CAltech Submillimeter Interstellar Medium Investigations Receiver (CASIMIR)

CASIMIR will be a submillimeter and far–infrared (500–2000 GHz) spectrometer, and is now being built for the SOFIA airborne observatory as a P.I.–class instrument. Since CASIMIR is a heterodyne instrument, it will have extremely high spectral resolution ($\nu/\Delta\nu \geq 10^6$), and will be capable of velocity–resolved observations of galactic objects. CASIMIR will also have very high sensitivity, as a result of the recent advances in superconducting detector technology (SIS and HEB mixers).

Science

CASIMIR is very well suited for studying the warm ($\sim$ 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 the table below. In particular, CASIMIR will be able to study the abundance and excitation of interstellar water in detail using a number of $H_2{}^{18}O$ transitions, as shown in Fig. 1.

SELECTED SUBMILLIMETER LINES

Species	Transition	Frequency (GHz)	$E_{\rm lower}$ (K)	Atmospheric Transmission (1 mm H_2O)	Transmission (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 %

Instrument Team

The CASIMIR team includes: Jonas Zmuidzinas (P.I.), Geoff Blake, Mick Edgar, Alexandre 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). Contact: J. Zmuidzinas, Caltech 320–47, Pasadena CA 91125; jonas@submm.caltech.edu, (626) 395 6229, (626) 796 8806 (FAX).

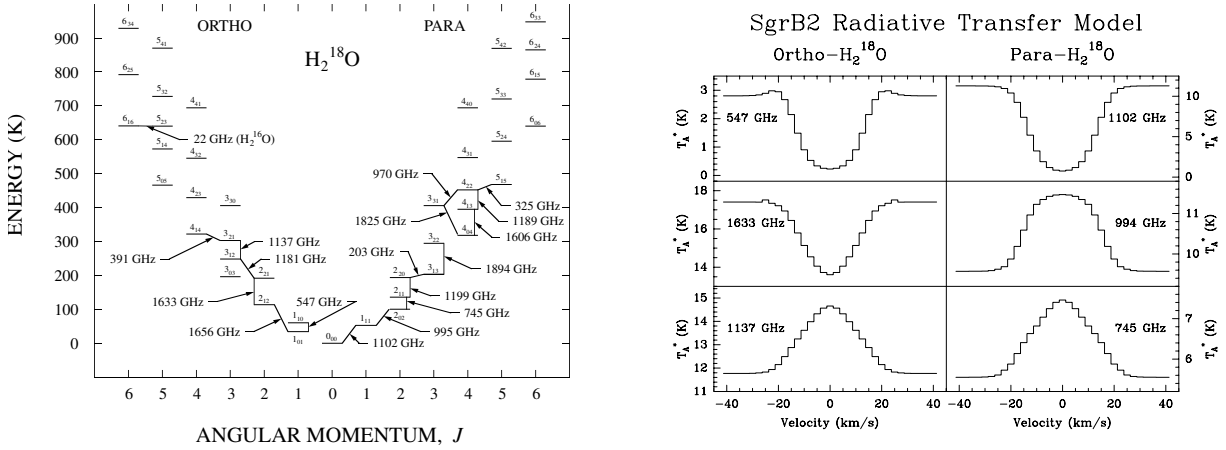

Figure 1: **Left**: The rotational energy level diagram for $H_2{}^{18}O$. **Right**: $H_2{}^{18}O$ line intensities predicted for SOFIA observations of SgrB2.

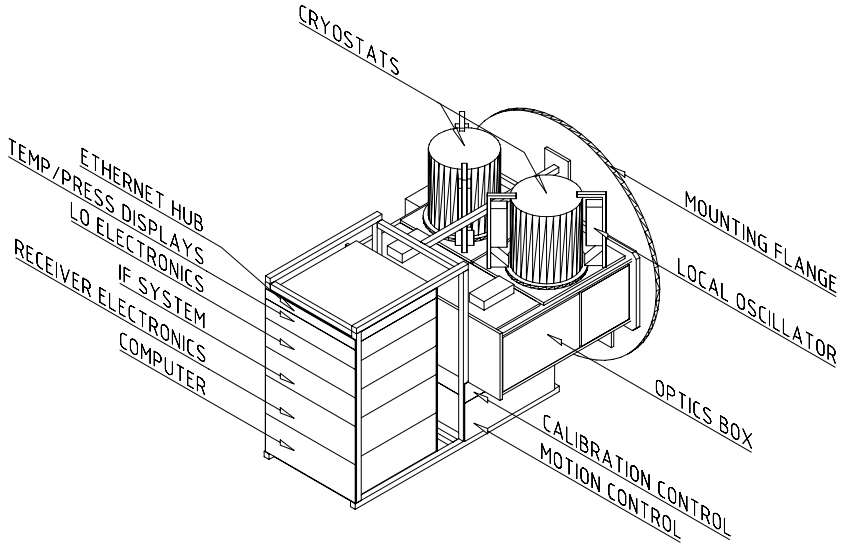

Figure 2: A sketch of the instrument. The optics are contained in a sealed (non–cryogenic) box, on which two helium cryostats are mounted. Each cryostat will contain two receiver bands (each band covering $\sim$ 150 GHz); up to 4 bands will be available on any given flight. SIS mixers using NbTiN superconductors will be used up to 1200 GHz; HEB mixers will be used for higher frequencies. The receiver noise temperatures are expected to be below 0.3 K/GHz for the SIS bands and 0.7 K/GHz for the HEB bands. The local oscillators are solid–state continuously tunable multiplier sources driven by either Gunn oscillators or HEMT power amplifiers. A mirror mounted on a rotary stage inside the optics box will select which cryostat receives the telescope beam. The backend spectrometers (4 GHz bandwidth) will also be mounted on the telescope, in an electronics rack near the counterweights.