Multiscale Simulations of Magnetohydrodynamic Flows

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Many problems in magnetized plasmas are inherently multiscale in nature where the small scale dynamics at the limit of the MHD approximation has a major impact on the dynamics on global scales. Prominent examples are magnetic reconnection, filamentation instabilities and turbulence. In most applications, the flow is compressible and should be treated numerically with an appropriate conservative scheme. A common technique to handle the multiscale nature in these flows is the application of block structured adaptive mesh refinement to resolve the small scales without too much effort. In this talk, I will give an overview of various techniques for conservation laws, methods to deal with the div B = 0 problem and ways to treat special complications which arise in adaptive mesh refinement simulations on massive parallel machines (# CPUs > 8.000). Since the topics mentioned above are not only multiscale but also multiphysics problems, I will give an outlook on the next step for coupling multiscale fluid simulations on global scales with kinetic simulations in nonideal regions.