**Laboratory Studies of Atomic Collision Processes**

The various electron and ion collision processes investigated under the ARO grant are enumerated. A list of the journal articles describing the results is given.

- Dissociative recombination, electronics, ions, ion-molecule reactions, ion-ion recombination, high-pressure recombination.
I. Scope of the Research Program

During the grant period, 11/1/83 to 1/31/87, we have carried out experimental investigations of basic atomic collision processes involving ions, electrons and neutrals in gaseous plasmas. Data of this kind are required for such purposes as model calculations of high-power laser plasmas, fast switches and ionized regions of the earth's ionosphere.

Accomplishments during the past report period:

A. Measurements of the electron-ion recombination of complex ions in plasmas at moderate gas pressures (10 to 20 Torr).

1. Dissociative recombination of O$_2^+$ ions with electrons as a function of electron temperature.
2. Development of computer codes to describe electron-energy gain and loss processes in plasmas heated by microwaves, including effects of inelastic collisions with molecules and spatially non-uniform fields.

B. Studies of atomic collisions in plasmas at high neutral densities

1. Development of the rf-conductivity method to determine electron and ion densities in plasmas at atmospheric neutral densities. Development of mass-spectrometric techniques to analyze the ion composition of plasmas at high neutral densities.
2. Measurements of electron-ion recombination for several ionic species in atmospheric density helium plasmas.
3. Development of computer codes to describe the decay of photo-ionized plasmas in a high-neutral-density environment.
4. Measurements of the pressure dependence of positive ion-negative ion recombination over the range from a few hundred Torr to 2 atmospheres.

C. Studies of ion-molecule reactions

1. Measurements of the temperature dependence of the first and second steps in the clustering reactions of H$_2$CN$^+$ ions with HCN.
II. Publications during the present grant period
(reprints available on request)

2. "Recent advances in in high pressure Swarms", R. Johnsen and H.S. Lee, in "Swarm studies and inelastic electron-molecule collisions" (edited by L.C. Pitchford et al., Springer 1987)
5. "Clustering reactions of H2CN+ ions with HCN", B.K. Chatterjee and R. Johnsen (to be submitted to J. Chem. Phys.)

III. Participating Scientific Personnel

Faculty: M.A. Biondi
         R. Johnsen
Graduate Students: J.L. Dulaney (Ph.D. 1986)
                  S. Dheandhanoo (Ph.D. 1984)
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