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A finite element elliptic solver for gyrokinetic particle simulations in a global field aligned mesh Y. NISHIMURA, Z. LIN, UC-Irvine, M.F. ADAMS, D.E. KEYES, Columbia University, W. LEE, J. MANICKAM, PPPL — In the presence of non-adiabatic kinetic electrons, the inversion matrix for the gyrokinetic Poisson equation is no longer diagonally dominant. An iterative method cannot be applied. The challenge is to develop an efficient solver applicable to a global field-aligned mesh with a resulting matrix of rank of order a million. A new finite element solver is developed with the aid of an algebraic multigrid (AMG) method, employing PETSc,[1] *hypre*,[2] and Prometheus.[3] The field aligned mesh can be applied to the open-field-line regions as long as the magnetic field is given by the Clebsch form $\mathbf{B} = \nabla\psi \times \nabla(\theta - \zeta/q)$. As one of the exercises, we apply our finite element field solver to a tokamak divertor geometry. This work is supported by Department of Energy, Scientific Discovery through Advanced Computing (SciDAC).

[1]PETSc: Portable Extensible Toolkit for Scientific computation, (http://www-fp.mcs.anl.gov).
[2]*hypre*: high performance preconditioners (http://www.llnl.gov/casc).
[3]Prometheus: (http://www.columbia.edu/ ma2325/prometheus).

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