Particle Simulations of Knudsen Layer Effects on DT Fusion*
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Lawrence Livermore National Laboratory — Kinetic effects have been shown to de-
grade fusion reactivities near an absorbing bounding surface in some circumstances,
the so-called Knudsen layer (KL) effect. There is renewed interest in the KL effect
[1] in the context of inertial fusion [2]. We report particle simulations (1D Cartesian
in space, 3D in velocity) of the transport of deuterium and tritium (DT) plasma in
a system with a partially absorbing boundary and including Coulomb collisions and
the effects of non-Maxwellian velocity distribution functions on fusion reactivity.
Ion-ion Coulomb collisions are implemented with a pairwise scheme that conserves
number, momentum, and energy. The influences of the albedo and temperature of
the boundary, ion slowing on electrons, ambipolar electric fields, fusion alphas, and
a Cu minority species are studied. Reductions in fusion reactivity are quantified.
For DT at 9 keV, the Gamow peak in the fusion reactivity is at 29 keV; but the
KL decrements in the ion tail from Maxwellian are observed to occur at higher en-
ergies so that the Maxwellian-averaged formula for the fusion reactivity using the
space-time local temperatures and densities gives a good fit to the kinetic fusion
rate. Kinetic effects are nevertheless important in determining end losses, velocity
tail decrements and anisotropy, and ion axial plasma profiles for density, kinetic
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