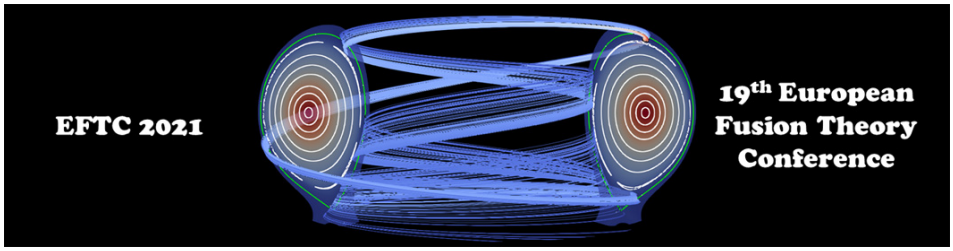


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# Gauge-free gyrokinetic models for hybrid-kinetic simulations of magnetized fusion plasmas

*Friday 15 October 2021 15:40 (40 minutes)*

What if you are interested in performing a particle simulation with kinetic electrons and gyrokinetic ions? In principle, the kinetic motion of electrons is described in terms of electric and magnetic fields, while the standard gyrokinetic motion of ions is described in terms of electric and magnetic potentials. The dependence of standard gyrokinetic theory on perturbed potentials, instead of perturbed fields, introduces the requirement of specifying a choice of gauge. Of course, you might decide to use the potential representations of the electromagnetic fields in your kinetic description, but that seems wrong to be moving away from physical fields. In this tutorial talk, I will show how standard gyrokinetic theory can be transformed into a gauge-free gyrokinetic theory, which is entirely expressed in terms of the perturbed electric and magnetic fields. A gauge-free gyrokinetic model can be used for hybrid-kinetic simulations of magnetized plasmas in which particle species can be represented in terms of either a Vlasov kinetic description or a gauge-free Vlasov gyrokinetic description. Explicit conservation laws of energy and toroidal angular momentum associated with an axisymmetric background magnetic field can also easily be constructed.

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