EXPLORATORY STUDY OF METAL VAPOR LASERS
OPERATING IN THE ULTRA-VIOLET AT KILOWATT
POWER LEVELS

Technical Progress Report
for Period June 1, 1975 - May 1, 1976

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I. Proposed Research

We proposed: one, to find new laser systems in the wavelength region between 2000 and 4500 Å; two, to attempt scaling our lasers to high output power; and finally to focus our research to metal vapor laser systems which have the promise of high efficiency (=1%).

II. Results to Date

A. New Laser Systems

We have observed 28 new laser transitions from Cu II spanning the wavelength region from 2486 - 7988 Å.

The four ultraviolet transitions of Cu II represent the lowest cw laser transitions currently available and the first cw laser transitions below 3000 Å.

Our results are summarized in the following papers and conference proceedings:

Papers

1. Appl. Phys. Letters 27 595 (1975).
2. Appl. Phys. Letters 28 207 (1976)

Conferences

1. VI Winter Colloquium on Laser Induced Chemistry, February 1976 held at Steamboat Springs, Colorado. "Cw Cu II Laser at 2500 Å".

B. Scaling to High Output Power

We have established a cooperative research program with NBS (Boulder) in order to scale the lasers we have developed at CSU.

Our preliminary results are described in the attached conference paper.

Conferences

2. 28th Annual Gaseous Electronics Conference held in Rolla, Missouri, October, 1975. "High Power Cu II Laser".

C. High Efficiency Lasers

We have measured the cross-section $\text{He}^+ + \text{Hg} \rightarrow (\text{Hg}^+)^* + \text{He} + \Delta E$, where ΔE represents the energy defect, and found $\sigma(\text{He}^+ - \text{Hg})$ to be $1.3 \times 10^{-14} \text{ cm}^2$. This cross-section is among the largest measured in atomic physics and promises to deliver a Hg^+ laser with system efficiencies approaching 1%.

This work is summarized in the following publications and conference proceedings.

Papers

3. Appl. Phys. Letters 27 610 (1975).

Conferences

3. Second Summer Colloquium on Electronic Transition Lasers held at Woods Hole, MA, September, 1975, "The He-Hg^+ Laser".
4. 28th Gaseous Electronics Conference held at Rolla, Missouri, October 1975 "Charge-Transfer Cross-Sections".

III. Research During Remainder of Contract May 1, 1976 - July 31, 1976

A. New Laser Systems

We will investigate the He-Ag⁺ system looking for new laser transitions.

B. Scaling to High Power

In cooperation with NBS (Boulder) we will construct a hollow cathode Cu II laser with output powers of 1 watt, thereby demonstrating a high power ion laser competitive with present rare-gas ion lasers.

C. High Efficiency Studies

No further experimental work will be conducted. However, in the proposed research for next year (August 1, 1976 - July 31, 1977), we propose to measure $\sigma(\text{He}^+ - \text{Cu})$, $\sigma(\text{Ne}^+ - \text{Cu})$ and $\sigma(\text{He}^{\text{M}} - \text{Cu})$. These measurements are required in order to determine the overall system efficiency of the Cu II laser.

IV. Effort of Principle Investigator

Two full months of ERDA support and one month of CSU support for a total of 25% of my time.

V. Summary of Publications and Conference Papers

Papers

1. Appl. Phys. Letters 27 595 (1975)
2. Appl. Phys. Letters 28 207 (1976)
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Conferences

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