Charge Transfer Collisions in Ionospheres, Exospheres, and Interstellar Clouds

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The ionization potentials of $O(^3P_1)$ and H atoms are equal to within the current experimental uncertainty. This means that the charge transfer reactions

$$O + H^+ \leftrightarrow O^+ + H$$

have very large cross sections in both directions, and thus play central roles in interactions with the solar wind and atomic escape in the exospheres of Venus, Earth, and Mars, as well as in interstellar clouds. We are performing *ab initio* electronic structure calculations [1] and quantum mechanical coupled channels calculations, including spin-orbit coupling, of differential and momentum transfer cross sections for charge exchange and fine structure excitation in this system. The work builds on previous theoretical [2–5] and photodissociation spectroscopy studies [3,6] of the OH^+ molecule and parallels our previous calculations on collisions of O^+ with O [7,8]. For several transitions, collision mechanisms based on curve crossings have been identified. The results indicate that long range coupling terms in the OH^+ potentials (internuclear distances of 10–15 a_0) contribute to the cross sections.

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