# Dynamic Modeling of Equilibrium in XGC Gyrokinetic Simulations of Pedestal Evolution

A. Pankin[1], G. Bateman[1], C.S. Chang[2], S. Ko[3], A. Kritz[1],
S. Ku[2], L. LoDestro[4], L.D. Pearlstein[4], G. Park[2], H. Strauss[2]

1. Lehigh University, USA; 2. New York University, USA;
3. Kaist, Korea; 4.Lawrence Livermore National Laboratory, USA

Abstract for the 2007 Transport Task Force Meeting

Improvements in numerical algorithms and computer resources have made it possible to run advanced gyro-kinetic simulations for longer physical times. During lengthy gyro-kinetic simulations, the plasma profiles can change significantly from the initial equilibrium profiles. In advanced hybrid modeling, which combines gyro-kinetic and MHD codes, it is important to update the equilibrium in a self-consistent manner during the course of the simulation. It is particularly important to compute accurate equilibria with fine resolution in the pedestal region where pressure gradients and the bootstrap current density are large. In order to address this issue, the TEQ equilibrium module will be implemented in the XGC gyro-kinetic code. The direct (free-boundary) equilibrium solver and the inverse (prescribed-boundary) equilibrium solver are two independent components of the TEQ module. The direct equilibrium solver computes the equilibrium profiles for whole plasma including the closed and open magnetic surface regions. The inverse equilibrium solver provides a solution only in the closed magnetic surface region in the plasma core up to the separatrix. The inverse equilibrium solver from the TEQ module is being implemented and validated in the XGC code. An algorithm is being developed for determining the conditions under which updating of the equilibrium is required. In addition, the direct equilibrium TEQ solver is being tested in the XGC and it will be validated for routine use within gyro-kinetic simulations. It is expected that the TEQ equilibrium solver within the XGC code will improve the numerical convergence and robustness of the gyro-kinetic simulations. The combined codes will extend the simulations to new physical time domains.