A Novel Implicit Solver for the Vlasov-Maxwell System*

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We present a novel method for solving Maxwell's equations, designed specifically to solve the Vlasov-Maxwell system. In such problems, the relevant plasma phenomena exist over a time scale that is long compared to that introduced by the speed of light. Our solver is built with the intent to accurately and efficiently simulate electrodynamics problems, but that can also transition to an efficient magnetostatic solver.

Our numerical method is based on using the method of lines transpose to formulate a boundary integral solution to Maxwell's equations. This method of solution is implicit, and therefore removes the restrictive CFL condition imposed by the speed of light upon explicit methods. Additionally, our method is asymptotic preserving, in the sense that the numerical solutions we obtain transition from hyperbolic to elliptic. Finally, the obtained Green's functions from our formulation drop off exponentially in space, and so fast summation techniques can be utilized to rapidly evaluate the convolution terms that appear in our boundary integral solution.

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