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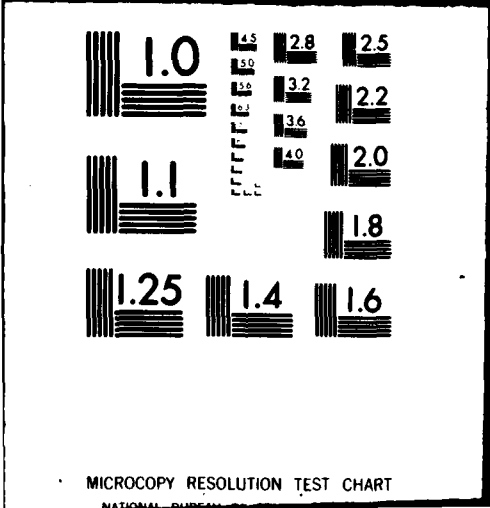
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18. SUPPLEMENTARY NOTES: The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number): dissociative recombination, rare gas molecular ions, mercury molecular ions, electrons, excited states, ion-molecule interactions and reactions, ionic mobilities, excited ionic states, singly charged ions, non-resonant charge transfer, radiative charge transfer, transfer ionization, ion association reactions of laser interest, doubly charged ions.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number): The various electron removal and ion-molecule reactions investigated experimentally under the ARO grant are enumerated. Reports containing the detailed scientific progress of these studies are cited. In addition, a list of the journal articles describing the results of the experimental investigations, together with appropriate citations, is given.

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I. Scope of the Research Program

During the period of this grant, 1/1/77 to 6/30/80, programs of experimental investigations of basic atomic collision interactions and reactions were carried out with the aim of providing fundamental understanding of the nature of plasma processes involving reactive collisions among electrons, ions and neutrals. The long-range goals of these investigations were to advance our knowledge of atomic collision processes relevant to such diverse media as laser plasmas and ionized regions of the earth's atmosphere. On occasion shorter-range goals of supplying specific reaction rate data (for example, such as needed for modelling new classes of lasers under development) was provided by our studies.

The topics investigated during the course of the grant include the following:

A. Electron removal processes

1. Dissociative recombination for rare gas and mercury diatomic ions
 - a) Total rate coefficient variation with electron temperature
 - b) Excited states produced by the recombination

B. Ion-molecule interaction and reaction processes

1. Ionic mobilities - singly and doubly charged rare gas ions
 - a) Effect of ionic state on mobilities, e.g. $\text{Ne}^{++}(^3P, ^1D \text{ or } ^1S)$ in Ne
2. Fast non-resonant charge transfer - singly and doubly charged ions
3. Radiative charge transfer - singly and doubly charged ions
4. Transfer ionization
5. Association reactions of singly and doubly charged rare gas ions
6. Reactions of specific laser interest

The results of these studies have been fully described in the seven semi-annual technical progress reports produced under the grant and appear in the general literature in the journal publications listed in the next section.

II. Publications under the present grant

The results of the various researches categorized in the previous section have been described in a number of journal articles. The following list gives the title, authors and journal reference for these papers. Reprints are available on request.

"Measurements of radiative charge transfer reactions of doubly- and singly-charged rare gas ions with rare gas atoms at thermal energies", Rainer Johnsen and Manfred A. Biondi, Phys. Rev. A 18, 996 (1978).

"Mobilities of doubly charged rare gas ions in their parent gases", Rainer Johnsen and Manfred A. Biondi, Phys. Rev. A 18, 989 (1978).

"Thermal-Energy Charge Transfer, Quenching and Association Reactions of Doubly Charged Ions in the Rare Gases", Rainer Johnsen and Manfred A. Biondi, Phys. Rev. A 20, 87 (1979).

"Mobilities of singly and doubly charged rare gas ions in helium and in neon", Rainer Johnsen and Manfred A. Biondi, Phys. Rev. A 20, 221 (1979).

"Three-body association reactions of He^+ , Ne^+ and Ar^+ ions in their parent gases from 78 K to 300 K", Rainer Johnsen, Aikwo Chen and Manfred A. Biondi, J. Chem. Phys., to be published (August 1980).

"Charge transfer of atomic and molecular rare-gas ions with mercury atoms at thermal energy", Rainer Johnsen and Manfred A. Biondi, J. Chem. Phys., to be published (August 1980).

"Ion-molecule reactions of He^+ , Ne^+ , N^+ , N_2^+ , N_3^+ , and N_4^+ ions with Hg atoms and Hg Br₂ molecules at thermal energy, Rainer Johnsen and Manfred A. Biondi, J. Chem. Phys., to be published (August 1980).

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