EVOLUTION OF THE ION VELOCITY DISTRIBUTION IN PULSED THRUSTER-LIKE PLASMAS

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A number of groups have been exploring the potential use of expanding helicon source plasmas as plasma thrusters [1-3]. The substantial ion acceleration observed in these experiments is believed to result from the formation of a current-free, electric double layer (DL) at the end of the source (where the magnetic field begins to rapidly diverge). Recent measurements suggest that the DL forms within 100 microsecond of plasma initiation [4]. Here we present detailed measurements of the ion velocity distribution in both steady-state and pulsed helicon plasmas that exhibit high-speed ion flows. The measurements were obtained with laser induced fluorescence on helicon source experiments at West Virginia University, Princeton Plasma Physics Laboratory, and the Australian National University. Detailed measurements of bulk ion flow towards the DL from the upstream side will be presented as well as measurements of ion flow speed downstream of the DL for a wide range of plasma conditions. For pulsed helicon plasmas, we will present time resolved measurements of the parallel ion velocity distribution that suggest the formation of the DL occurs well after the initiation of the plasma. The time resolved measurements also suggest that the DL can be unstable, therefore it only exists for part of the plasma pulse. Details of the experimental apparatus used to make the measurements will also be presented. [1] C. Charles and R. Boswell, Applied Phys. Letters 82, 1356 (2003) [2] Cohen, S.A., N.S. Siefert, S. Stange, E.E. Scime, R. F. Boivin, and F. Levinton, Phys. Plasmas 10, 2593 (2003) [3] Sun, X., C. Biloiu, and E. Scime, 13, 359 (2004). [4] C. Charles and R. Boswell, Phys. Plasmas 11, 3803 (2004) *In collaboration with X. Sun, A. Keesee, S. Cohen, C. Charles, and R. Boswell

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2. H - Waves in Plasma

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4. I - Invited Paper, Program chair: Scott Robertson

5. No special instructions