

# Algorithms for High-Performance Global Gyrokinetic PIC Simulations of ITER-size Plasmas

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High-physics-fidelity predictive simulation capability is crucial to understand the confinement properties of magnetically confinement plasmas, e.g. ITER. While the gyrokinetic PIC method has been well established to study low-frequency turbulence, significant challenges remain, e.g. numerical noise issue for long time simulation, computational cost for high fidelity simulation. In this talk, we will present the algorithm and software advances in the modern Gyrokinetic Toroidal Code, GTCP, addressing noise issue and the scalability of the code on high-end computing platforms. We present our latest results in simulating long-time evolution of Ion-Temperature-Gradient (ITG)-driven plasma turbulence on Mira, the third generation BG/Q system at Argonne National Laboratory. This highly efficient code has achieved a 5x performance enhancement compared with the previous version and clearly demonstrates that advanced mathematical algorithm and high performance computing can lead to a significant return in solving a complex problem.