A Particle-in-Cell Approach to
Time Domain Simulations of the ICRF Edge Regions*

D. N. SMITHE[1], C. K. PHILLIPS[2]
[1]*ATK Mission Research*, *Newington, VA*
[2]*Princeton Plasma Physics Laboratory, Princeton, NJ*

Traditional particle-in-cell / time-domain methods excel in situations of complex geometry, but are difficult to use in fusion plasma type problems, primarily because of explicit time-step algorithms that become numerically unstable when confronted with temporally or spatially unresolved physics, at high frequency and short scale-length, such as plasma oscillations and sheaths. We discuss an approach for a progressive treatment of these difficulties with carefully planned intermediate steps, each fully functional and useful in its own right. In our first year we plan to implement, in an implicit algorithm, the standard linear magnetized cold-plasma dielectric tensor in time-domain to treat the RF propagation. Particles will be pushed, but initially only for comparison purposes with the currents of the linear dielectric medium. This will permit cataloging of kinetic and non-linear departures from the linear model, while at the same time assuring numerical stability. The linear equations are identical to the fluid equations, and so subsequent upgrades involve relaxation of fluid linearity, and eventual feedback from particle information into the fluid quantities, and incorporation of new sheath boundary physics models.

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