Abstract Submitted
for the DPP08 Meeting of
The American Physical Society

Determining electron temperature for small spherical probes from network analyzer measurements of complex impedance[1] DAVID N. WALKER, SFA (Crofton, MD), RICHARD F. FERNSLER, DAVID D. BLACKWELL, WILLIAM E. AMATUCCI, Naval Research Laboratory — In earlier work,[2] using a network analyzer, we have shown the existence of collisionless resistance (CR) in the sheath of a spherical probe when driven by a small rf signal. As shown in that paper the CR depends on the plasma density gradient at a given location. Because of this there is a cutoff in the CR which is proportional to the applied bias level and which will occur at the plasma frequency at the surface of the probe, $r = r_0$. We show that, in the frequency regime $\omega_{pi} << \omega << \omega_{pe}(r_0)$, the complex impedance measurements made with a network analyzer can be used to determine electron temperature. We present an overview of the theory used along with comparisons to data sets made using three small spherical probes of different sizes. The numerical algorithm requires only a solution of the Poisson equation to determine the approximate sheath dimensions and integrals to determine approximate plasma and sheath inductances. We compare the results of the temperature measurements to those made by conventional Langmuir probe sweeps.

[1]Work supported by the Office of Naval Research.
[2]Walker, D.N., R.F. Fernsler, D.D. Blackwell, W.E. Amatucci, S.J. Messer, *Phys of Plasmas*, 13, 032108 (2006)

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Date submitted: 17 Jul 2008 Electronic form version 1.4