

## VI. GEOPHYSICAL RESEARCH

### A. High Magnetic Fields<sup>\*</sup>

#### Academic and Research Staff

Prof. F. Bitter  
Prof. G. Fiocco

Dr. T. Fohl  
Dr. J. F. Waymouth

### B. Upper Atmospheric Physics<sup>†</sup>

#### Academic and Research Staff

Prof. G. Fiocco

#### Graduate Students

R. Chiang  
J. B. DeWolf

G. W. Grams

D. F. Kitrosser  
H. C. Koons

## RESEARCH OBJECTIVES

This group is concerned with a variety of problems of geophysical interest. The production of magnetic fields in the multimillion gauss range and the consequent attainment of very high pressures is a subject of continued interest: for this purpose, a fast capacity bank of 20 kJ at 50 kv discharging into a single-turn coil is being assembled. Studies of the upper atmosphere by pulsed optical radar continue. Some correlations between dust and Ionospheric Sporadic E-layer irregularities have been found, and a study of the interaction of dust and ozone in the 15-25 km altitude region is being carried out. Techniques for the measurement of atmospheric parameters, in particular, wind speed and temperature, by cw optical radar are being investigated, as well as the scattering and absorption of optical radiation by plasmas.

F. Bitter, G. Fiocco

### 1. ELECTROMAGNETIC BACK-SCATTERING FROM SPHERES

The scattering of electromagnetic waves by a sphere is a well-known classical problem; however, computations have been made and published for only a few cases. Since such solutions are of interest in many problems in atmospheric physics, and are particularly essential in the interpretation of optical radar results, we have started a computation program by means of the Mie series solution for complex refractive index. The computations of the normalized back-scattering cross section are being carried out for values of the parameter  $a = 2\pi r/\lambda \leq 30$  (where  $\lambda$  is the wavelength, and  $r$  is the sphere radius), and values of the refractive index  $n = n_{\text{real}} + i n_{\text{im}}$ , where  $1 \leq n_{\text{real}} \leq 2$  and

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$n_{\text{real}} < n_{\text{im}}$ . In these computations we utilize a program developed by J. Rheinstein of Lincoln Laboratory, M. I. T.

R. Chiang, G. Fiocco

### 2. SEARCH FOR Comet Ikeya-Seki (1965 f) AT 8 Gc/sec AND 15 Gc/sec

A search for Comet Ikeya-Seki (1965 f) on its approach to perihelion was carried out with the Haystack antenna and its microwave radiometer system. The antenna is a moveable 120-ft paraboloid located at the Millstone Hill station of Lincoln Laboratory.

The radiometers were operated either in the 7.75-8.0 Gc/sec channel with an antenna beamwidth of  $0.069^\circ$  or in the 15.0-15.5 Gc/sec and 15.5-16.0 Gc/sec channels simultaneously, with an antenna beamwidth of  $0.038^\circ$ , according to the schedule in Table VI-1. Beam switching was used to reduce drifts caused by atmospheric conditions. Within  $0.25^\circ$  of the coordinates for the comet given by Cunningham<sup>1</sup> no signals exceeding an antenna temperature  $T_A = 0.5^\circ\text{K}$  could be detected.

Table VI-1. Schedule of the search for radio emission from Comet Ikeya-Seki (1965 f).

Date (1965)	Time (U. T.)	Frequency (Gc)
15 October	1242-1758	8
17 October	1316-1915	8
19 October	1233-1851	15
20 October	1417-1833	15

Westphal and Murray<sup>2</sup> have carried out infrared measurements in the spectral intervals  $1.3\text{-}2.5\mu$ ,  $3.5\text{-}4.0\mu$ , and  $8\text{-}14\mu$  that are consistent with the spectrum of radiation from a thermal source of color temperature  $T_C(\text{IR}) = 1500^\circ\text{K}$ . The brightness temperature reported in the interval  $8\text{-}14\mu$  is  $T_B(\text{IR}) = 180^\circ\text{K}$ , and the angular size of the source, at  $z = 0.7$  AU distance from the Sun, is approximately one minute of arc.

The apparent discrepancy between the results at infrared and microwave wavelengths leads to the interpretation that the detected infrared radiation is essentially due to the scattering of sunlight by small particles constituting the head of the comet, since one would expect both the size and the brightness of the source to be comparable in the two spectral regions. If this interpretation is correct, then a color temperature  $T_C(\text{IR}) = 1500^\circ\text{K}$  is indicative of a strong depletion of particles smaller than a few microns. Presumably, the depletion is due to the mechanisms that are responsible for the formation of the tail, that is, the effects of radiation and solar wind pressure.

G. Fiocco, H. C. Koons, M. L. Meeks

[Dr. Marion L. Meeks is a staff member of Lincoln Laboratory, M. I. T.]

References

1. International Astronomical Union Circular No. 1928, 7 October 1965.
2. J. Westphal and B. C. Murray (Private communication, October 20, 1965).

