Studies of the modification of Langmuir probe traces in strongly magnetized plasmas using the Magnetized Dusty Plasma Experiment (MDPX) device

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Complex (or "dusty") plasmas are four-component plasma systems consisting of ions, electrons, neutral atoms, and charged, micron-sized particles (i.e., "dust"). Although the dust particles can become highly charged, often with hundreds to thousands of elementary charges, because of their large mass, the charge to mass ratio of a micron-sized dust grain in a glow discharge laboratory plasma can be quite small, $\sim 10^{-12}$ of the charge to mass ratio of an electron. This means that to study the properties of dusty plasma experiments in which magnetic force on the dust particles can play a role, requires a large magnetic field usually above 1 Tesla.

However, this requirement on a large magnetic field has important consequences for diagnosing the properties of the background plasma. First, many dusty plasma experiments are operated under dc or rf glow discharge conditions, which means that these plasmas are weakly-ionized and neutral dominated and the role of ion-neutral and electron-neutral collision may be important when trying to interpret in-situ probe measurements. Second, for magnetic fields above 1 T, both the ions and electrons are magnetized which strongly impacts charged particle transport parallel vs. perpendicular to the magnetic field. For in-situ probes, this manifests itself as a significant reduction in the electron current and highly modified perturbed Langmuir probe traces.

This presentation will describe a one of our first systematic studies of the modification of the Langmuir probe current-voltage (I-V) traces over a range of input power, neutral pressure, and magnetic field strength. A qualitative model for describing the changes in the probe traces may be presented.