Hybrid-Vlasov simulation of plasma instabilities: first results from Vlasiator

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The newly developed code called Vlasiator simulates the dynamics of plasma using the hybrid-Vlasov model, where plasma ions are described by a full six-dimensional distribution function in ordinary and velocity space and electrons are modelled as a charge-neutralizing fluid. The Vlasiator code solves kinetic Vlasov equation for ions and ideal MHD equations for electron fluid. The code is engineered to run in a massively parallel setup on modern supercomputers using hybrid MPI-OpenMP parallelisation. First results of modelling plasma instabilities using Vlasiator in magnetosheath-type plasma environment will be presented. Large-scale shear flow instabilities, such as Kelvin-Helmholtz instability, will be considered, as well as the medium-scale mirror mode instability resulting from large temperature anisotropy across the magnetic field in high-beta magnetosheath plasma. Also the firehose instability typically occurring in the solar wind plasma will be considered. It will be shown that the new hybrid-Vlasov code is able to reproduce known features of the key instabilities.