

Models for Global Plasma Dynamics

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This lecture will introduce the various theoretical models that describe global plasma dynamics. It will emphasize the relationship between these models and the conditions under which they apply based on the time and space scales of the phenomena of interest. In particular, the lecture will describe the reduction of the Maxwell-Vlasov system to the drift-kinetic and the gyrokinetic equations. It will then describe the fluid equations obtained by taking moments of the various kinetic models. Numerical considerations such as the use of implicit vs. explicit algorithms, the choice of representation, and the choice between Eulerian and Lagrangian formulations will be discussed. The role of the Hamiltonian structure of plasma models in ensuring the solubility of the equilibrium equations and in establishing the conservation properties and the properties of coherent structures will also be described.