Proton Aurora on Mars: A Dayside Phenomenon Pervasive in Southern Summer

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1. Introduction and Background

We observe and characterize Martian proton aurora, a third type of aurora in addition to diffuse and discrete recently identified at Mars (e.g., Deighan et al., 2018, Ritter et al., 2018).

Project Goals:
- Create a comprehensive catalog of Martian proton aurora detections and characterize based on phenomenology
- Identify statistical trends and abnormalities in detections
- Better understand solar wind’s interaction with Mars hydrogen corona

2. Data and Methods

Using data from the Imaging Ultra-Violet Spectrograph (IUVS) onboard the Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft, we create and assess altitude-intensity profiles of the hydrogen Lyman-alpha (Lyα) emission.

3. Proton Aurora Variability and Phenomenology

- Proton aurora exhibit high emission enhancements and peak intensities, and occur on the planet’s dayside (i.e., low SZA).
- Because proton aurora form via interactions between the solar wind and H coronal, seasonal variations (e.g., in dust and temperature) lead to inflation of the corona further beyond the bow shock, increasing occurrence rates, intensities, and peak altitude.

4. Summary, Conclusions, and Future Work

Summary and Conclusions:
- Using current detection constraints we observe proton aurora in >90% of perihelion periods and aurora detections at <1% of perihelion points.
- Proton aurora occur in ~18% of dayside periods (SZA<105°) in our dataset, varying significantly with season.
- Proton aurora are most active around 5. Summer solstice when atmospheric temperatures and dust content are high: occuring >80% of the time in dayside summer observations.
- Proton aurora events are far more common than originally thought, and are actually the most commonly observed type of aurora on Mars.
- Proton aurora therefore have an unexpected direct link to MAVEN’s study of Mars’ loss of atmosphere and water.

Outstanding Questions/Future Work:
What are the locations (geographic, temporal, etc.) of proton aurora events at Mars? Is there any interaction with an upstream magnetic field?
Compare selected altitude profiles to model predictions via a modeling challenge.