EXPERIMENTAL TEST OF RESONANT ABSORPTION THEORY

Progress Report for Period January 1, 1978 - March 31, 1978

Eli Yablonovitch

Harvard University Cambridge, Massachusetts 02138

The report was prepared at an account of most spontaneal by the Linned Scans Government Newber the Linned States Government Newber the Linned States Department of Energy, are any of these mystoyees, not say of their continuously, substances, partners of explan or supplied, or alternate my fegal limiting or responsibility for the accuracy, complementary in understance, approximate the protection decisions, are experiently that six was would not nigrate formatify owned uplus.

#### NOTICE

This report was prepared as an account of work sponsored by the United States Covernment. 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.

April 1978

Master

Prepared For

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



## 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

We report the initial progress in studying the interaction of an ultrashort CO, laser pulse with an overdense shock front.

### Progress Report

Our efforts in the first phase of this experiment are directed at the reliable production and detection of a strong (Mach number ca. 10) shock wave in D<sub>2</sub> gas. For ease of operation and electronic synchronization, we use a capacitive-discharge electrothermal shock tube rather than the diaphragm type. We have measured the dependence of shock speed on such parameters as charging voltage and fill pressure.

Shock waves have been detected by two means. In the first the moving shock front reflects a HeNe laser beam ( $\lambda$  = .633 µm) into a photomultiplier tube as it passes through a section of the shock tube. This method has rather small signals, since the reflection coefficient of the shock front is typically on the order of  $10^{-3}$ . Nevertheless, the reflectivity as a function of angle gives important information about the density profile of the shock.

The most vital technical constraint of this experiment is the need to synchronize the 500 psec CO<sub>2</sub> laser pulse with the fast-moving shock. In order to provide a strong and fast synchronization signal, a second method is used. It relies on the fact that light rays in a probe laser beam are deflected towards regions of higher optical density behind the shock front, and thus may strike a photomultiplier as the shock front passes through the probe beam. This technique produces a

strong signal, since it happens that a significant fraction of the laser beam intensity is deflected into the photomultiplier by the passing shock front. In fact, the signal is so strong that it appears that all shock waves that we might contemplate producing in this experiment will be detectable. This method is also rather insensitive to angular misalignments of the laser beam with respect to the shock tube, and to displacements of the knife edge.

Displaying a pair of probe beams a fixed distance apart on an oscilloscope, we have measured the Mach numbers of shocks in argon, nitrogen, helium and hydrogen.

Very shortly the engineering of shock wave production and detection will be finished, and we will move on to the real business of studying the interaction of the shock front and an intense pulse of infrared laser light.