

On the Hamiltonian-Jacobi variational formulation of the Vlasov equation

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The Vlasov-Poisson and Vlasov-Maxwell equations possess various variational formulations¹ or action principles, as they are generally termed by physicists. I will discuss a particular variational principle that is based on a Hamiltonian-Jacobi formulation of Vlasov theory², a formulation that is not widely known, and show how this formulation can be reduced for describing the Vlasov-Poisson system. The resulting system is of Hamilton-Jacobi form, but with nonlinear coupling to the Poisson equation. A description of phase (function) space geometry will be given and comments about Hamilton-Jacobi pde methods and weak KAM will be made.

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¹H. Ye and P. J. Morrison Phys. Fluids 4B 771 (1992).

²D. Pfirsch, Z. Naturforsch. 39a, 1 (1984); D. Pfirsch and P. J. Morrison, Phys. Rev. 32A, 1714 (1985).