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Pullback approach for gyrokinetic electromagnetic simulations

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Recently, the pullback approach has been suggested for gyrokinetic electromagnetic simulations [1]. It has been verified in global tokamak and stellarator particle-in-cell simulations, where various kinds of Alfvenic instabilities have been considered. It has been found that the pullback scheme is a very powerful mitigation technique for the so-called cancellation problem appearing in the conventional formulation of the gyrokinetic theory. The mixed-variable formulation of the gyrokinetic theory [2] used in the pullback approach is tailored in such a way that the cancellation problem is minimised through the choice of the phase-space coordinates. Recently, the pullback scheme has been further developed to be applicable for fully-nonlinear simulations [3] and to include collisions into the electromagnetic simulations. A consistent field-theoretical formulation of the mixed-variable gyrokinetics using a variational principle based on the phase-space Lagrangian has been developed. This formulation provides explicit expressions for the energy and momentum conservation laws appearing as Noether's invariants of the theory.

In my talk, I will briefly review the cancellation problem and the conventional mitigation techniques. I will describe the mixed-variable formulation of the gyrokinetic theory and introduce the pullback mitigation scheme. Finally, I will present the state of the art of our work on this subject.

References

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