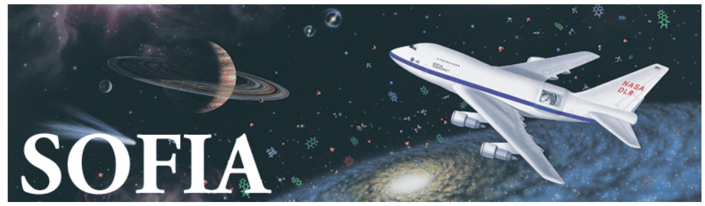
CASIMIR



Caltech Airborne Submillimeter Interstellar Medium Investigations Receiver

CASIMIR will be a submillimeter and far-infrared (500–2000 GHz) spectrometer, now under development for the SOFIA airborne observatory as a P.I.-class instrument. As CASIMIR is a heterodyne instrument, it will have extremely high spectral resolution ($\upsilon / \Delta\upsilon > 10^6$), and will be capable of velocity-resolved observations of galactic objects. This instrument will also have very high sensitivity, as a result of the recent advances in superconducting mixer technology, (SIS and HEBs).

Science

CASIMIR is very well suited for studying the warm (~ 100 K) molecular interstellar medium in our own galaxy, as well as in external galaxies. This warm gas is heated by shock waves or UV radiation, processes which are often associated with active star formation. In addition, CASIMIR will be able to study the fundamental rotational transitions of many important hydride molecules, some of which are listed in Table 1. In particular, CASIMIR will be able to study in detail the abundance and excitations of interstellar water, using a number of $H_2{}^{18}O$ transitions. These transitions are shown in Figure 1, overleaf.

Species	Transition	Frequency (GHz)	E_{lower} (K)	Atmospheric Transmission 1 mm H_20	SOFIA
CH	$F_1 \rightarrow F_2;\ J = 3/2^- \rightarrow 1/2^+$	536.76	0.0	0 %	97 %
$H_2{}^{18}O$	$1_{10} \rightarrow 1_{01}$	547.68	34.2	0 %	81 %
NH_3	$1_0 \rightarrow 0_0$	572.50	0.0	0 %	94 %
$H_2{}^{18}O$	$2_{11} \rightarrow 2_{02}$	745.32	100.6	0 %	82 %
NH	$N = 1 \rightarrow 0;\ J = 2 \rightarrow 1$	974.48	0.0	0 %	96 %
H_3O^+	$0_0^- \rightarrow 1_0^+$	984.66	7.5	0 %	65 %
NH^+	$3/2^+ \rightarrow 1/2^-$	998.90	0.0	0 %	95 %
HF	$1 \rightarrow 0$	1232.48	0.0	0 %	30 %
H_2D^+	$1_{01} \rightarrow 0_{00}$	1370.09	0.0	0 %	94 %
N^+	${}^3P\ J = 1 \rightarrow 0$	1461.13	0.0	0 %	92 %
${}^{16}OH$	${}^2\Pi_{1/2}\ J = 3/2^+ \rightarrow 1/2^-$	1837.82	181.9	0 %	94 %
C^+	${}^2P\ J = 3/2 \rightarrow 1/2$	1900.54	0.0	0 %	88 %
CH_2	$1_{10} \rightarrow 1_{01}$	1917.66	22.4	0 %	99 %
CO	$18 \rightarrow 17$	1956.02	751.7	0 %	90 %

Table 1: Selected submillimter lines within the CASIMIR spectral bandpass. Also shown is a comparison of the atmospheric transmission for these lines at a site similar to Mauna Kea and at SOFIA's operating altitude.

Instrument Team

The CASIMIR team inludes: Jonas Zmuidzinas (P. I.), Geoff Blake, Michael Edgar, Alexander Karpov, Jocelyn Keene, David Miller and Tom Phillips (Caltech); Paul Goldsmith (Cornell); Bill Langer, Rick LeDuc, Rob McGrath (JPL); Mark Morris (UCLA); Andrew Harris (U. Maryland); Neal Erickson (U. Massachusetts).

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SOFIA and Other Instruments; **www.sofia.usra.edu**

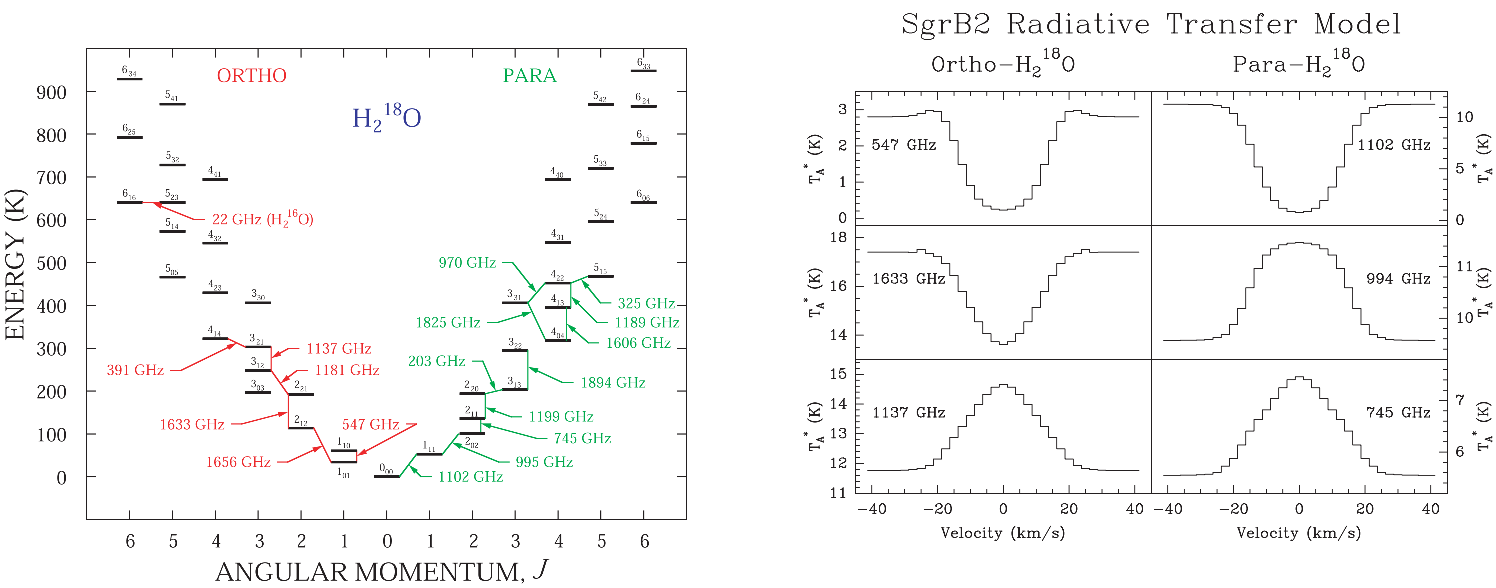

Figure 1: **Left:** The rotational energy level diagram for $H_2^{18}O$. **Right:** $H_2^{18}O$ line intensities predicted for SOFIA observations of SgrB2.

Figure 2: Schematic diagram of the CASIMIR instrument. Relay optics are mounted inside a sealed (non-cryogenic) box, on which two liquid helium cryostats are mounted. Each cryostat will contain two receiver bands (each of which covers ~150 GHz); up to 4 bands will be available on any given flight. Only a single band can be used at a given time, and this band is selected by a rotating mirror inside the optics box. SIS mixers using NbTiN superconductors will be used up to 1200 GHz, with HEB mixers used at higher frequencies. The receiver noise temperatures are expected to be less than 0.3 K/GHz and 0.7 K/GHz for the SIS and HEB bands, respectively. The local oscillators are solid-state continuously tunable multiplier sources, driven by either Gunn oscillators or HEMT power amplifiers, located on the sides of the cryostats. The backend spectrometers are mounted on the telescope, either directly on the instrument or in an electronics rack near the telescope's counterweights. Each spectrometer has a bandwidth of up to 4 GHz. The total mass is ~540 kg.