Summary characteristics for CASIMIR at first flights

September 2004

Receivers:

CASIMIR will first fly with two input bands contained in a single cryostat. Observations will be possible with only one band at a time. The receivers are double-sideband with temperatures of approximately 0.5 K/GHz. Boldface in the table below highlights the bands for which LO sources are presently available. Observations in the other bands may be possible but are mainly limited by LO availability.

Band	Frequencies	T_{rec} (DSB)	LO now available
550 GHz	**500-600 GHz**	**100 K**	**Yes**
750 GHz	700-800 GHz	350 K	No
1000 GHz	920-1070 GHz	500 K	No
1100 GHz	1000-1100 GHz	500 K	No
1200 GHz	**1110-1260 GHz**	**600 K**	**Yes**
1400 GHz	~1.4 THz	1000 K	No

Spectrometers:

We expect to have both a moderate-resolution wide-bandwidth analog correlator and a high-resolution moderate-bandwidth digital correlator on board. The digital correlator has four fixed-frequency 1 GHz samplers for 500 MHz sub-bands. There are 224 lags for each 500 MHz sub-band, but lags can be redistributed behind the samplers for higher spectral resolution within a smaller number of 500 MHz sub-bands. The table below does not yet include the number of lags that overlap between sub-bands.

Bandwidth	Type	Lags	Resolution	Center in IF
3.5 GHz	Analog	128	33 MHz	6.00 GHz
2 GHz	Digital	896	2.2 MHz	6.00 GHz
1 GHz	Digital	896	1.1 MHz	5.50 GHz
500 MHz	Digital	896	0.6 MHz	5.75 GHz

Representative spot frequency summary:

Frequency	T_{rec}	Beam FWHM	Max/Min Bandwidth	Max/Min Resolution
550 GHz	100 K	51	1910/272 km/s	18/0.3 km/s
700 GHz	300 K	40	1500/214 km/s	14/0.2 km/s
1200 GHz	600 K	23	875/125 km/s	8/0.1 km/s

Atmospheric absorption:

Absorption for specific lines is listed in the reference materials at http://www.astro.umd.edu/~harris/casimir. Also see summary from the original proposal, or check with Jonas. The JPL line list at http://spec.jpl.nasa.gov/ covers CASIMIR's frequency range.

Optics:

D_{Tel}	2.5 m (underilluminated 2.7 m)
D_{Sec}	0.352 m
η_{MB}	0.80 (theoretical for 11 dB edge taper)
η_A	0.77 (theoretical for 11 dB edge taper)
η_{Ohmic}	0.95 at 240 K
Chopping secondary	±4 arcmin max. throw
Elevation range	20 to 60 degrees unvignetted
f-ratios	*f*/19.6 system, *f*/1.28 primary
D_{Sec}/D_{Tel}	0.141

Signal-to-noise ratio calculation:

The general expression for the signal-to-noise ratio for a small line source is:

$$\frac{S}{N} = \frac{f^{2.5}}{c^{2.5}} \frac{T_{sou} \Delta \mathrm{v} \, \phi \, \Omega_{sou} \eta_A A_{geom} e^{-\tau_z AM}}{\left(T_{rec} + T_{excess}\right) + \left(1 - e^{-\tau_z AM}\right) T_{atm}} \sqrt{\tau}$$

where:

S/N is the signal-to-noise ratio
f is the observing frequency
c is the speed of light
T_{sou} is the source temperature
$\Delta \mathrm{v}$ is the equivalent velocity width
ϕ is the areal filling factor
Ω_{sou} is the source solid angle
η_A is the aperture efficiency including scattering and ohmic losses
τ_z is the atmospheric optical depth at zenith
AM is the source airmass, $1/\cos(z)$, where z is the zenith angle
T_{rec} is the single-sideband receiver temperature
T_{excess} is the single-sideband excess temperature from loss, scattering, and spillover
T_{atm} is the physical temperature of the atmosphere
τ is the integration time