MEMORIAL

This Proceedings of the First International Conference on Submillimeter Waves and Their Applications is dedicated to our departed friend and colleague

JOHN CHAMBERLAIN

At the time of his death by stroke in October 1974, he was planning the Third Conference to be held in England in the Spring of 1978. John Chamberlain was respected and admired as a pioneer in far infrared Fourier transform spectroscopy. As part of his rich scientific legacy, he has left us the technique of measurement of complex dielectric constant by dispersive Fourier spectrometry.

Foreword

SPECIAL ISSUE ON THE PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON SUBMILLIMETER WAVES AND THEIR APPLICATIONS

A REVOLUTION in submillimeter wave techniques has taken place during the past ten years. Prior to the 1970's there was essentially no engineering interest in the development of this range of the spectrum. A small, but significant, amount of work was done on the spectroscopy of molecular gases, semiconductors, and antiferromagnetic insulators by optical engineers who used a mercury vapor source, grating dispersion, and a Golay cell detector. A few of these instruments are still used but most optical scientists now prefer Fourier transform spectroscopy which came into general use during the past ten years. This rapid growth of Fourier transform spectroscopy was made possible by the ready availability of large scale digital computers, the development of the rapidly converging fast Fourier transform, the availability of commercial Fourier spectrometers, and to a lesser extent, the development of sensitive semiconductor bolometers. The newest installations of Fourier equipment contain their own minicomputers providing real-time display of spectra.

The microwave engineers approached the submillimeter gap from the low frequency side by scaling down their cavity resonator sources or by using high harmonics of magnetrons and crystals. The French microwave engineers use carcinotrons at frequencies as high as 1000 GHz and the Russian scientists use backward-wave tubes in the range of about 50–1000 GHz. Many Japanese and European scientists have preferred to use the water-vapor and hydrogen-cyanide lasers which provide considerably more power in several CW monochromatic emission lines. Their work is reminiscent of the efforts of early microwave engineers who had only a few frequencies available from their klystrons. The North Americans have tended recently to favor the optically pumped lasers as described by Chang in the first paper because they provide additional emission frequencies with less noise and higher power.

Laser-pumped tunable sources of radiation have been pursued by several groups so vigorously that there are at least four different systems that provide useful power that can be tuned over a useful submillimeter range.

Among the emerging applications of submillimeter waves is the measurement and study of cosmic and atmospheric phenomena and the interaction of submillimeter radiation with plasmas. Electron plasma studies have been revitalized by the renewed interest in thermonuclear plasmas and the recent construction of Tokamak machines for the containment of high-density plasmas. Submillimeter waves are more useful for high-density plasma diagnostics than microwaves or millimeter waves.

Several semiconductor and antiferromagnetic phenomena can be studied only at submillimeter wavelengths. These include electron–phonon coupling, shallow bound states in semiconductors, energy band measurements in low-mobility semiconductors, antiferromagnetic resonance, and localized spin-wave modes.

This revolution in submillimeter and far infrared techniques and applications marks the end of the scientific development of the electromagnetic spectrum that began with the statement of Maxwell's equations 110 years ago. This last unused region of the spectrum will provide submillimeter wave engineers with fewer and fewer significant challenges of ever decreasing interest if the pattern of development follows that of the other discrete ranges of the spectrum. At this point in time, however, there is the familiar excitement of an emerging technology that all