

9th Summer School

Plasmas in super-intense laser fields



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Numerical simulations for laser-plasma interactions

Numerical simulations represent an invaluable tool for the study of plasma physics and high-intensity laser-plasma interactions. They provide a way to address the complexity of the underlying physics thereby integrating and complementing experiments and theory. In this series of lectures, we will overview the main numerical methods typically used in kinetic simulations of collisionless plasmas, i.e. particle-in-cell simulations.

The structure of the lectures is the following:

- Importance and capabilities of numerical simulations
- Vlasov-Maxwell system
- Finite differences
- Approximation of a charged particle motion in given electromagnetic fields
- Approximation of Maxwell equations with given sources
- Particle-in-cell method
- Examples and visualizations suitable for laptops
- Examples and visualizations of supercomputer-based numerical campaigns

These lectures are also meant to give the students the basic tools, knowledge, and material to start performing their own simulations.