Full device 6D modelling of magnetically confined plasmas with fully kinetic ions and electrons

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There are processes in magnetically confined plasmas where electron physics is important and where the assumption that the phase space can be reduced to 5 dimensions breaks down. An important example is reconnection, where in the vicinity of the reconnection site the electron physics becomes fully 6D. Implicit PIC provides a useful approach to model full devices. We present the Energy Conserving Semi Implicit (ECsim) method [1] that allows the treatment of macroscopic problems with full 6D description. The resolution can be chosen based on the accuracy needed without lack of energy conservation. Energy remains exactly conserved to machine precision, a feature that greatly reduces the onset of numerical instabilities. ECsim has been developed into a massively parallel code that runs efficiently on the world's top supercomputers[3] (see Fig. 1) The code has been applied to 2D cylindrical problems [4] and to fully 3D models of fusion devices [5]. We report on the latest developments that include new HPC performance developments, the application to tokamak and a new algorithm for exact charge conservation.

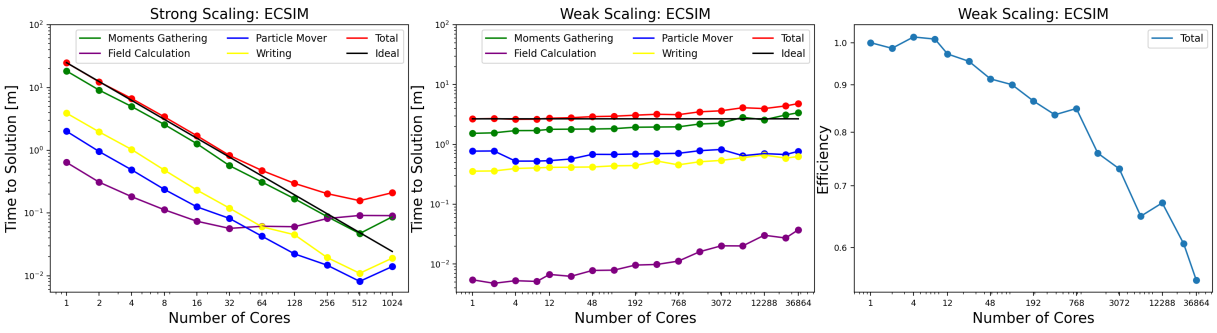

Figure 1: *Weak and strong scaling on the German SuperMUC-NG computer, made available by a PRACE Tier-0 allocation*

References

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