Closures of the Vlasov-Poisson System

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Closure refers to the process of generating a fluid description of a system, which evolves functions of space and time such as density, fluid velocity and pressure, from kinetic theory, which is a probabilistic description of the classical dynamical evolution of positions and momenta. In the case of the Vlasov-Poisson system, a kinetic theoretical description of a one-dimensional electrostatic plasma, there exist closures for which the fluid equations locally exactly describe the full kinetic description. These exact closures, called water bag models or contour dynamics, have an algebraic structure that presents itself in the equations of motion of the moments of the distribution function. We discuss this structure and what happens to it as inexactness is introduced.

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