Abstract Submitted
for the GEC10 Meeting of
The American Physical Society

RF Probe Theory[1] R.F. FERNSLER, Plasma Physics Division, Naval Research Laboratory, D.N. WALKER, Global Strageies Group, Inc., D.D. BLACKWELL, Naval Research Laboratory, D.R. BORIS, NRC Postdoctoral Associate — Langmuir probes are the preferred method for diagnosing plasmas, but interpreting the dc data is difficult. In this work we show that the ac probe impedance Z is easier to interpret and provides more information because it contains real and imaginary parts and depends on both the applied frequency f and dc bias V. At the bulk plasma frequency, Re(Z) peaks while Im(Z) equals zero. These two conditions uniquely determine the bulk plasma electron density. In addition, the electron density within the sheath can be computed from the variation in Re(Z) with f. At much lower frequencies, Re(Z) becomes independent of f and approaches dV/dI_e, where I_e is the dc electron current. The variation in Re(Z) with V can be used to determine the plasma potential and the electron energy distribution and temperature. Compared with Langmuir probes, the rf method requires one less derivative and provides more information and multiple checks. Experimental results are presented for spherical probes, cylindrical probes, and a pair of closely spaced parallel plates in broad and narrow plasmas with densities ranging from 10^7 to 10^{11} cm^{-3}. The parallel-plate scheme is especially useful in magnetized plasmas.

[1]Work supported by the Office of Naval Research.

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Date submitted: 09 Jun 2010 Electronic form version 1.4