Foreword

PART II: SOURCES BASED ON RELATIVISTIC ELECTRON BEAMS

At the first conference in this series which was held in Atlanta, GA, in the spring of 1974, our group at the Naval Research Laboratory (NRL) reported an initial observation of strong submillimeter radiation from an intense relativistic electron beam. In a conference that was dominated by discussions of molecular laser sources, this was the only paper describing a source based on relativistic electron beams.

Thus, when Ken Button, the Program Chairman, asked us to organize a complete session on submillimeter-wave sources based on relativistic electron beams for the second conference, we approached the task with some skepticism. It was clear that research activity on this topic had indeed increased, but still, to go from a single paper to a complete session in a two-year span seemed to be a tall order. However, when we began to enumerate the various groups that had become involved in this type of research we found that the list was impressive. In addition to the work at NRL, research on submillimeter radiation from relativistic electron beams was in progress at a number of other institutions including Columbia University, Cornell University, Dartmouth College, Stanford University, University of California at Irvine, École Polytechnique (France), and the Gorky State University (USSR).

We were able to organize two sessions, the first being composed of tutorial papers, and the second containing 15 invited papers describing recent research results. A précis of these presentations is to be found in the Conference Digest (IEEE Cat. No. 76 CH1152-8 MTT).

The papers presented generally fall into two broad categories. First, a number of imaginative schemes have been described for using the unique properties of pulsed relativistic e beams with large peak power. Secondly, a group of papers described work on the cyclotron maser or gyrotron which involves a relativistic instability but typically e beams of more modest power. Representative of the existing capabilities established by these two streams of investigation are the measurement of 1 MW of peak power at $\lambda = 400\ \mu$m from a 50-ns pulsed intense beam, and the demonstration of a gyrotron producing 1.5 kW of CW power at $\lambda = 900\ \mu$m.

The cyclotron maser (gyrotron) work is the more mature, and has progressed from basic research to a stage of advanced development. These proceedings begin with three papers on the cyclotron maser, including two survey papers, one by Soviet workers and the other by American workers. The third paper by Sprangle and Drobot describes a self-consistent nonlinear theory of the cyclotron maser, and constitutes a definitive work on the subject. It is a paper of greater length than is usually found in journals; however, we regard it as a major contribution to the understanding of a very important new class of millimeter and submillimeter-wave sources, and accordingly, have decided to publish it in unabridged form.

The work with powerful pulsed relativistic e beams is still very much in the nature of basic research, and its variety is well represented by the remaining six papers in these proceedings. The survey paper, "Mechanisms for coherent scattering of electromagnetic waves from relativistic electron beams," attempts to encompass a large portion of this work in a single framework. The remaining five papers describe initial results of vigorous research projects which are currently in progress.

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