



On One-Dimensional Force-Free Vlasov-Maxwell Equilibria

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The conditions for the existence of force-free non-relativistic translationally invariant one-dimensional (1D) Vlasov-Maxwell (VM) equilibria are investigated using general properties of the 1D VM equilibrium problem. As has been shown before, the 1D VM equilibrium equations are equivalent to the motion of a pseudo-particle in a conservative pseudo-potential, with the pseudo-potential being proportional to one of the diagonal components of the plasma pressure tensor.

Based on this theoretical framework, a necessary condition on the pseudo-potential (plasma pressure) to allow for force-free 1D VM equilibria is formulated. It is shown that linear force-free 1D VM solutions, which until recently were the only force-free 1D VM solutions known, correspond to the case where the pseudo-potential is an attractive central potential. A general class of distribution functions leading to central pseudo-potentials is discussed.