Ion focusing behind charged obstacles in a plasma flow

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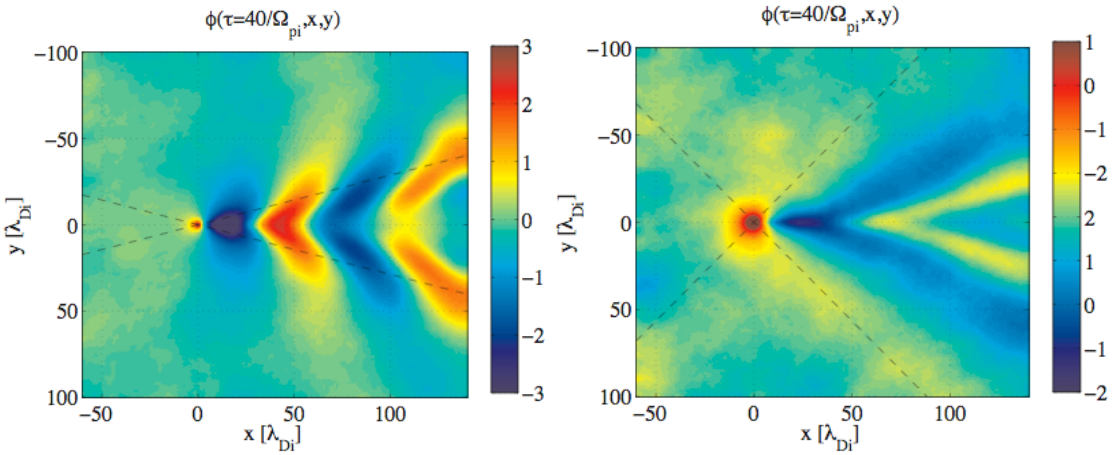
Abstract

The potential and plasma density variations around charged objects in plasma flows [1] is studied. These objects can be charged dust particles. Two limits are considered, one where the electron-ion temperature ratio is large, $T_e >> T_i$, and one where $T_e \approx T_i$. The former limit can be described by a simple model based on geometrical optics, while the latter requires a kinetic model to account for effects of ion Landau damping [2]. The results for $T_e >> T_i$ are here illustrated by numerical simulation using a Particle-in-Cell code, where the electrons are treated as an isothermal mass less fluid, giving a nonlinear Poisson equation.



In the figures we show the potential variations for two Mach numbers, 0.75 and 1.33. The temperature ratio is $T_e/T_i = 100$. When the temperature ratio is reduced, we find that ion Landau damping smears out the details of the waveforms, and the only significant potential variations are found for Mach numbers exceeding unity. We have analytical models supporting the numerical results.

References

1. O. Ishihara and S. V. Vladimiriv, "Wake potential of a dust grain in a plasma flow", *Phys. Plasmas*, **4**, 1997, pp. 69-74

2. P. Guio and H. L. Pécseli, "Radiation of sound from a charged dust particle moving at high velocity", *Phys. plasmas*, **10**, 2003, pp. 221-225.