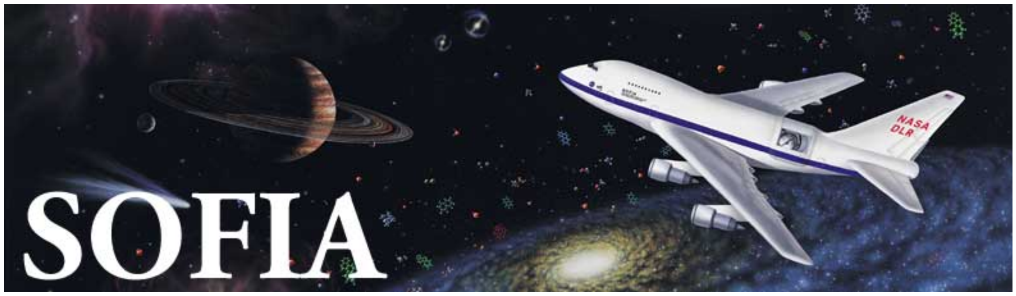
GREAT

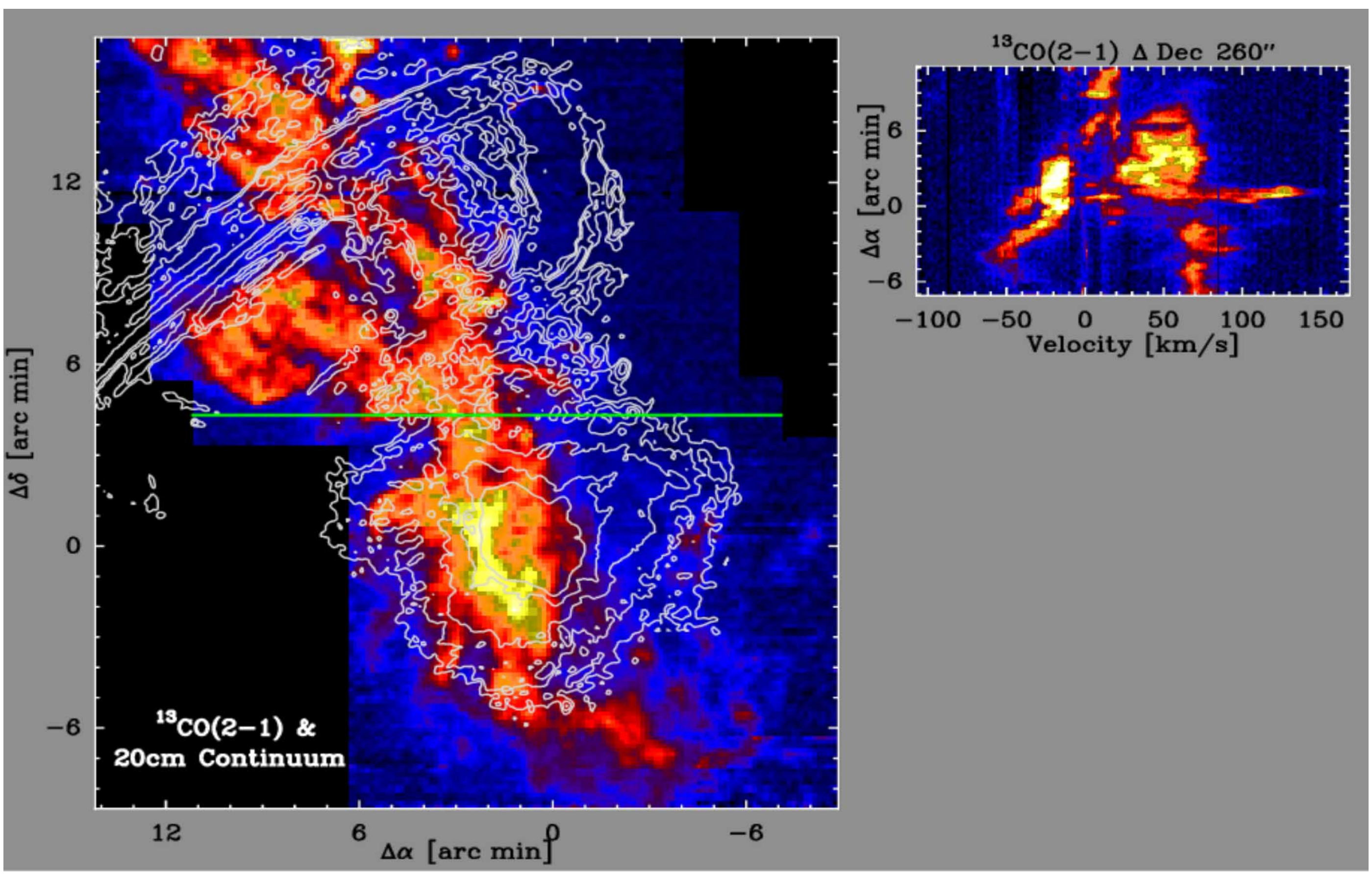
German Receiver for Astronomy at THz Frequencies



High-spectral resolution ($\nu/\Delta\nu \geq 10^6$) is required to address a wide range of topics of modern astrophysics, from questions about planetary atmospheres and the interstellar medium in the Galaxy to investigations about the early Universe. With the impressive progress in detector technology over the recent years, the development of sensitive heterodyne receivers for the Terahertz spectral range has now become possible. A consortium of German research institutes has been established for the development of GREAT, a first-generation dual-channel heterodyne instrument for high-resolution spectroscopy aboard SOFIA (German P.I.-class instrument).

Scientific highlights: a number of unique lines, from atomic fine-structure transitions to fundamental rotational transitions of hydride molecules, will be studied with GREAT. Two examples:

- [CII] 158µm and [OI] 63µm fine-structure transitions. The ionized Carbon line is the most important cooling line of the cold interstellar medium, therefore crucial for its energy balance. KAO observations have demonstrated, that on larger scale, the integrated [CII] line intensity is an excellent tracer of the overall star formation activity of a galaxy;
- observations of the 112µm ground-state transition of deuterated molecular hydrogen HD will allow the determination of the abundance profile of deuterium across the Galaxy and nearby galaxies, thereby providing critical information on their star formation history and on Big Bang nucleosynthesis models.



Specifications

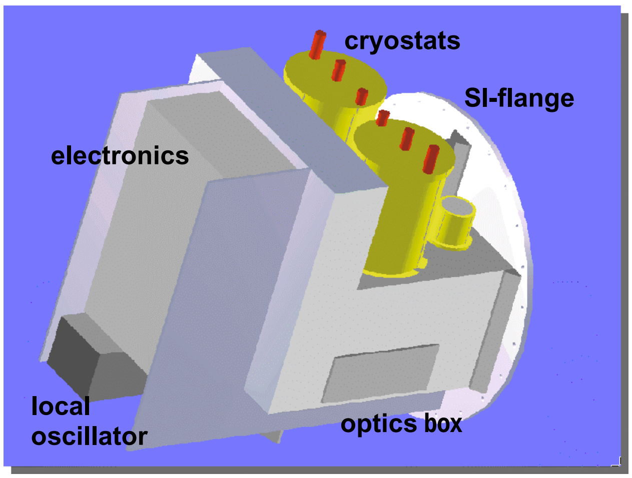
The consortium develops a modular dual-channel heterodyne instrument for high-resolution spectroscopy ($\nu/\Delta\nu \approx 10^{6-8}$) aboard SOFIA. The modularity of the system permits the perspective of later upgrades and – with time – of an increasingly more complete coverage of the FIR-spectral range. Our first-flight version will offer parallel observations in two (out of three) scientifically-selected frequency bands:

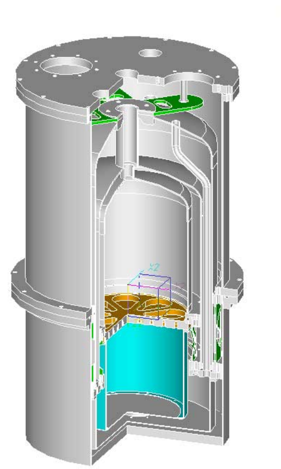
- low-frequency band: 1.6-1.9 THz [KOSMA]
- mid-frequency band: 2.4-2.7 THz [MPIfR]
- high-frequency band: ca. 4.7 THz [DLR-WP]

We will have a choice of spectrometer backends, including a

- mid-resolution Array Acousto-Optical Spectrometer (4x1 GHz bandwidth, $\Delta\nu$ = 1 MHz) [KOSMA]
- high-resolution Chirp-Transform-Spectrometer (180 MHz bandwidth, $\Delta\nu$ = 45 kHz) [MPAe]

The detectors will employ superconducting mixer elements, like hot electron bolometers or SIS junctions.





Structural layout (left) of the GREAT frontend, displaying the science instrument flange, the two cryostats, the optics box hosting the beamsplitter and LO couplers, racks with control electronics and the local oscillator(s). Front-end cryostat (right).

Collaborating Institutes:

- Max-Planck-Institut für Radioastronomie, Bonn
- KOSMA, I.Physikalisches Institut der Universität zu Köln
- Max-Planck-Institut für Aeronomie, Lindau
- DLR, Institute for Space Sensor Technology and Planetary Exploration, Berlin

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For more information, visit: http://www.sofia.usra.edu/observatory/instruments/