Ultrahigh Resolution Simulations of Mode Converted Ion Cyclotron Waves and Lower Hybrid Waves

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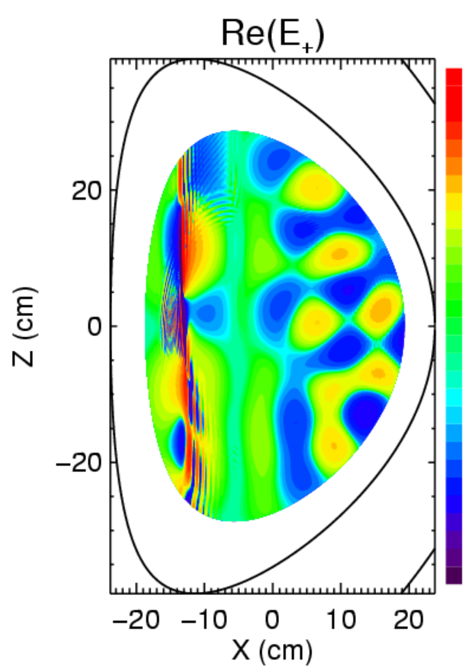
Full Wave (FW) studies of mode conversion (MC) processes in toroidal plasmas have required prohibitive amount of computer resources in the past because of the disparate spatial scales involved. The `TORIC` code solves the linear fourth order reduced wave equation for the ion cyclotron range of frequencies (ICRF), in toroidal geometry using a Fourier representation for the poloidal dimension and finite elements in the flux dimension. The range of problems that `TORIC` can do has been extended through both new serial algorithms and parallelization of memory and processing. The implementation of out-of-core memory management, FFT convolutions, and improved memory management brought MC studies just into range of the serial version of the code running on a Nersc Cray SV1. Some simple tests and arguments show that more resolution that is possible on a single processor system is needed to fully resolve these scenarios. By distributing the large linear system across many processors in conjunction with the out-of-core technique, the resolution limitations are effectively removed. ScaLapack is used to do the linear algebra operations and mpi is used to distribute the significant amount of postprocessing. The new parallel version of the code can easily do the most difficult MC problems on present day tokamaks(Alcator C-Mod and Asdex-Upgrade), including the first converged MC case from Asdex-Upgrade, with only 32 pc from a local Beowulf cluster. Using all 48 processors allows us to do problems in the lower hybrid range of frequencies.



This figure shows the real positively polarized electric field in a $480N_\psi \times 1023N_m$ mode conversion simulation.Three separate wave scales may be seen. The ICRF propagates in from the right. On axis, the IBW continues to the right at r=-10cm. Off axis, particularly below the midplane, the ICW is clearly seen propagating to the right to the low field side. Also, the evanescent region at r=-6cm to the right of the MC layer is unmistakable.