Assessing the Evolution and Variability of Hydrogen in the Martian Atmosphere

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The abundance of spectroscopic and geomorphologic evidence demonstrating that liquid water once flowed on Mars raises significant questions regarding the history of Martian water and the evolution of the atmosphere into the current hyper-arid climate. Because Hydrogen in the present day Martian atmosphere is primarily derived from ancient liquid water entrained in rocks and polar ice caps, studying atmospheric Hydrogen is a means to addressing these questions and thereby constraining the history of water on Mars, and the evolution of the atmosphere. Furthermore, studying the time-history of Martian water loss has important astrobiological implications in informing our understanding of the conditions necessary for habitability not only on Mars, but also for life to exist on Mars-like planets throughout the universe.

Using data from the Imaging UltraViolet Spectrograph (IUVS) onboard the Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft, my research entails evaluating the hydrogen Lyman-alpha emission (located at 121.6 nm) across multiple Martian years and solar zenith angles. The NAI Early Career Collaboration Award gave me the opportunity to collaborate in-person with my external committee member, Dr. Michael Chaffin, at the Laboratory for Atmospheric and Space Physics (LASP) in Boulder, CO. Dr. Chaffin's expertise in Martian atmospheric hydrogen, involvement in the IUVS team, and proficiency in analyzing IUVS and other Martian atmospheric data (particularly using his radiative transfer model) make him a valuable collaborator for my research. During my visit to LASP I developed a Python code that allowed me to create altitude-intensity profiles of IUVS-detected atmospheric hydrogen emission. I also started becoming familiar with Dr. Chaffin's radiative transfer model, which I will ultimately use to extrapolate temperatures and densities of the upper atmosphere. This collaboration allowed me to interact on a daily basis with Dr. Chaffin, to have direct access to on-site IUVS team data and software, to understand data analysis techniques to a level of detail understood by only the IUVS instrument team, and to develop a working relationship with other IUVS team members. The NAI funding has helped further my research and career goals, as well as to advance our current understanding of the evolution of the Martian atmosphere through time.