## Subcycling of particle orbits in variational electromagnetic particle-in-cell methods

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In this talk, we will discuss subcycling of particle orbits in variational particlein-cell methods for the Vlasov–Maxwell system in magnetized plasmas. The purpose of subcycling is to allow different time steps for different particle species and, ideally, time steps longer than the electron gyroperiod for the global field solves while sampling the local cyclotron orbits accurately. An algorithm that is explicit in time can be achieved when the magnetic field is properly orbitaveraged but the electric field impulse is evaluated only once per the subcycling period. On the other hand, we propose an implicit variant with proper orbit-averaging of the electric field. The considered algorithms retain the electromagnetic gauge invariance of the discrete action, guaranteeing a local charge conservation law, while the variational approach provides a bounded long-time energy behavior.

## References

 E. Hirvijoki, K. Kormann, F. Zonta: Subcycling of particle orbits in variational electromagnetic particle-in-cell methods, Phys. Plasmas 27, 092506 (2020)