

2D full-wave simulations of high harmonic fast waves in the scrape-off layer of NSTX/NSTX-U

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In this presentation, we perform full-wave simulations using recently developed 2D full-wave (FW2D) code [1, 2] for high harmonic fast wave (HHFW) in the scrape-off layer (SOL) of NSTX and NSTX-U. The SOL region, the region of the plasma between the last closed flux surface and the tokamak vessel, is important for radio frequency wave heating of tokamaks because significant wave power loss can occur in this region - for instance, up to 60% of the coupled HHFW power can be lost in the SOL of NSTX [3,4]. We first adopt a rectangular boundary to benchmark with previous AORSA simulation results [5]. As results, FW2D and AORSA simulations show an excellent agreement and the maximum energy loss ratio in the SOL increases up to 25% for $\nu/\omega = 0.01$ as shown in Figure 1, where ω and ν are the HHFW wave and collisional frequencies, respectively. The realistic limiter boundary is also adopted in the FW2D code. FW2D results with a limiter boundary are significantly different to results with the rectangular vessel boundary. Moreover, we found that the energy loss ratio in the SOL is sensitive to SOL size and is significantly reduced in the smaller SOL.

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[5] N. Bertelli et al., 2014, Nuclear Fusion, 54, 083004.

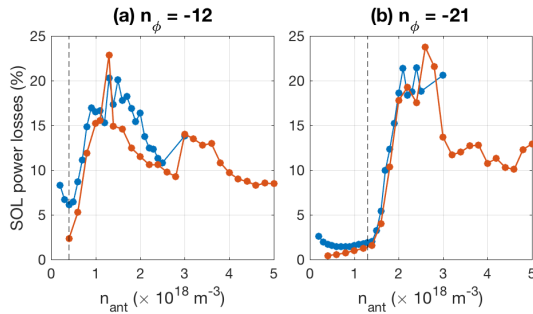


Figure 1. Fraction of power lost to the SOL calculated by FW2D (red lines) and AORSA (blue lines) as a function of the density in front of the antenna for (a) $n_\phi = -12$ and (b) $n_\phi = -21$ for an NSTX shot 130 608, where n_ϕ is the toroidal wave number. The vertical lines represent the value of the density for which the FW can propagate in the SOL. The results from FW2D show excellent agreement with AORSA.

References

- [1] E.-H. Kim et al., 2015, Geophys. Res. Lett., 42, 5147.
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- [3] J. Hosea et al., 2008, Phys. Plasmas 15, 056104.