Dust Measurements from the Langmuir Probe and Waves Instrument on the MAVEN Mission. L. Andersson[1], T. Weber[1], D. Malaspina[1], F. Crary[1], R. E. Ergun[1], G. T. Delory[2], M. W. Morooka[1], C. M. Fowler[1], T. McEnulty[1], T. Weber[1], A. I. Eriksson[3], D. Andrews[3], D. L. Mitchell[2], J. P. McFadden[2], J. S. Halekas[4], D. Larson[2], J. E. P. Connerney[5], J. Espley[5], and F. Eparvier[1], [1]Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, 80303 (laila.andersson@lasp.colorado.edu), [2]Space Sciences Laboratory, University of California, Berkeley CA 94720, [3]Swedish Institute for Spacephysics, Uppsala, Sweden, [4]Department of Physics and Astronomy, University of Iowa, Iowa City, IA 52242, [5]NASA Goddard Space Flight Center, Greenbelt, MD 20771.

Introduction: Electron temperature and density are critical quantities in understanding an upper atmosphere. Approximately 40 years ago, the Viking landers reached the Martian surface, measuring the first (and only) two temperature profiles during descent [1]. All spacecraft that have visited the red planet thereafter have had limited plasma packages and 'high' altitude orbits, preventing those missions from gaining detailed information about Mars' upper atmosphere. Remotely, the upper atmosphere of Mars has been studied for example, by the MARSIS sounder on Mars Express (MEX) [2], but complete plasma measurements are lacking.

The MAVEN mission was designed to characterize the upper atmosphere and included the Langmuir Probe and Waves (LPW) instrument[3] to provide fundamental measurements of the basic atmospheric dynamics at Mars. MAVEN reached Mars in the fall of 2014 and the first months of data from the LPW instrument have provided exciting information from an interesting planet.

Topic of This Presentation: A special dust mode was developed for the LPW instrument when it became clear that the Comet Siding Spring would arrive at Mars at the same time as the MAVEN mission. In this mode the instrument measures the potential between one probe and the spacecraft potential using a burst capture system. The burst capture system can measure in three different frequency bands independently. The LPW instrument was operated in dust mode partly in cruise phase and during some periods in the transition phase. This allowed a 'background' dust level to be established; providing an estimate for which dust populations the satellite is sensitive to prior to the Comet Siding Spring encounter. With help of recent laboratory results [4] many of the signals measured in dust mode can be attributed to dust impacts.

This results presented in this poster validate some of the laboratory results with direct observations from space. The focus of this work is on how the different measured signals are interpreted. Based on these interpretations, the work presented in this poster describes how the Comet Siding Spring impacted the normal dust population at Mars and demonstrates that there was no direct observation of dust from the Comet Siding Spring by MAVEN/LPW.

Background: The MAVEN mission is the first satellite sent to Mars with a complete plasma package. The Particle and Fields (PF) suite consists of 7 instruments: the Langmuir Probe and Waves (LPW), an Extreme Ultra Violet sensor (EUV), a magnetometer (MAG), two ion instruments (SWIA and STATIC), an electron instrument (SWEA), and an energetic particle instrument (SEP). Together, these instruments allow the upper atmosphere of Mars to be well characterized. The LPW instrument has two sensors located on ~7 m booms that can be operated both as two separate Langmuir probes or as an electric field instrument. LPW shares a common electronics box with EUV, but on the MAVEN mission EUV is operated as a separate science instrument.

The LPW instrument makes fundamentally different measurements in Langmuir Probe mode versus Electric Field (Waves) mode. When the sensors are operated in Langmuir Probe mode, the potential is swept over a set voltage steps, and the current to the sensor at each voltage step is measured. This allows the density and temperature of the cold plasma to be measured. Data from the Langmuir probes is complex to analyze as changes such as spacecraft photoelectrons and instrument aging need to be removed from the measurement curved. Therefore, the LPW instrument was designed to also measure the plasma line (using the Electric Field mode) and hence obtain accurate information about the local electron density. The plasma line can be observed naturally but the LPW instrument also can stimulate this measurement with a weak white noise broadcast. The LPW instrument also observes low frequency waves to identify where wave-particle energy conversions occurs. Hence, the LPW instrument provides information about how energy is flowing in the Martian system together with the other PF instruments. Finally, the LPW instrument can detect nano-size dust particles impacting the spacecraft, providing information about Phobos-Diemos-Mars-Sun interactions.

Summary: This presentation has focused on one of the multiple research areas that the LPW instrument is contributing to in understanding the dynamics of the Martian upper atmosphere. As the MAVEN orbit precesses over different latitudes and local times, the

LPW observations will provide critical information to drive models that can demonstrate how the upper atmosphere varies and what processes are critical for atmospheric escape at Mars.

References: [1] Hanson, Sanatani, and Zuccaro, (1977) *JGR, 82, 4351-4363.* [2] Gurnett et al. (2005) *Science*, 310, 1929-1933 [3] Andersson et al., LPW instrument paper submitted to *Space Science Review*. [4] Zoltan et al (2014) Fall AGU.