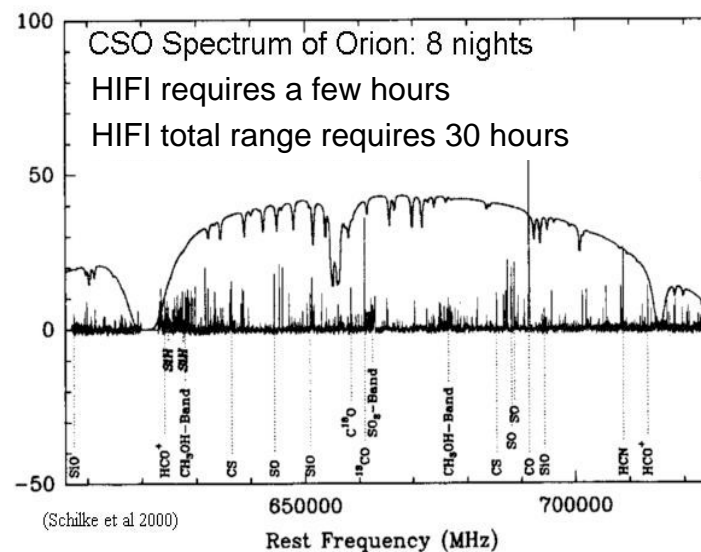
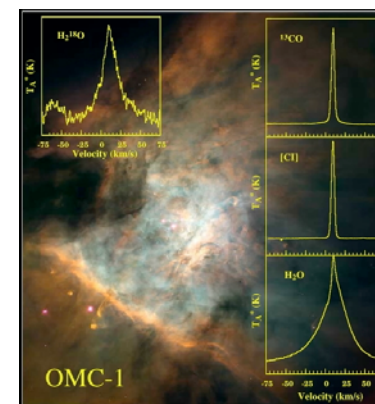
<http://www.sron.rug.nl/hifiscience/>

<http://www.ipac.caltech.edu/Herschel/index.shtml>

<http://herschel.jpl.nasa.gov/>

*The Netherlands: SRON Groningen/Utrecht; Kavli Inst. For Nanoscience, University of Delft; USA: JPL/Caltech; UMass; Germany: KOSMA, Physikalisches Institut, Köln; MPIfR, Bonn; MPS, Lindau; France: CESR, Toulouse, LERMA, Paris; Observatoire de Bordeaux; Italy: CAISMI-CNR, Firenze, IFSI, Frascati; Spain: Centro Astronómico de Yebes/OAN; Switzerland: ETH, Zürich; Sweden: Onsala/Chalmers TH, Göteborg; Poland: Space Research Center, Warsaw; Canada: CSA; Ireland, Maynooth College, NUI.

SWAS observations of water towards a region of high-mass star-formation in the Orion Molecular Cloud. HIFI will be able to zoom in on this and other regions where a newly formed star interacts with the surrounding molecular cloud. Note the broad water line profiles generated by the shocked wind, compared to the narrow molecular cloud line profiles of [CII] and ^{13}CO .



A submillimeter window on Orion, first opened by the Caltech Sub-millimeter Observatory, exemplifies a star-forming region where HIFI capabilities can be put to great advantage. Here a rich molecular line survey can be made with HIFI, utilizing its high sensitivity (free from telluric absorption), its high frequency resolution (to resolve blended transitions in emission and absorption) and to rapidly span nearly 15 times the passband shown above.

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