Parallelization of a Vlasov plasma simulation code

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In this study we are interested in the ion-acoustic instability driven by a drift velocity between ions and electrons. A common way to deal with this kind of problems is to use a Vlasov code. Because of the different time scale (electron/ion) involved, this kind of code is time consuming.

Nowadays, clusters are becoming increasingly popular. One solution for decreasing the computation time is to parallelize the code in order to make it run on Kraken (one of the clusters available in our institute). Several methods of parallelization are available. The most common are OpenMP and MPI. And, as clusters of shared memory nodes become the dominant parallel architecture, a new method is emerging - the hybrid programming - using the advantages of OpenMP and MPI.

The code has been parallelized using three different approaches: a pure OpenMP, a pure MPI and a hybrid approach. Their results have been compared.

However, because of the bad efficiency of these methods, we developed a domain decomposition scheme, which appeared to be very effective with our code.

First, we will present the different parallelization methods. Then we will introduce our domain decomposition scheme. And finally, we will show the first results obtained with a realistic case.