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Ion acceleration and non-Maxwellian electron distributions in a low collisionality, high power helicon plasma source YAN LI, YUNG-TA SUNG, JOHN SCHARER, UW-Madison, ECE Department — Ion acceleration through plasma double layer and non-Maxwellian two temperature electron distributions have been observed in Madison Helicon Experiment (MadHeX) operated in high RF power (>1000 W) and low Ar pressure (0.17 mtorr) inductive mode. By applying Optical Emission Spectroscopy (OES)[1] cross-checked with an RF-compensated Langmuir probe (at 13.56 MHz and its second and third harmonics), the fast (>80 eV), untrapped electrons downstream of the double layer have a higher temperature of 13 eV than the trapped bulk electrons upstream with a temperature of 4 eV[2]. The reduction of plasma potential and density observed in the double layer region require an upstream temperature ten times the measured 4 eV if occurring via Boltzmann ambipolar expansion. The hot tail electrons of the non-Maxwellian electron distribution affect the formation and the potential drop of the double layer region. The mechanism behind this has been explored via several non-invasive plasma diagnostics tools. The OES measured electron temperatures and densities are also cross-checked with Atomic Data and Analysis Structure (ADAS) and a millimeter wave interferometer respectively. The IEDF is measured by a four-grid RPA and also cross-checked with argon 668 nm Laser Induced Fluorescence (LIF). An emissive probe has been used to measure the plasma potential. [1] J. B. Boffard, R. O. Jung, C. C. Lin, A. E. Wendt, Plasma Sources Sci. Technol. 19, 065001 (2010) [2] Y.-T. Sung, Y. Li, J. E. Scharer, Phys. Plasmas 22, 034503 (2015)

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