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The plasma-sheath transition in the Tonks-Langmuir model

KARL-ULRICH RIEMANN, Ruhr-University, D 4470 Bochum, Germany — The plasma-sheath matching problem in the hydrodynamic plane Tonks-Langmuir model has attracted considerable interest during the last few years. It is complicated not only by the singular structure of the asymptotic ($\lambda_D/L \rightarrow 0$) plasma and sheath solutions but also by a coupling with the eigenvalue problem originating from the plasma balance. Due to these difficulties the existence of a matched asymptotic expression uniformly valid from the plasma core to the wall is widely questioned. The issue is clarified both analytically and numerically by the explicit construction of a matched asymptotic expression and comparison with exact solutions. Accounting for a shift in the ionization eigenvalue, the approximations obtained by consistent matching show an excellent agreement with numerical potential curves. The singularities of the asymptotic components are reflected by small discontinuities in the derivatives that vanish in the limit $\lambda_D/L \rightarrow 0$. Finally an outlook is given to the kinetic analysis of the same problem.

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