Lifting of the Vlasov-Maxwell Bracket by Lie-transform Method[1]

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— The Vlasov-Maxwell equations possess a Hamiltonian structure expressed in terms of a Hamiltonian functional and a functional bracket. The transformation ("lift") of the Vlasov-Maxwell bracket [1,2] induced by the dynamical reduction of single-particle dynamics is investigated when the reduction is carried out by Lie-transform perturbation methods. The ultimate goal of this work is to derive explicit Hamiltonian formulations for the guiding-center and gyrokinetic Vlasov-Maxwell equations that have important applications in our understanding of turbulent magnetized plasmas.

In particular, we investigate how the Hamiltonian properties of the reduced Vlasov-Maxwell bracket survive (1) the *closure* problem: the process of truncation of the guiding-center Vlasov-Maxwell bracket at a finite order in ϵ (so far expressions have been derived at all orders in ϵ) and (2) the *averaging* problem: the process by which which the gyroangle is eliminated from the guiding-center Vlasov-Maxwell bracket (since guiding-center Vlasov-Maxwell equations do not involve the fast gyromotion time scale).

[1] P.J. Morrison, PoP 20 (2013) 012104.
[2] A.J. Brizard, P.J. Morrison, J.W. Burby, *et al.*, submitted for publication.

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