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STUDIES OF DISCHARGE EXCITED ORGANIC VAPORS FOR
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EFFICIENT LASER--ETC(U)
DAH04-75-G-0095

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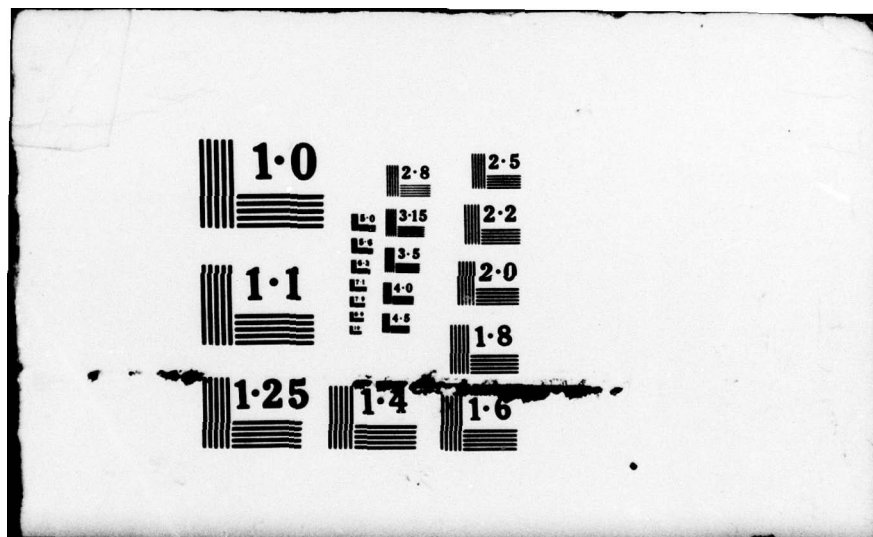
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STUDIES OF DISCHARGE EXCITED ORGANIC
VAPORS FOR EFFICIENT LASER EMISSION.

FINAL REPORT.

T. K. Gustafson

1 FEBRUARY 1975 - 30 SEPTEMBER 1978

30 Sep 78

U. S. ARMY RESEARCH OFFICE

DAHCO4-75-G-0095

DAHCO4-75-G-0095

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Studies of discharge excited organic vapors for efficient laser emission		5. TYPE OF REPORT & PERIOD COVERED final 2/1/75 - 9/30/78
7. AUTHOR(s) T. K. Gustafson		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS Electronics Research Laboratory University of California Berkeley, CA 94720		8. CONTRACT OR GRANT NUMBER(s) G DAHCO4-75-G-0095
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Research Office Post Office Box 12211 Research Triangle Park, NC 27709		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE
		13. NUMBER OF PAGES
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE NA
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) NA		
18. SUPPLEMENTARY NOTES The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) dye vapor laser density matrix nonlinear optics mode-locked dye lasers		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The areas of dye vapor lasers, diagrammatic calculations of the density matrix and mode-locked flashlamp dye lasers have been pursued. The various results which have been obtained are summarized.		

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The basic problems studied on this grant were: the possibility of obtaining dye vapor laser action, the diagrammatic analysis of the density operator for the derivation of nonlinear optical susceptibilities, and the generation of organic dye laser mode-locked pulses.

The organic dye vapor work related to the radiative excitation of one species followed by an energy transfer to a second species, the transfer being detected by the fluorescence of the latter. A ten percent conversion efficiency was observed in a transfer from pyrene to perylene. Based upon these experiments it was believed that a discharge excited transfer laser was possible with a fair efficiency.

The diagrammatic work has lead to a specific and simple classification of perturbative non-linear optical effects and an evaluation of the nonlinear polarizations according to well established rules. A single diagram for each term of the density matrix is obtained, although it has been shown that several diagrams can contribute to one particular nonlinear effect. For certain approximations several diagrams which have a time-ordering relationship can be combined into a single one. This has in the past given rise to discrepancies in the definition of nonlinear optical susceptibilities. Further advantages to be gained by these double-sided Feynman graphs include the simplicity with which damping and Doppler effects can be included, the ease with which results pertaining to a quantized radiation field can be obtained and the simplicity with which transition rates can be obtained.

In a third phase of the work we have been constructing a mode-locked flash-lamp pumped dye laser in order to investigate certain nonlinear terms which have been predicted on the basis of the diagrammatic analysis.

The flashlamp pumped dye laser operates in the simmer mode and is pre-pulsed in order to increase efficiency and to increase the power out of the laser.

Students Supported on the ARO Grant

Bunsen Fan	Ph.D
Steven Yee	Masters, will obtain Ph.D. 1979
Timothy Ryan	Ph.D
Robert Davovdzadeh	Masters
M. Quedes	Will obtain a Ph.D. in 1979

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Publications Pertaining to the Above

- [1] S. A. J. Druet, B. Attal, T. K. Gustafson and J. -P. Taran, "Electronic Resonant Enhancement of Coherent Anti-Stokes Raman Scattering," Phys. Rev. A, 18, 1529 (1978).
- [2] T. K. Yee and T. K. Gustafson, "Diagrammatic Analysis of the Density Operator For Nonlinear Optical Calculations: Pulsed and C. W. Responses," Phys. Rev., 18, No. 4 (1978).
- [3] C. T. Ryan and T. K. Gustafson, "Vapor Phase Excitation Transfer from Pyrene to Perelene," Chem. Phys. Lett., 44, 241 (1976).
- [4] T. K. Yee, B. Fan and T. K. Gustafson, "A Reliable Simmer-Enhanced Flashlamp-Pumped Dye Laser," submitted to Applied Optics.

Other Publications Carried Out While on ARO Support

- [1] D. P. Siu and T. K. Gustafson, "Coherent Coupling of Radiation to Metal-Barrier-Metal Structures By Surface Plasmons," Appl. Phys. Lett., 31, 71 (1977).