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MAVEN Imaging UV Spectrograph Results on the Mars Atmosphere and Atmospheric Escape

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The Imaging Ultraviolet Spectrograph (IUVS) is one of nine science instruments aboard the Mars Atmosphere and Volatile and EvolutioN (MAVEN) spacecraft, whose payload is dedicated to exploring the upper atmosphere of Mars and understanding the magnitude and drivers of Mars' atmospheric escape rate. IUVS uses ultraviolet light to investigate the lower and upper atmosphere and ionosphere of Mars. The instrument is among the most powerful spectrographs sent to another planet, with several key capabilities: (1) separate Far-UV & Mid-UV channels for stray light control, (2) a high resolution echelle mode to resolve deuterium and hydrogen emission, (3) internal instrument pointing and scanning capabilities to allow complete mapping and nearly continuous operation, and (4) optimization for airglow studies. IUVS, along with other MAVEN instruments, obtains a comprehensive picture of the current state of the Mars upper atmosphere and ionosphere and the processes that control atmospheric escape. We present an overview of selected IUVS results, including (1) the discovery of diffuse aurora at Mars, and its contrast with previously detected discrete aurora localized near crustal magnetic fields; (2) widespread detection of mesospheric clouds; (3) Significant seasonal and short-timescale variability in thermospheric composition; (4) Global ozone maps spanning six months of seasonal evolution; and (5) mapping of the Mars H and O coronas, deriving the escape rates of H and O and their variability. This last is of particular importance for understanding the long term evolution of Mars and its atmosphere, with the observed preset escape of H potentially capable of removing a large fraction of Mars' initial water inventory, and the differential escape of O relative to H potentially providing a net source of oxidizing power to the atmosphere and planet at present, in contrast with a photochemical theory that predicts stoichiometrically balanced escape. The atmospheric and escape physics probed by IUVS is hardly unique to Mars, having broad implications throughout the Solar System and beyond for all planets with CO_2-dominated atmospheres.