

## II. MOLECULAR COLLISIONS\*

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### RESEARCH OBJECTIVES

We are concerned primarily with molecular collision processes at thermal energies, which are studied mainly in molecular beam scattering experiments. Some areas in which work is being done are the following.

1. Study of long-lived complexes formed in a single binary collision.
2. Study of the effect of rotational or vibrational excitation on one-step chemical reactions in crossed beams.
3. Molecular beam studies of the reactive, elastic, and inelastic scattering of electronically excited atoms.
4. Investigation of the He-H<sub>2</sub> anisotropic intermolecular potential, both theoretically and in total scattering cross-section measurements.

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### A. EVIDENCE FOR LONG-LIVED COMPLEXES IN ADDITIONAL SYSTEMS

In Quarterly Progress Report No. 87 (pages 1-3) we reported the results of some crossed molecular beam scattering experiments that demonstrate the existence of long-lived collision complexes in single collisions of alkali-metal atoms with several oxygen-containing molecules. Analysis of additional experiments has provided evidence for long-lived complexes in collisions of K with O<sub>2</sub> and NH<sub>3</sub>. Results have also been obtained for the scattering of K by Benzene molecules which show that the cross section for complex formation in this system is too small to be detected in our experiments. Long-lived complexes of K and Benzene have been suggested as an explanation of especially large values for spin relaxation cross sections of Rb in Benzene.<sup>1</sup>

Computer programs have been written to calculate the distributions of inelasticity and the angular distributions in these experiments from a statistical theory similar to that of Light and his co-workers.<sup>2</sup> Since only rotational excitation is possible in many of our experiments, this comparison should be an especially stringent test of this

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\*This work is supported in part by the Joint Services Electronics Programs (U.S. Army, U.S. Navy, and U.S. Air Force) under Contract DA 28-043-AMC-02536(E).

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theory. Preliminary results indicate that curves calculated by using this theory can be made to fit our results within the experimental error, with the adjustment of only one parameter. A communication summarizing some of the early conclusions from this work will appear in the Journal of Chemical Physics.<sup>3</sup>

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References

1. R. J. McNeal, J. Chem. Phys. 40, 1089 (1964).
2. P. Pechukas, J. C. Light, and C. Rankin, J. Chem. Phys. 44, 794 (1966) and references contained therein.
3. D. O. Ham and J. L. Kinsey, J. Chem. Phys. (to appear in the January 15, 1968 issue).