EARLY RESULTS FROM THE MAVEN IUVS ECHELLE CHANNEL.

J. T. Clarke[1], M. Matta[1], W. McClintock[2], N. Schneider[2], J. Deighan[2], I. Stewart[2], G. Holsclaw[2], and B. Jakosky[2]
[1]Center for Space Physics, Boston University, 725 Commonwealth Ave, Boston MA 02215
[2]LASP, Univ. of Colorado 3665 Discovery Drive, Boulder, CO 80303

Introduction: The IUVS instrument on MAVEN contains the first echelle spectrograph to be sent to another planet. The system has a novel optical design to enable long-aperture measurements of emission lines in the absence of continuum, intended primarily to measure the H and D Ly α emission lines and thereby the D/H ratio from the martian upper atmosphere [1]. The system also detects the OI 1304 triplet with the three component lines well resolved. The echelle system obtains altitude profiles of these emissions every fourth MAVEN orbit, with data both outbound and inbound looking at a constant look direction that scans the atmosphere in altitude. The echelle spectrum is recorded using the same FUV microchannel plate detector as the low resolution IUVS system, and emission lines appear diffusely filling a 1.6 x 0.1 degree aperture (Figure 1) with a spectral resolution of 0.008 nm.

Scientific Goals:

The main scientific goal of the echelle channel is to measure H and D Ly α emissions and thereby derive the D/H ratio of the martian upper atmosphere. This ratio is roughly 5 times higher than in the terrestrial atmosphere due to the escape of a large volume of water into space, likely early in the history of Mars [2,3]. Since H atoms escape faster than D atoms, the D/H ratio increases with time as more water is lost [4]. There are a number of caveats to this interpretation, including uncertainties in the diffusion of H and D atoms to the upper atmosphere. MAVEN measurements are intended to determine the average ratio, and any changes with location or season on Mars to provide a detailed understanding of the physical principles of the escape of both species.

The derivation of the D/H ratio from brightness measurements requires the use of a radiative transfer model, since the H line is optically thick while the D line is optically thin. The D line exhibits limb brightening, and the effective altitude of the peak can also in principle be used to determine the altitude of the homopause. The OI 1304 triplet line ratio will provide information about both the optical depth of the O line of sight column, and also the contribution of photoelectron excitation to the total emission. Early results from the echelle channel will be presented.

References:

[1] McClintock, W.E. et al. (2014) *Sp. Sci. Rev.* doi:10.1007/s11214-014-0098-7. [2] Owen, T., in *Mars,* ed. H. Keiffer *et al.,* Univ. of Arizona Press, 818-833 [3] Krasnopolsky, V., M. Mumma, and R. Gladstone [1998], *Science, 280*, 1576-1580 [4] Y.L. Yung and D. Kass, (1999) *Science, 280,* 1545-1546.

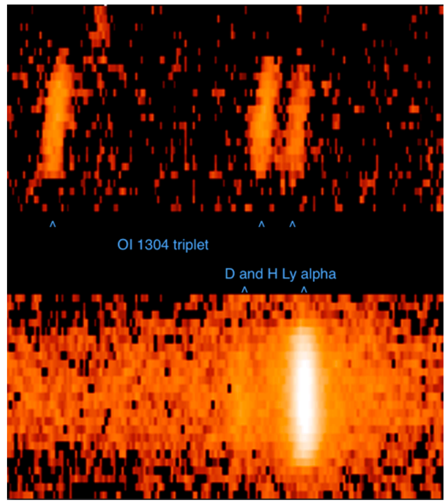

Figure 1: Detector image of the H and D lines (below) and the OI triplet (above) resolved into images of the aperture. The H and D lines (separation 0.033 nm) are well separated by the 0.008 nm resolution of the instrument, however the D line is much fainter and requires a longer integration time to detect.

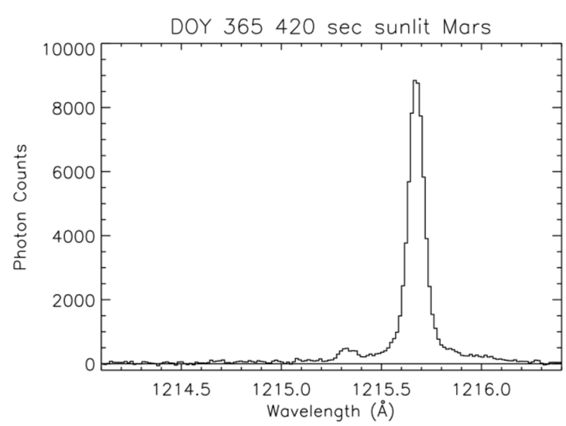

Figure 2: Reduced spectrum of the H (1215.67 A) and D (1215.33 A) lines from the observation in Figure 1, with a 420 sec exposure looking down on the sunlit martian disc. The extended wings on the H line are due to grating scatter.