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Extreme-scale high-fidelity simulation of tokamak edge plasma en route to exascale computing[1] C.S. CHANG, PPPL, M. SHEPHARD, RPI, S. KLASKY, ORNL, S. PARKER, U. Colorado, L. CHACON, LANL, P. WORLEY, PHWorley Consulting, MARK ADAMS, LBNL, M. GREENWALD, MIT, E. D'AZEVEDO, ORNL, S. KU, PPPL, THE SCIDAC HBPS TEAM TEAM —
XGC is a high-fidelity gyrokinetic code aiming at understanding the difficult plasma dynamics in the edge region of a tokamak reactor. Tokamak edge plasma is in a non-Maxwellian state, dominated by several multiscale multi-physics kinetic dynamics in complicated geometry that includes divertor and magnetic X-point. In order to solve this difficult problem, XGC is designed to utilize extreme scale computers, eventually aiming for exascale and post-exascale computers. XGC was in the early science program (ESP) for Summit, is in the ESP for the upcoming exascale computer Aurora, and in the ESP for the upcoming Permutter at NERSC. XGC is also a SciDAC and ECP code. We will present the performance of and the scientific achievements by XGC on the US leadership class computers Titan, Summit, Theta and Cori. The scientific achievements presented here would not have been possible without such leadership class computers, which include the L-H bifurcation dynamics, divertor heat-flux width for ITER, neutral particle effect on edge turbulence, RMP-turbulence interaction, pedestal shape in ITER, blob dynamics, etc. We will also present the future plans toward exascale computing.

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