Abstract Submitted
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Non-linear Plasma Wakes I.H. HUTCHINSON, MIT Plasma Science and Fusion Center — Objects moving through plasmas give rise to strong plasma perturbations which are vital for understanding space-craft or dusty plasma interactions, for example. If the object is smaller than the Debye length, λ_{De}, and if ion Landau damping is small because $T_i \ll T_e$, then linearized response theory predicts an oscillatory wake extending over many wavelengths. However, these linearized predictions' accuracy is doubtful, since the floating potential is several times $-T_e/e$. A non-linear computational kinetic-ion treatment of the unmagnetized problem has therefore been undertaken using a 3-D hybrid PIC code, for a spherical object. It shows that while the wavelength of the wake oscillations agrees with the linear approximation ($2\pi v_p/\omega_{pi}$), their amplitude is nonlinearly limited. The wake potential does not exceed typically $\sim 0.2T_e/e$, no matter how strong the perturbation by the object [i.e. its normalized charge $\bar{Q} \equiv Q/(4\pi\epsilon_0\lambda_{De}T_e/e)$]. Linear response is accurate only for approximately $\bar{Q} < 0.02$, which means the wake of a floating sphere is linear only if it has a small radius $< 0.01\lambda_{De}$. Larger objects require non-linear calculations in which greater wake damping occurs. The detailed shape of wakes will be presented.

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