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# Towards a self consistent evaluation of the RF wave-field and the ion distribution functions in tokamak plasmas

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The injection of fast waves (FW) in the ion cyclotron range of frequency (ICRF) is a well-established method of heating and driving current in magnetically confined toroidal plasma and it will play an important role in the ITER experiment. Taking into account self-consistently the interaction of FW with both the minority ion population and fast-ion / neutral beam populations is a crucial aspect to more faithfully model and understand experimental results and to more accurately design future devices. This paper examines precisely this aspect combining the evaluation of the wave-field, through a full wave solver, with the ion distribution function provided by either a Monte-Carlo particle or Fokker-Planck codes. The recent extension of TORIC v.5 to include non-Maxwellian distribution functions (both in minority and high harmonic heating regimes) is employed in this work. First, for the case of the thermal distribution function, the extended TORIC v.5 has been verified against the standard TORIC v.5 showing an excellent agreement both in IC minority and high harmonic fast wave (HHFW) heating regimes. Second, an implementation of the bi-Maxwellian and slowing down analytical distributions has also been done. The application of such distributions shows different behavior in the total absorbed power between the IC minority and HHFW heating regimes. In particular, for IC minority heating regime, the total absorbed power at the H fundamental is insensitive to variations in the perpendicular temperature, but varies with changes in parallel temperature, whereas for HHFW regime, the behavior is the other way around, although power deposition profile varies with changes in the parallel temperature. Third, a comparison of the wave electric field and the power deposition profile with a slowing-down and a numerical distribution function obtained from the Monte-Carlo NUBEAM module is presented and discussed. First attempts to apply the close iterative loop between the extension of TORIC v.5 in a self-consistent way and the NUBEAM module are also discussed and presented. Finally, for the IC minority regime, a self-consistent distribution function will be then obtained by iterating TORIC v.5 and the Fokker-Planck code CQL3D through the quasilinear diffusion coefficients, which has been recently derived and implemented in TORIC v.5, and the non-Maxwellian dielectric tensor.

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