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Collisionless energy absorption in inhomogeneous plasmas in spherical geometry[1] DAVID N. WALKER, RICHARD F. FERNSLER, DAVID D. BLACKWELL, WILLIAM E. AMATUCCI, Plasma Physics Division, Naval Research Laboratory, SARAH J. MESSER, NRL-NRL Postoctoral Associate — We are continuing an investigation of the RF impedance characteristics of a small spherical probe immersed in a laboratory plasma. The data taken are from network analyzer measurements of the reflection coefficient obtained when applying a low level RF signal to the probe near floating potential or negatively DC-biased in a low pressure plasma. Surprisingly, the plasma impedance in the sheath surrounding the object becomes "resistive," and energy absorption is observed experimentally, even though the plasma is effectively collisionless. This behavior can be realized by solving Maxwell's equations together with cold fluid equations, and the solutions obtained indicate that the plasma resistance is inversely proportional to the plasma density gradient evaluated at the location where the plasma frequency is equal to the applied frequency. This is consistent with a body of earlier work which concentrated mostly on planar probes.[2] The interpretation of results is simpler for a sphere and the results agree well with theory. Maximum energy absorption is observed at frequencies generally near one-half the plasma frequency. We calculate collisionless resistance for a derived density profile and compare to laboratory data.
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