A Physico-Chemical Model for Recent Comets

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To understand the important physical and chemical processes that operate in cometary atmospheres (comae), modeling the relevant physico-chemical processes is required. Photochemistry is a major source of ions and electrons that further initiate key gas-phase reactions, leading to the plethora of molecules and atoms seen in comets. The effects of photoelectrons that react via electron impact reactions are important to the overall ionization for moderate to high production rate comets. The relevant physico-chemical processes are identified within a global modeling framework to understand observations and *in situ* measurements of comets and to provide valuable insights into the intrinsic properties of their nuclei.

Details of these processes are presented in the collision-dominated, inner coma of recent comets (including 9P/Tempel 1, 19P/Borrelly, and Machholz); including thermodynamics (e.g., temperature and velocity structure) and photo- and gas-phase chemistry (e.g., composition, gas and electron energetics) throughout this inner region. Prior model results have successfully accounted for the comet Halley water-group composition [1], *in situ* measurements of the PEPE instrument onboard the Deep Space 1 Mission to comet Borrelly [2], S_2 in comet Hyakutake [3], and observations of C_2, C_3, CS, and NS in comet Hale-Bopp [4, 5]. This extensive modeling effort to investigate these important cometary processes is highly relevant to ground-based observations of comets and past, on going, and future spacecraft missions to these primitive objects and possibly shedding light on issues of comet formation (time and place) and matters of the prebiotic to biotic evolution of life.

Acknowledgements. We acknowledge funding and support from the SwRI Internal Research and Development Program, the NASA Discovery Data Analysis Program and the NSF Planetary Astronomy Program.

Keywords: Comets, Cometary Comae; Reactive Gas Dynamics Models,

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