Structure-preserving finite-element particle-in-cell methods for the Vlasov-Maxwell system

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In this talk, we present a finite-element particle-in-cell discretization of the Vlasov-Maxwell equation in a semi-discrete Poisson structure. In order to preserve the de Rham complex formed by the physical quantities in the Maxwell system, we use spline bases functions forming a discrete de Rham complex. For a reduced system of one spatial and two velocity dimensions, we design two types of fully discrete systems: An energy-preserving time discretization is derived applying the average-vector-field method combined with an antisymmetric splitting of the Poisson structure. This yields a semi-implicit method. Moreover, we derive an explicit Hamiltonian splitting that preserved the Poisson structure. Numerical results are shown for the Weibel instability test case.