

MHD-PIC interlocked simulation model in space plasma: application to collisionless shocks

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A new simulation model has been developed to understand the multi-scale coupling in space plasmas. In this new model, so-called macro-micro interlocked simulation, Hall-MHD and PIC simulations are simultaneously performed, and the mutual interaction between them is handled self-consistently. The model can treat MHD-scale dynamics including particle kinetic effects. Here we have applied this interlocked simulation model onto a collisionless shock problem. Hall MHD simulation covers the whole system, and, only in the shock transition region, PIC simulation is performed to incorporate the wave-particle interaction. It has been demonstrated that the interlocked model can work well for the shock-related multiscale coupling process, in which the whistler waves excited in the shock transition region propagates into the upstream region and modifies the incoming plasma flow. The results are a good indication of the validity and the effectiveness of the new model for the multiscale plasma processes.