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Observation of warm, higher energy electrons transiting a double layer in a helicon plasma YUNG-TA SUNG, YAN LI, JOHN SCHARER, UW-Madison, ECE Department — Experimental observations in MadiHeX indicate that fast electrons with substantial density fractions can be created at low helicon operating pressure. Two-temperature electron distributions including a fast (>80 eV) tail are observed in an inductive RF helicon argon plasma double layer at 0.17 mTorr Ar pressure. The fast, untrapped electrons measured downstream of the double layer have a higher temperature of 13 eV than the trapped, upstream electrons with a temperature of 4 eV [1]. The reduction of plasma potential and density observed in the double layer region would require an upstream temperature ten times the measured 4 eV if occurring via Boltzmann ambipolar expansion. Upstream fluctuations of ± 30% are also observed in the emissive probe measured plasma potential. Sideband frequencies have been observed at ± 2 kHz of the driven RF frequency of 13.56 MHz, implying a beam instability effect dominantly upstream of the double layer. This can affect ion acceleration and electron temperature distribution in the region. The mechanism behind this has been explored via several plasma diagnostics tools. An RF-compensated Langmuir probe has been used to measure the electron temperatures and densities, which are cross-checked with ADAS, OES and millimeter wave IF. The EEDF in the plasma has also been profiled to understand the acceleration mechanism. A four-grid RPA and an emissive probe have been used to measure the IEDF and plasma potential. The measured IEDF has also been checked with LIF techniques.

[1] Y.-T. Sung, Y. Li, J. E. Scharer, Phys. Plasmas 22, 034503 (2015)

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