MASTER**EXPERIMENTAL TEST OF RESONANT ABSORPTION THEORY**

Progress Report
for Period April 1, 1978 - June 30, 1978

Eli Yablonovitch

Harvard University
Cambridge, Massachusetts 02138

292 9000

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed or represents that its use would not infringe privately owned rights.

July 1978

Prepared For

THE U. S. DEPARTMENT OF ENERGY
UNDER CONTRACT NO. ED-78-S-02-4631

EB

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Abstract

In this progress report we discuss the engineering of the shock tube design and the shock front detection/laser synchronization system.

Progress Report

In the last three months significant advances have been made towards the final deployment of the laser-shock front interaction experiment. These have come in the engineering of the shock tube and of the shock front detection/laser synchronization system.

The original large (1" i.d.) shock tube has evolved into a smaller (1/2" i.d.) more efficient design. The engineering of the electric discharge system has been essentially completed; the result is that the tube can produce shock waves of Mach number $M = 9.0$ in 40 torr of Ar, N_2 , H_2 , and, presumably, in any other gas. Reproducibility of the shock velocity is better than 5%; this is quite adequate. With a new discharge capacitor (presently on order), the tube will be capable of generating reproducible shocks in the range $M \leq 10.5$, several times a minute. The outstanding problem is that of electrode sputtering, which darkens the glass tube, interfering with the shock front detection system. With a new electrode material, however, this problem should be easily overcome.

The shock front detection system is in the final stages of engineering. The concept of the system is illustrated below: as the shock front moves past the laser beam, it deflects some of the laser light past the knife edge into the photodetector. The major problems

Before arrival of
shock front

encountered in perfecting this system have been choosing an appropriate photodetector and designing a noise-free, fast amplifier for it. The knife edge is positioned so as to allow a certain fraction of the laser beam to strike the detector in the absence of a shock. This d.c. background level generates shot noise which may easily overwhelm the shock signal. A certain amount of experimentation was required to find the shock signal and establish that a silicon photodiode is more appropriate to the task than a photomultiplier. The diode and its following amplifier are enclosed in a small aluminum box for electrical shielding. The problems of amplifier noise and stray light rejection have been resolved. Present measurements indicate shock signal characteristics as follows:

pulse height: 10 V (shot-to-shot reproducibility < 5%)

pulse rise time: < 40 nsec

noise: < 100 mV

The specifications will be obtainable for all conceivable experimental conditions and will allow synchronization of the laser pulse and the shock front with jitter of only tens of nanoseconds.