The Role of Laboratory Investigations in Elucidating the Nature of Organic Molecules in the Titan Haze

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Titan's haze dominates its temperature, atmospheric circulation and climate control. Photochemistry plays a key role in the structure and evolution of the haze. We describe the impact of the presence of aromatic macromolecules in the haze via laboratory work done at NASA Ames and describe the synergistic relationship to quantum chemistry and photochemistry. PAH molecules have a strong influence over the thermodynamics and radiation absorption properties of the Titan haze because they are efficient absorbers in the ultraviolet and strong emitters in the infrared. They profoundly influence Titan's chemistry directly through their charge state because they are efficient charge exchange intermediaries and are highly electrophilic. This facilitates the catalytic formation of molecular hydrogen and provides a viable mechanism for the removal of highly reactive hydrogen atoms from the atmosphere. We find that the dominant charge state for macromolecules is neutral and negative, while for the larger aerosols, the predominant charge state is positive. We describe the prompt reaction model for the formation of molecular hydrogen on aerosol surfaces and contrast this with the formation of molecular hydrogen using negatively charged aromatics. The charge states of these two populations affect aerosol agglomeration and influence seasonal variations of the albedo of the Titan Haze.