

# Closures of the Vlasov-Poisson System

Christopher S. Jones\*, Philip J. Morrison

*Institute for Fusion Studies, Dept. of Physics, UT Austin*

Parametric closures of one-dimensional Vlasov-Poisson are studied through the inclusion of a source. Parameterizations are considered which may be identified with a closed set of moments. The remaining moments are shown to obey constitutive relations which characterize the set of distributions allowed under the closure. These relations are restricted by the symmetries of the system, thus constraining the form of parametric closures which maintain those symmetries. The dynamics of the distribution subject to closure are shown to be Vlasov-Poisson dynamics with a source determined by the form of the closure. Equating this source to zero reveals constraints on closures which exactly reproduce Vlasov-Poisson dynamics, such as water bag models. These constraints are compared with those that arise from the requirement that the Poisson bracket satisfy the Jacobi identity, preserving the Hamiltonian character of the dynamics.

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