On the Solar Wind Proton Temperature Anisotropy at Mars' Orbital Location

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Radially emanating from the Sun, solar wind consists of highly ionized and strongly magnetized plasma. During its expansion, the solar wind develops into a turbulent flow. This turbulence functions as a reservoir of energy. Instabilities associated with turbulent flows can then disperse free energy by wave excitation. How turbulence in the solar wind operates, what its dynamics are, and how it is dissipated are all topics of interest in solar wind physics. While there has been multiple spacecraft to characterize turbulence at 1 AU, there exist very few opportunities to obtain these same measurements beyond this orbital location. In an effort to study how solar wind turbulence evolves beyond 1 AU, the Mars Atmosphere and Volatile EvolutionN (MAVEN) spacecraft can act as an intermittent upstream solar wind monitor at ~1.5 AU. To inspect the evolution of solar wind turbulence in the Martian exosphere, we have gathered proton temperature measurements taken by the Solar Wind Ion Analyzer (SWIA) onboard the MAVEN spacecraft. Removing alpha particles, which are distinguished from protons based on their energy/charge, we have calculated proton temperature moments. Here we report on the properties of turbulence near Mars' orbital location during upstream solar wind intervals along with time periods that have significant proton cyclotron wave (PCW) activity. Furthermore, we investigate instabilities driven by the proton temperature anisotropy at Mars. We look at the temperature anisotropy $T_{\perp p}/T_{||p}$ (i.e., the ratio of the perpendicular proton temperature component to the parallel proton temperature component) and the proton parallel beta, $\beta_{||p}$, to determine the most present plasma instability mode. These results provide novel insights into the physics of solar wind around Mars, and a more complete understanding of the role turbulence and plasma instabilities play in the evolution of the solar wind plasma.