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Dynamics of electrically conducting fluids

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Electrically conducting fluids are described by the magneto-hydrodynamic (MHD) formalism that combines the classical laws of fluid mechanics and electromagnetism. After a brief review of this formalism, several examples of electrically conducting fluids will be discussed. For instance, liquid metal flows are important in several industrial applications including the steel industry as well as in the description of geophysical flows and laboratory experiments on the dynamo effect. Also, plasmas represent an important class of electrically conductive fluids when they are treated in the limit of continuous media. Plasma physics is relevant in the study of various astrophysical systems as well as in laboratory experiments on magnetic confinement fusion. The importance of MHD effects for the ITER (International Thermonuclear Experimental Reactor) experiment will also be briefly discussed. Numerical simulations of the MHD equations play an increasingly important role in the description of electrically conducting fluids. Recent numerical results will be presented and MHD turbulence will be analyzed in terms of energy transfers, locality functions as well as sub-grid scale modeling in large eddy simulations.