Numerical Study of multiscale phenomena in magnetized plasma

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The latest results of plasma physics problems modeling with the codes, developed by the authors [1,2], are presented. The majority of plasma instabilities were studied by particle-in-cell codes since the development of this method in 1970-1980 years, but even now the 3D3V instabilities (such as Weibel instability [3]) are of scientific interest even now. The same can be said of the later turbulent stages of previously studied instabilities. Only with the progress of the computer technologies the simulation becomes possible.

It is important to choose the adequate mathematical model, boundary conditions, numerical parameters for each problem statement of a simulation. It is necessary to take into account the accuracy of simulation as well as the cost of computational resources and simulation time.

In this paper the process of parameter choice is presented for a problem of Weibel instability simulation. Three separate problems are studied. (1) Two cold relativistic beams with opposite velocities. (2) Two relativistic beams with opposite velocities and finite thermal velocity (3) laser interaction with overdense plasma.

First two problems give an insight to optimal parameter choice for Weibel instability study in complex plasma systems. With the simulation of the third problem it is shown that the energy loss for magnetic field generation may be up to 5%.

References

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