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FAR INFRARED SKY SURVEY

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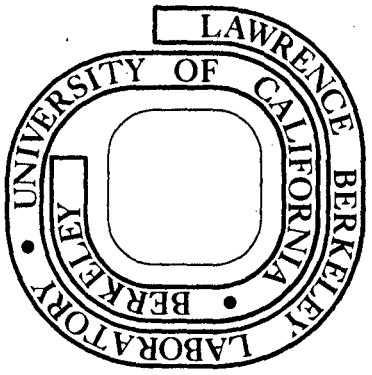

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Far Infrared Sky Survey

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A one-meter balloon telescope has been assembled at Berkeley which is designed to survey the sky in seven spectral bands between 10 and 3000μm. The system will have a beam size of 16 arc-min and a limiting sensitivity of a few flux units. The sensitivity will remain high for extended sources up to several degrees in size. In its initial phase the survey will cover the northern sky from -15° to +75° latitude. The primary scientific goal of this project is to measure the temperature, emissivity, and distribution of extended cool dust clouds. A catalogue of all far infrared sources observed will be prepared.

A schematic diagram of the gondola is shown in Fig. 1. The gondola will be suspended from a $1.5 \times 10^5 m^3$ balloon at a zenith angle of ~45° and rotated at ~2 rpm. A minimum of 4 observations of each point in the scanned region of the sky will be obtained with 24 hours of balloon flights from the latitude of Palestine, Texas. The orientation of the gondola is determined from magnetometers, an N-slit photomultiplier star finder system, and rate gyroscopes.

The f/1 parabolic primary mirror and the hyperbolic secondary mirror are made from diamond turned, copper coated aluminum. The top-looking cryostat cools the entire region behind the hole in the primary mirror. The diagram of the cryostat insert in Fig. 2 shows a cross section of the hexagonal array of Winston concentrators used to convey radiation from the focal plane, through the filters, to the seven composite bolometric detectors.[1] In order to achieve background limited sensitivities it is necessary to cool the detectors below the temperature of the main helium bath which is in equilibrium with the ambient pressure at the flight altitude of 30 Km. The bolometers are attached to a small He^4 bath which is pumped by cooled activated charcoal to obtain an operating temperature of 1.0 K. The operating parameters of the telescope system are given in Tables I and II. It is anticipated that the results of the first flight will be reported at the conference.

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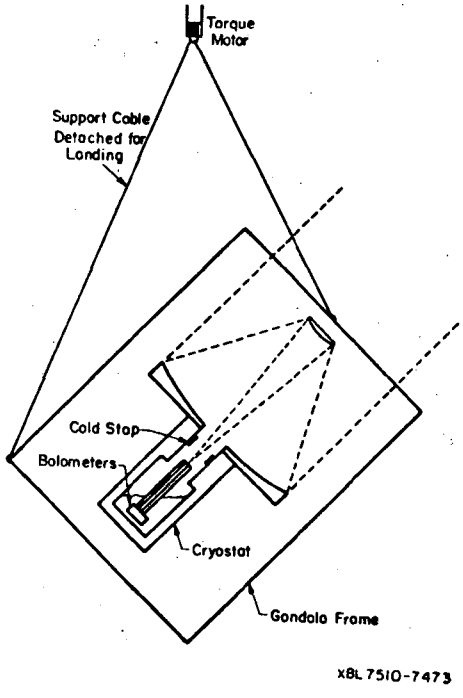
1. N. S. Nishioka, P. L. Richards and D. P. Woody, Appl. Opt. 17, 1562 (1978).



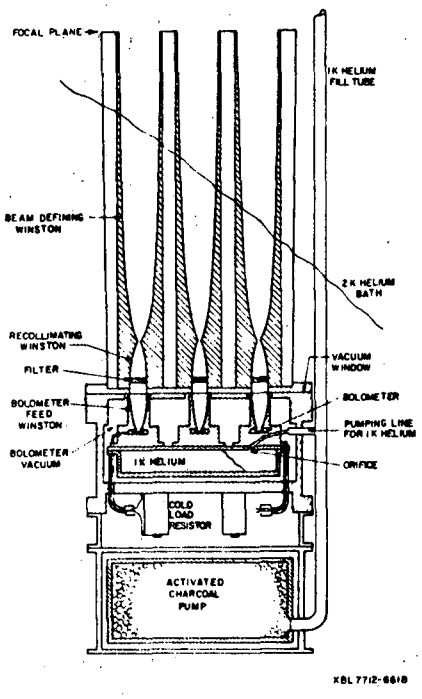


Fig. 1. Configuration of gondola

Fig. 2. Cryostat insert

Table I. System parameters

1.	Telescope area:	$0.73 m^2$
2.	System throughput:	0.086 sterad cm^2
3.	Detector dimensions:	4 × 4 mm
4.	Beam diameter:	16 arc-min
5.	Rotation period:	27 sec at 45° zenith angle
6.	Pulse length from point source:	30 ms
7.	Noise bandwidth:	12 Hz
8.	Dark electrical bolometer NEP:	$2 \times 10^{-15} W/\sqrt{Hz}$
9.	Optical efficiency:	0.16 - 0.24 (including filters and bolometer absorption)
10.	Background radiation:	ε = 0.02 to 0.06 depending on band, T = 235 K

Table II. Background limits for NEP and NEF in various frequency bands for a 24-hour survey with a throughput of $A\Omega = 0.086$ sterad cm^2 and a background characterized by the expected emissivity and efficiency of the survey instrument at altitude.

Frequency Band ν_L, ν_H [cm^{-1}]	Emissivity ε	Efficiency T	NEP [$W/\sqrt{Hz}$] (referenced to bolometer)	NEF W/cm^2	NEF Flux Units
3 - 17	0.027	0.20	2.0×10^{-15} (bolometer limited)	4.7×10^{-14}	11
3 - 37	0.027	0.24	4.2×10^{-15}	8.3×10^{-14}	5.3
3 - 83	0.035	0.24	1.8×10^{-14}	3.6×10^{-13}	11
3 - 166	0.03	0.24	4.3×10^{-14}	8.5×10^{-13}	14
3 - 330	0.021	0.20	7.8×10^{-14}	1.9×10^{-12}	16
455 - 618	0.025	0.16	9.9×10^{-14}	2.9×10^{-12}	60
742 - 1279	0.06	0.24	2.8×10^{-13}	5.5×10^{-12}	34

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