Progress on FY2008 Second Quarter Milestone

The second quarterly milestone for the FY2008 JOULE Theory Milestone states that MIT shall "*Validate an Alcator C-Mod LH simulation with TORIC-LH on the CRAY XT3/XT4 Jaguar facility using 1000 radial elements and 1023 poloidal modes.*". This milestone was accomplished. The simulation was not performed on the CRAY XT3/XT4 Jaguar Computer at Oak Ridge National Laboratory however, since we no longer have access to that facility. Instead, the calculation was performed on the Loki computing cluster at the MIT Plasma Science and Fusion Center. The simulation utilized 256 processor cores for 5.6 hours of wall clock time, for a total of 1434 CPU hours. This work was performed by Dr. John Wright at MIT and preliminary results were presented at the 2008 International Sherwood Fusion Theory Conference (March 31, 2008 – April 2, 2008), in a paper titled "*Full-wave Electromagnetic Field Simulations of Lower Hybrid Wave Propagation in ITER Relevant Regimes*". The parameters used for the second quarter Joule milestone simulation are characteristic of LHRF experiments in the Alcator C-Mod device at MIT with B_0 = 5.4 T, $n_e(0) = 7 \times 10^{19}$ m^{-3}, $T_e(0)$ = 2.2 keV, and f_0 = 4.6 GHz. Spectral plots of the fast Fourier transform (FFT) of the parallel electric field of the wave versus poloidal mode number, plotted on different flux surfaces demonstrates the solution is almost converged. It will require about 2047 modes to fully converge the solution, which was expected initially.

During the third quarter we plan to test the scaling of the full-wave solver to 2047 poloidal modes. Thus far, CPU requirements have scaled as expected as the number of poloidal modes has been increased from 127 to 1023 and it is anticipated that the full-wave simulation with 2047 poloidal modes will require about 10^4 CPU hours, being run on 256 processor cores for about 39 wall clock hours. We shall also carry out verification studies to confirm that the physics kernel of the full-wave solver is behaving properly. This will consist of scanning the impressed wave phase speed and the thermal electron temperature in order to observe if the spatial location of the wave absorption changes as expected. The background electron density will also be varied in order to study physical effects related to wavelength variation such as focusing and diffraction. Finally, we shall begin to carry out comparisons between the absorption and propagation predicted by the full-wave solver and a torodial ray tracing treatment.