STRUCTURE OF THE MARTIAN IONOSPHERE AND ATMOSPHERIC LOSS: MAVEN STATIC FIRST RESULTS. J. P. McFadden[1], R. Livi[1], J. Luhmann[1], J. Connerney[2], D. Mitchell[1], C. Mazelle[3], L. Andersson[4], B. Jakosky[4], [1]Space Science Laboratory, University of California, Berkeley, 7 Gauss Way, Berkeley, CA 94720-7450, mcfadden@ssl.berkeley.edu, [2]Goddard Space Flight Center, Mail Code 695, Greenbelt, MD, 20771, [3]L'Institut de Recherche en Astrophysique et Planétologie, 31028 Toulouse Cedex 4, France, [4]Laboratory for Space and Atmospheric Physics, University of Colorado, Boulder, 1234 Innovation Dr., Boulder, CO, 80303.

Introduction: The Suprathermal And Thermal Ion Composition (STATIC) [1] sensor on the MAVEN [2] spacecraft provides the first detailed look at the Martian ionosphere and the solar wind ionospheric interface where atmospheric energization and loss mechanisms act. STATIC's unique design allows it to measure both a wide range in energy (0.1 eV to 30,000 eV) and the large dynamic range in flux that results from an orbit that samples both the dense ionosphere and tenuous pickup ions at altitudes of ~6000 km.

STATIC provides the first measurements of the ion composition, temperature, and flows in the deep ionosphere (<150 km), resolving the cold O_2+ dominated plasma whose temperature is often less than 0.02 eV. STATIC's 4 s cadence can also identify the variety of sharp gradients in ionospheric composition that mark the transition to warmer, multi-component plasmas (primarily H+, O+ O_2+) at intermediate altitudes.

Preliminary measurements indicate H+ densities at ionospheric altitudes are higher than model predictions. Both the low altitude and intermediate altitude plasmas show structure on ~10 km scales, with sharp transitions in composition and density. Plasma voids, where density can drop by factors of 10 to 100 are quite common in the nightside ionosphere. Ionospheric plasma can be observed to several thousand km in eclipse, often dominated by cold H+ similar to Earth's plasmasphere.

At intermediate altitudes, ion distributions can be complex with low temperature (<10 eV) counterstreaming ions of the same mass, in addition to counterstreaming ions of different mass. Evidence of heating is seen in the gradual increase in temperature with altitude.

At still higher altitudes, plasma mixing is observed between cold ionospheric plasma and solar proton dominated sheath plasma. Colder ionospheric ions attain escape velocity in these mixing regions. This interface is often characterized by velocity dispersed ion signatures, both in the sheath protons and in heavier ions of ionospheric origin. The initial acceleration of atmospheric pickup ions is also observed at these intermediate altitudes, sometimes forming a distinctive particle signature, or plasma plume signature, that can extend continuously out into the solar wind.

Pickup ion fluxes are observed on all orbits, however their distribution in space and time varies dramatically from orbit to orbit with solar wind conditions. In this paper we will summarize the first results from STATIC's ionospheric composition and outflow measurements, and compare those results with previous observations in the Martian environment. We will also present preliminary results on ion heating mechanisms and loss rates.

References: [1] McFadden J.P. et al. (2015) Space Science Review, Submitted. [2] Jakosky B. et al. (2015) Space Science Review, Submitted.