A Fully-Neoclassical Finite-Orbit-Width Version of the CQL3D Fokker-Planck Code

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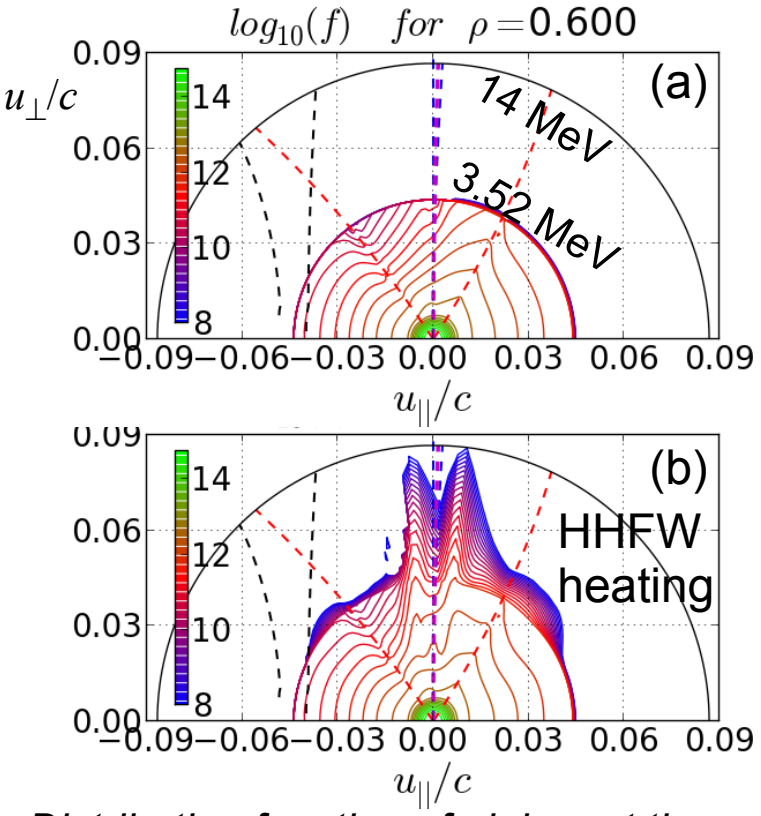
The recently developed finite-orbit-width (FOW) fully-neoclassical version of the CQL3D code (Petrov and Harvey, PPCF, 2016) coupled to GENRAY demonstrates that fusion-born alpha-particles can absorb ~50% of high-harmonic fast wave (HHFW) power in ITER.

T_{e0}= 30 keV, T_{D0}=T_{T0}= 32 keV, n_{e0}= 7e19 m^{-3}, 50/50 % mix of D+T,

B_0 = 4.75 T, I_p = 7.6 MA, f_{RF} = 500 MHz, initial $n_{||} \cong$ 1–5.

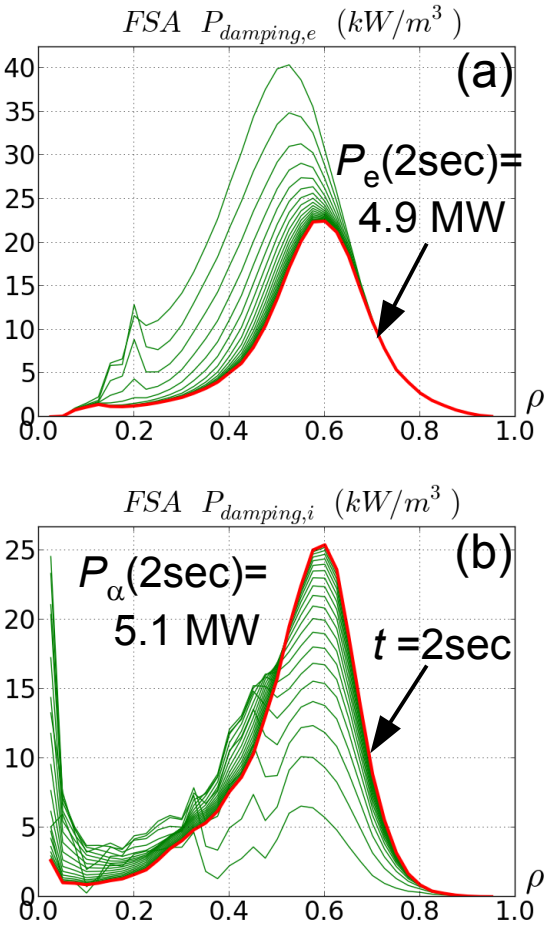


Distribution function of alphas at the midplane point ρ = 0.6: (a) no RF heating, and (b) with heating by HHFW waves. The solutions are at t =2sec, approximately steady-state.

HHFW generates a high-energy tail in the distribution beyond 3.52 MeV, especially at pitch angles close to $\pi/2$.

The region of highest damping, $\rho \cong 0.6$ on the midplane, corresponds to damping on the 15th and 16th harmonics.

Alpha particle power absorption can be a substantial parasitic effect in current drive by HHFW in ITER.



Self-consistent profiles of power deposition from HHFW waves: (a) to electrons, and (b) to alphas at different time steps, with the last one, at t = 2 sec, marked by the red line.