

# Landau damping for non-Maxwellian distribution functions

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Landau damping is one of the cornerstones of plasma physics. Based on the initial-value approach adopted by Landau in his original derivation of Landau damping, we examine the solutions of the linear Vlasov–Poisson system for different equilibrium distribution functions  $f_0(v)$ , going beyond the traditional focus on the root with largest imaginary part and investigating the full set of roots that the dispersion relation of the system generally admits. Specifically, we provide analytical insights into the number and the structure of the roots for entire and meromorphic functions  $f_0(v)$ , such as Maxwellian and kappa distributions, we discuss the potential issues related to the redefinition of  $\partial f_0(v)/\partial v$  as a complex variable function and we show how different sigmoids affect the root structure associated with non-meromorphic cut-off distribution functions. Finally, based on the comparison of the several root structures considered, we wonder if the multiple roots might hint at a deeper understanding of the Landau damping phenomenon.