# Global Gyrokinetic Particle-in-cell Simulations with Trapped Electrons*

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The treatment of electron dynamics in global, toroidal, gyrokinetic Particle-in-Cell (PIC) codes represents a major challenge. As it was recently demonstrated, it is physically[1,2] and computationally[3] meaningful to follow dynamically only the nonadiabatic part of the electron response. This approach, however, requires the global solution of a Poisson-like equation for the so-called polarization field[1], $\chi \equiv \partial\Phi/\partial t$, where $\Phi$ is the electrostatic potential. The overall viability of the scheme depends crucially on the efficiency of the solution of the Poisson-like equation for $\chi$. To address this issue, a finite-difference based matrix $A$ is generated and the inversion of $A\mathbf{x} = \mathbf{b}$ (where the number of unknowns is typically in the range of $N \in [10^5 - 10^7]$) is carried out using the PETSC[4] library routines. A complementary approach based on the finite element method can also be used to perform the inversion of $A$ (Y. Nishimura *et al*; this conference). An algebraic multigrid (AMG) solver from the hypre[5] library is used as a preconditioner for the matrix $A$. The elliptic solver is compatible with the parallel structure of the GTC code[6]. Preliminary results of ITG turbulence with trapped electrons will be reported.

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