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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
Cross sections for excited state production in ion-molecule collisions have been measured by observing radiation resulting from decay of the excited species. Recent work involving collisions of He^+ or He_2 with Mg and Zn are discussed.

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He_2^+

Research Summary: ONR Contract No. N00014-76-C-0760

"Potential Laser Action in He-Metal Vapor Mixtures"

Principal Investigator: J. J. Leventhal
Professor of Physics
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1. Contract Description: Experimental studies of energy partitioning among internal states of products of atomic and molecular collisions. Such collision processes can selectively populate excited states, thus producing the population inversion necessary to achieve laser action.

2. Scientific Problem: The most important aspects of this work are to determine the fundamental rules that govern internal energy level selection in molecular collisions. Using the experimental technique developed at UMSL for the study of such processes, specific collision systems can be tested for promise as lasants.

3. Scientific and Technical Approach: The experiments are performed by combining molecular beam techniques with those of emission spectroscopy. A low energy mass selected ion beam is intersected by a thermal energy atomic or molecular beam, and the luminescence from radiative decay of excited species formed in the collision process detected by single photon counting. By scanning the wavelength a collision-produced emission spectrum is assembled. This spectrum directly leads to information on the internal energy states of products of the interaction.

4. Progress: In addition to some important apparatus modifications that were made during the past contract period, detailed studies of interactions between He^+ and He_2^+ ions with Zn and Mg were completed. These studies provided information which is potentially useful for the design and construction of laser devices employing high partial pressure of helium buffer gas. Insights into the operative pumping mechanisms for lasing on ZnII transitions were obtained. This work also showed why laser transitions between MgII levels has not been achieved in He-Mg mixtures.

5. Publications:

G. D. Myers, J. G. Ambrose, P. B. James and J. J. Leventhal, "Spin conservation in electron capture collisions", Phys. Rev. A18, 85 (1978).

G. D. Myers and J. J. Leventhal, "Inelastic collisions of 2-800eV He^+ and He_2^+ with Mg and Zn atoms", Phys. Rev. A (in press).

6. Extenuating Circumstances: None.

7. Personnel: J. J. Leventhal - Principal Investigator
H. H. Harris - Faculty Associate
G. D. Myers - Postdoctoral Research Associate

8. Graduate Students Earning Degrees: Fahrad Ranjbar - Ph.D.