

This Week's Citation Classic

Taylor R L & Bitterman S. Survey of vibrational relaxation data for processes important in the $\text{CO}_2\text{-N}_2$ laser system. *Rev. Mod. Phys.* **41**:26-47, 1969. [Avco Everett Research Laboratory, Everett, MA]

This paper reviews the data in vibrational energy transfer rate constants for the $\text{CO}_2/\text{N}_2/\text{H}_2\text{O}$ molecular system with particular emphasis on processes important for the CO_2 laser. In most cases comparison of the data with theory is made. Suggested best fits to the data are given. [The **SCI**[®] indicates that this paper has been cited over 275 times since 1969.]

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"This work was performed and published while the authors were with the Avco Everett Research Laboratory, Inc. The mid-1960s were a particularly exciting period for research at Avco. The high energy CO_2 gas dynamic laser (GDL) was invented and demonstrated during that time. This breakthrough was an important milestone in the development of laser technology from a laboratory curiosity into many exciting commercial and military applications.

"There were several technical reasons why this breakthrough took place at Avco at this particular time. One fact was the availability at Avco of a large amount of data on the mechanism and kinetics of molecular energy transfer. For several years I had been studying vibrational energy transfer processes important in the wakes of re-entry vehicles. This work was motivated by our interest in the infrared signatures of such wakes. When interest in the CO_2 GDL arose, it was immediately apparent that the $\text{CO}_2/\text{N}_2/\text{H}_2\text{O}$ molecular system, being studied in the wake, was also of interest for the laser. Thus, all the kinetic

rates that we had been gathering to model the wake would allow us to understand and model the laser. In a short time, I became the

in-house laser 'Kinetics Expert' and have continued to devote most of my research effort since that time to understanding the detailed kinetics of various laser devices.

"After several years I realized that we had assembled a large amount of kinetic data on the CO_2 laser system. Some was the result of our own measurements, but most of it was the work of others that we had assembled and critiqued, often with the assistance of theory. I recognized that this data base represented a significant advance in its own right and would certainly be useful to other workers in the field.

"The major problem in publishing this work was obtaining the required approvals. Avco was concerned about the competitive disadvantage of having the survey published; the government was concerned with classification even though most of the data already existed in the open literature. It was over two years from the initial inception of the idea until the article was approved and accepted.

"Clearly, the major reason why this article has been so highly cited is the fact that it appeared at an early and critical time in the development of the CO_2 laser. Although developed for the CO_2 GDL, the results are equally applicable to the CO_2 electric discharge laser. In addition, the results have also been applied to radiative transport and energy balance problems in the atmosphere.

"The field of molecular energy transfer received considerable impetus because of laser device development. Today there are a number of other surveys of energy transfer which provide a better physical (theoretical) laser for the experimental result(s).^{1,2} However, the basic kinetic results of our survey are still valid and are widely used by the laser community."

1. Taylor R L. Energy transfer processes in the stratosphere. *Can. J. Chem.* **52**:1436-51, 1974.
2. Ormonde S. Vibrational relaxation. *Rev. Mod. Phys.* **47**:193-258, 1975.