Hamiltonian and action principle descriptions of plasma physics

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Because charged particles interacting self-consistently via the electromagnetic interaction possess Hamiltonian and action principle (HAP) formulations, the same is true for important fluid and kinetic descriptions of plasmas. HAP formulations provide a unifying picture of plasma physics in which conventional equilibrium and stability analyses can be organized and more clearly understood. They also provide a guide for performing new such analyses. These lectures will review HAP formulations and show how various HAP formulations are interrelated. Also, they will describe how HAP formulations can be used to obtain new equilibrium and stability results and how various generalized and reduced, yet consistent, physical descriptions of plasmas can be derived. The lectures will begin at the level of my review articles[†] leading into more mathematical topics.

[†] P. J. Morrison Rev. Mod. Phys. **70**, 467 (1998); AIP Conf. Proc. **1188**, 329 (2009).