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RESPONSES TO SUMMARY QUESTIONNAIRE. TRAPPED ION RESEARCH AT HAR--ETC(U)
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REPORT DOCUMENTATION PAGE

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18. SUPPLEMENTARY NOTES

Responses to Summary Questionnaire. Trapped Ion Research at Harvard University and Proposed Research at the University of Virginia.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Trapped ions, frequency standards, precision spectroscopy, negative ions, photodetachment.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The trapped ion apparatus has been assembled during the past year and successfully used to study the photodetachment of S_4^- ions. A periodic dependence of the photodetachment cross section on the light frequency was observed for the first time in any atom. The oscillatory structure could be attributed to the excitation of the detached electrons to discrete cyclotron levels in the magnetic field. The experiments so far also indicate that state dependent photodetachment should provide an effective means over

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20. for producing and detecting population differences in certain stored ionic species. Plans are now in preparation for studying the microwave spectrum of S_4^+ with this technique.

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RESPONSES TO SUMMARY QUESTIONNAIRE

TRAPPED ION RESEARCH AT HARVARD UNIVERSITY

AND PROPOSED RESEARCH AT THE UNIVERSITY OF VIRGINIA

1) Contract Description

The new trapped ion apparatus at Harvard will be moved to the University of Virginia. It will be improved and used to study the optical and microwave spectra of suitable negative ions. Atomic and molecular ions suitable for frequency standards will be considered and possibilities for ion cooling to reduce Doppler effects will be investigated.

2) Scientific Problems

Developments of trapping and detection techniques for ions have made them extremely attractive for ultraprecision spectroscopy and for application as frequency standards. Two very substantial problems which at present prevent ready development of trapped ion frequency standards are the difficulty of producing and detecting population differences with large signal to noise and the high temperatures of trapped ions leading to large uncertainties in the second order Doppler shift.

3) Scientific and Technical Approach

Negative ions hold promise, not yet realized, for microwave spectroscopy with large signal to noise since state selective photodetachment provides an effective means for creation of population differences and for detection of changes in state. Various techniques hold promise for ion cooling including interaction with nearly resonant optical radiation.

4) Progress

The trapped ion apparatus has been assembled during the past year and successfully used to study the photodetachment of S^- ions. A periodic dependence of the photodetachment cross section on the light frequency was observed for the first time in any atom. The oscillatory structure could be attributed to the excitation of the detached electrons to discrete cyclotron levels in the magnetic field. The experiments so far also indicate that state dependent photodetachment should provide an effective means for producing and detecting population differences in certain stored ionic species. Plans are now in preparation for studying the microwave spectrum of S^- with this technique.

5) Publications

1. High Resolution Photodetachment Spectroscopy of Stored Negative Ions. W. A. Blumberg, R. Jopson and D. J. Larson. Bul. Am. Phys. Soc. 22, 1324 (1977).
2. Precision Measurement of Atomic Structure in Strong Magnetic Fields. D. J. Larson, Bul. Am. Phys. Soc. 23, 10 (1978).
3. Precision Laser Photodetachment Spectroscopy in Magnetic Fields. W. A. Blumberg, R. Jopson and D. J. Larson, Phys. Rev. Lett. 40, 1320 (1978).

6) Extenuating Circumstances

None

7) Personnel

Faculty: Daniel J. Larson and Norman F. Ramsey.

Graduate Students: William A. M. Blumberg and Robert M. Jopson

8) W. A. M. Blumberg has completed experimental work and analysis for his thesis and is presently writing the thesis.