

CONF-850558--2

DE85 012883

CONF-850558-2

INFRARED GENERATION AND WAVE-MIXING STUDIES IN CESIUM

Wolfgang Christian,¹ J.A.D. Stockdale, Adila Dodhy, and R. N. Compton

Oak Ridge National Laboratory

Oak Ridge, Tennessee 37831, U.S.A.

Telephone (615) 574-6239

For Presentation at the Conference on Lasers and Electro-Optics

Baltimore, Maryland, May 21-24, 1985

**Research sponsored by the Office of Health and Environmental Research,
U.S. Department of Energy under contract DE-AC05-84OR21400 with the
Martin Marietta Energy Systems, Inc.**

¹Physics Department, Davidson College, Davidson, North Carolina 28036

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.

By acceptance of this article, the publisher or recipient acknowledges the U.S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering the article.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Infrared Generation and Wave-Mixing Studies in Cesium

W. Christian,¹ J.A.D. Stockdale, Adila Dodhy, and R. N. Compton

Chemical Physics Section

Oak Ridge National Laboratory

Oak Ridge, Tennessee 37831, U.S.A.

Telephone (615) 574-6238

Abstract

A Nd-YAG pumped dye laser and heat pipe has been used to investigate stimulated infrared production, wave mixing, and ionization in cesium vapor near the one-photon resonant $7P_{1/2,3/2}$ fine structure states.

This research was sponsored by the Office of Health and Environmental Research, U.S. Department of Energy under contract DE-AC05-84OR21400 with the Martin Marietta Energy Systems, Inc.

¹Physics Department, Davidson College, Davidson, North Carolina 28036.

Infrared Generation and Wave-Mixing Studies in Cesium

W. Christian,¹ J.A.D. Stockdale, Adila Dodhy, and E. N. Compton

Chemical Physics Section

Oak Ridge National Laboratory

Oak Ridge, Tennessee 37831, U.S.A.

Telephone (615) 574-6238

Summary

A Nd-YAG laser (Quanta Ray DCR-II) and dye laser (Quanta Ray PDL-I) have been used in combination with a Cs heat-pipe oven (70 cm length, 3 cm diam) to probe tunable infrared generation by stimulated electronic Raman scattering (SERS) and to examine wave-mixing processes in which SERS photons are combined with the input laser frequency. In addition, we have made simultaneous ionization measurements using an insulated collection wire through the heat pipe parallel to the laser beam. Cesium pressures were in the region from 5 to 12 torr; average input power during the ~5 ns laser pulses was 2×10^6 W at the dye peak near 460 nm. The region chosen for examination in this study was that surrounding the Cs $7P_{1/2,3/2}$ fine structure states. Previous studies in this region at lower power have been reported by Cotter and Hanna² and by Wynne and Sorokin³.

Figures 1 and 2 show infrared and total red emission intensities, respectively, over the input (blue) pump wavelength range from 445 to 470 nm. In Fig. 1, in addition to the SERS emission which appears on either side of each of the $7P$ fine structure resonances at 459.4 ($7P_{1/2}$) and 455.7 nm ($7P_{3/2}$), there are a number of other features. These will be discussed in the paper. The total red emission spectrum largely corresponds to wave

Infrared Generation in Cs

mixing of the form $\omega_L - 2\omega_s$, as described by Wynne and Sorokin,³ where ω_L is the input laser frequency and ω_s is that of the corresponding SERS photon. When the laser is tuned to either of the 7P states, forward directed green emission is observed but not presently understood. Scans of multiphoton ionization intensity over this region show minima at the fine structure resonance positions at low laser power and a transition to broad ionization continua peaking at the resonance positions at high power. The influence of SERS emission on multiphoton ionization will be discussed.

This research was sponsored by the Office of Health and Environmental Research, U.S. Department of Energy under contract DE-AC05-84OR21400 with the Martin Marietta Energy Systems, Inc.

References

1. Physics Department, Davidson College, Davidson, North Carolina 28036.
2. D. Cotter and D. C. Hanna, *J. Phys B* 9, 2165 (1976).
3. J. J. Wynne and P. P. Sorokin, "Nonlinear Infrared Generation" (Y-R Shen, Ed.), *TOPICS IN APPLIED PHYSICS*, 16, 159, Springer Verlag, Berlin and New York (1977).

Infrared Generation in Cs

Figure Captions

Fig. 1. Infrared emission intensity vs pump laser wavelength. The cesium $7P_{1/2}$ fine structure resonance is at 459.4 nm; the $7P_{3/2}$ at 455.7. The major peaks on either side of the 459.4 nm position and the two smaller peaks immediately to either side of the 455.7 nm position are produced through the stimulated electron Raman scattering process.

Fig. 2. Total red emission intensity vs pump laser wavelength.

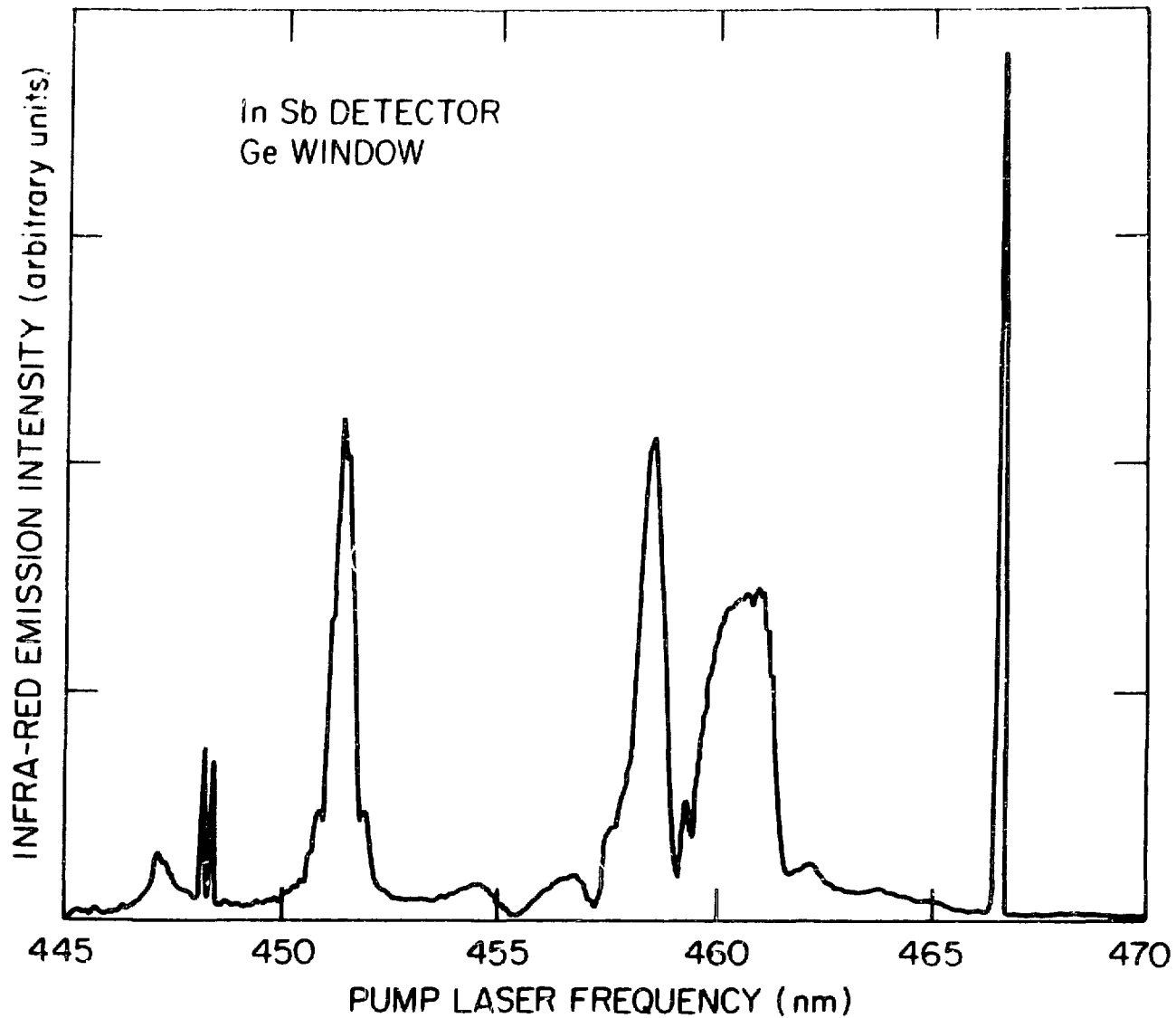


Fig. 1
Stockdale

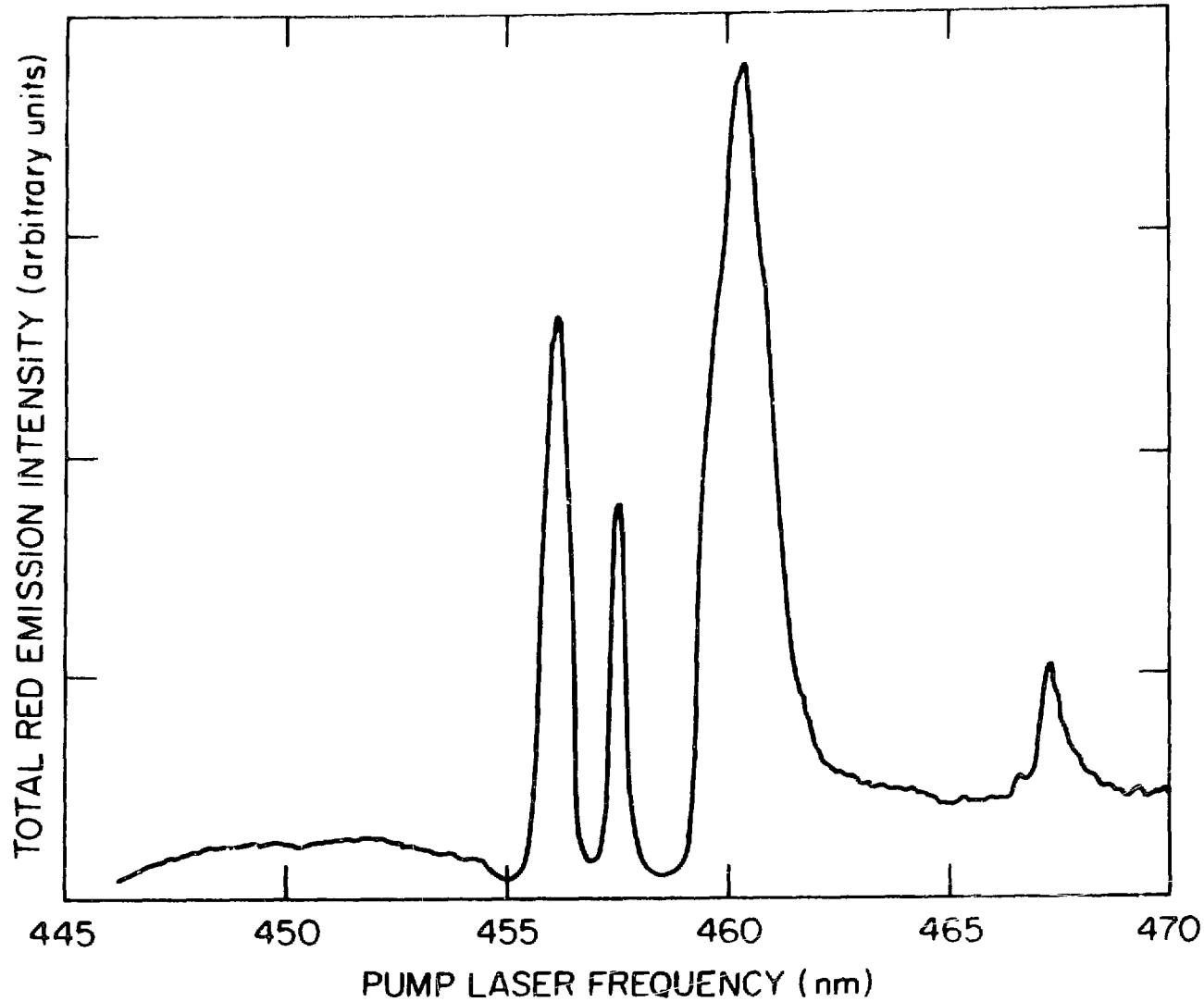


Fig. 2
Stockdale