Time Dependent evolution of RF-generated non-thermal particle distributions in fusion plasmas

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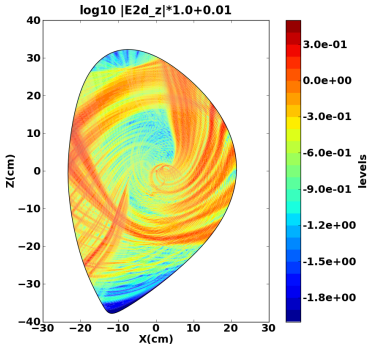
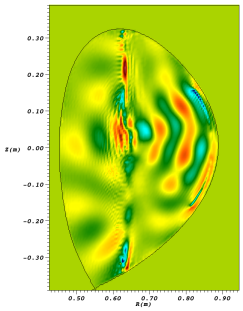
We describe fully self-consistent time dependent simulations of radio frequency (RF) generated ion distributions in the ion cyclotron range of frequencies and RF generated electron distributions in the lower hybrid range of frequencies using combined Fokker-Planck and full wave electromagnetic field solvers. In each regime, the non-thermal particle distributions have been used in synthetic diagnostic codes to compare with diagnostic measurements from experiment, thus providing validation of the simulation capability. The computational intensive simulations require multiple full wave code runs that iterate with a Fokker-Planck(FP) code. A python framework has been used to facilitate the coupling between the multiple codes and ensure consistency of physics and mesh inputs.

We will discuss advanced algorithms that have been implemented to accelerate both the massively parallel full wave simulations as well as the iteration with the distribution code. A vector extrapolation method [Sidi,A. 2008 *Comput. Math. Appl., Pergamon Press, Inc.*, **56**] that permits Jacobian free acceleration of the traditional fixed point iteration technique is used to reduce the number of iterations needed between the distribution and wave codes to converge to self-consistency. The computational burden of the lower hybrid parallel full wave code has been reduced by using a more efficient three dimensional parallel decomposition that improves the strong scaling of the code and reduces the communication overhead.



TORLH/CQL3D simulation of LH weak damping regime in Alcator C-Mod ($n_{||}$ = -1.6). The RF electric field parallel to the magnetic field is shown for a single toroidal mode.



AORSA/CQL3D simulation of ICRF minority heating in Alcator C-Mod (n_ϕ = 10). The real postive circular polarized component of the electric field parallel to the magnetic field is shown.