

## VII. GRAVITATION RESEARCH\*

### Academic and Research Staff

Prof. R. Weiss  
Dr. D. J. Muehlner  
R. L. Benford

### Graduate Students

D. K. Owens  
N. A. Pierre  
M. Rosenbluh

## RESEARCH OBJECTIVES AND SUMMARY OF RESEARCH

The research in this group is in the field broadly labeled experimental relativity, in particular, experiments related to the gravitational interaction and measurable consequences of cosmological models.

### Specific Projects

#### 1. Astronomy in the Region 1-0.1 mm

Our present knowledge concerning the sky in the region between 1 mm and 0.1 mm is still very limited. This region of the electromagnetic spectrum includes the isotropic blackbody background radiation which may be of cosmic origin, thermal radiation by intergalactic dust, and most likely discrete sources that are not visible in other regions of the spectrum.

Balloon-borne experiments performed during the past year have led to the following conclusions. (a) In the spectral region below  $12 \text{ cm}^{-1}$  the isotropic background spectrum follows a Planck distribution appropriate to a blackbody at  $\sim 2.7^\circ \text{K}$ . At this temperature the spectral peak occurs at approximately  $6 \text{ cm}^{-1}$ . (b) In the region between  $12 \text{ cm}^{-1}$  and  $18 \text{ cm}^{-1}$  we have measured an upper limit of radiation equivalent to a  $3.3^\circ \text{K}$  blackbody. We have measured a substantial atmospheric contribution in this region, but the actual value of this contribution is still unknown.

We plan two specific projects during 1972. The first is to refine measurements of the spectrum of the isotropic background radiation in the region  $12\text{-}20 \text{ cm}^{-1}$ . By designing new filters, we hope to establish unambiguously the radiative contributions of  $\text{H}_2\text{O}$  and  $\text{O}_3$  in the upper atmosphere. We also hope to reach higher altitudes than in previous flights.

The second project is to make a measurement of the large-scale isotropy of the background radiation. This measurement is important in order to identify the source of this radiation. If the source is cosmic, then we may succeed in measuring the Earth's velocity relative to the frame of reference in which the universe is isotropic.

J. Muehlner, R. Weiss

---

\*This work was supported in part by the Joint Services Electronics Programs (U.S. Army, U.S. Navy, and U.S. Air Force) under Contract DAAB07-71-C-0300, and in part by the National Aeronautics and Space Administration (Grant NGR 22-009-526) and the National Science Foundation (Grant GP-24254).

## (VII. GRAVITATION RESEARCH)

### 2. Far Infrared Detection

(a) Development of nonmechanical modulators for the far infrared.

(b) Far infrared detection by parametric up-conversion in CdS pumped by the 5145 Å line of the argon laser (see Quarterly Progress Report No. 100, p. 54).

### 3. Gravitational Wave Antenna

We have made design studies and begun prototype construction of a long-baseline, broadband, electromagnetically coupled gravitational wave antenna. The antenna, in principle, should enable us to set a meaningful upper limit on the gravitational radiation from the Crab Nebula pulsar, as well as to measure the spectrum of the Weber sources.

D. K. Owens, R. Weiss

### 4. Laser Research

An intracavity laser interferometer with circular polarization of novel design has been constructed. With this instrument we have measured differences of the index of refraction for right- and left-circular polarization as little as  $10^{-15}$  over a 1-cm optical path length. The instrument is useful in measuring small Verdet's constants, and we may be able to measure intrinsic laser phase noise.

D. K. Owens