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STUDY OF THE INTERACTION OF ELECTRO-  
MAGNETIC RADIATION WITH MATTER

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## MODR WITH A CW DYE LASER

A cw dye laser has been constructed which meets all of our requirements for microwave optical double resonance spectroscopy. The laser is sufficiently stable, monochromatic, tunable and powerful. A vacuum flow system for production of metal oxides and halides has been constructed and tested. This system is similar to those in use in the Broida labs and is useful for studying the chemiluminescence and laser photoluminescence of any of the alkaline earth oxides and halides. A reliable microwave sweep system has been assembled which will enable us to search for new microwave transitions and to accurately measure the transition frequencies. We have tested the three components of the MODR system on several transitions of BaO and are prepared to move in the following directions:

1. MODR on new molecules: CaF and CaCl.
2. Stark effect measurements of excited state electronic dipole moments with BaO as test case and future calibration of electric field strength.
3. Photoluminescence spectroscopy to obtain unknown spectroscopic constants for several of the alkaline earth oxides and halides.

4. MODR on polyatomic molecules such as  $\text{NO}_2$  and  $\text{HNO}$ .
5. Continuing investigation of the physical origin of the MODR signal - understand signal strength and linewidths.

A supersonic beam has been constructed for a series of experiments involving the  $A^1\Pi$ ,  $d^3\Delta$ , and  $e^3\Sigma^-$  excited states of  $\text{CO}$ . A beam of rotationally cooled molecules is optically pumped in a region to which intense magnetic and electric fields can be applied while fluorescence intensity is monitored. This experiment will measure excited state electric and magnetic dipole moments, radiative lifetimes of single rotational levels, and spin-orbit mixing of excited states. The vacuum system is completed and initial experiments using an effusive rather than supersonic beam are expected to begin in the Spring quarter.

## ULTRASONIC IMAGING

Since September of 1972 the research work being funded by the UCSB Quantum Institute has been a continuation of two previously begun and closely related projects involving ultrasonic imaging. One of these, the technique of ultrasonic imaging by Bragg diffraction, we have already shown to be potentially valuable at acoustic frequencies of 15 MHz or more as a method for detecting flaws in optically opaque materials. The present work is directed toward extending the method to lower frequencies (3.6 MHz) for bio-medical imaging purposes and involves the incorporation of a recently purchased Argon laser which greatly increases the sensitivity of the technique. Preliminary results are being obtained and will soon be reported.

The second project is not yet operational. It involves a so-called Pohlman acousto-optic conversion cell which will be used in conjunction with either acoustic lenses or a spherical reflector. The acoustic lenses have been completed and a 6 inch diameter brass spherical reflector has been fabricated. Some results are expected during the Spring Quarter which will indicate the relative merits of the acoustic lenses vs. the reflector as image-forming components for the technique. This work is also being carried out at lower acoustic frequencies to enable its use for bio-medical purposes.

## PUBLICATIONS

1. "On the Effective Spin-Spin Constants of Some States of Diatomic Molecules. Application to the CO Molecules," Robert W. Field and H. Lefebvre-Brion. Submitted for publication to Acta. Physica Hungarica Journal.
2. "The Valence States of  $\text{NO}^+$ ," Robert W. Field. Submitted for publication to J. of Molec. Spectroscopy.