INITIAL MAVEN OBSERVATIONS OF ION CYCLOTRON WAVES AND PICKUP PROTONS: A MEASUREMENT OF HYDROGEN LOSS IN THE UPPER MARTIAN EXOSPHERE F. J. Crary1, J. E. P. Connerney2, J. R. Espley3 and J. P. McFadden4, 1Laboratory for Space and Atmospheric Physics, University of Colorado, Boulder, 1234 Innovation Dr., Boulder, CO, 80303, frank.crary@lasp.colorado.edu 2Goddard Space Flight Center, Mail Code 695, Greenbelt, MD, 20771, Jack.connerney@nasa.gov 3Goddard Space Flight Center, Mail Code 695, Greenbelt, MD, 20771, jared.espley@nasa.gov, 4Space Science Laboratory, University of California, Berkeley, 7 Gauss Way, Berkeley, CA 94720-7450, mcfadden@ssl.berkeley.edu.

Introduction: Observations by the Mars Global Surveyor, Mars Express and Phobos 2 spacecraft [1],[2],[3] have shown that Mars has a hydrogen exosphere which extends as much as ten Martian radii from the planet. These hydrogen atoms ionize and are “picked up” in the solar wind flow. Neither the associated hydrogen loss rate nor the structure of this extended exosphere, have previously been well determined. The resulting pickup protons have a distinctive velocity distribution and generate low frequency electromagnetic waves near the ion cyclotron frequency.

Proton pickup ions have been observed by Mars Express [4] and proton cyclotron waves have been observed by Mars Global Surveyor [2]. The MAVEN spacecraft is the first Mars orbiter able to simultaneously measure both ion cyclotron waves. Data from the spacecraft’s magnetometer [5], providing the vector magnetic field at a rate of 32 samples per second, is Fourier transformed to produce dynamic spectra of right-circularly polarized (whistler mode) and left-circularly polarized (ion cyclotron mode) ultralow frequency electromagnetic waves. At the same time, the Super-Thermal And Thermal Ion Composition (STATIC) instrument [6], an electrostatic analyzer and mass spectrometer, measures the flux of ions as a function of energy, direction and ion mass-to-charge ratio.

We present initial observations of both ion cyclotron waves and proton pickup ions from the first few months of the MAVEN science mission. We focus on times when the spacecraft was outside the Martian bow shock. Although wave activity and non-thermal proton distributions are present in the Martian magnetosheath, there interpretation is more complex. Outside the bow shock, the measurements may be more easily used to estimate the structure of the Martian exosphere and the rate of hydrogen ionization.