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Fast wave heating and edge power losses in NSTX and NSTX-U[1]

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Experimental studies of high harmonic fast wave (HHFW) heating on the National Spherical Torus Experiment (NSTX) have demonstrated that substantial HHFW power loss can occur along the open field lines in the scrape-off layer (SOL), but the mechanism behind the loss is not yet understood [1]. Extended ray tracing and full wave codes are being applied to specific NSTX discharges in order to predict the causes of this power loss. Previous full wave simulations predict that cavity-like modes may form outside of the LCFS [2]. We find that inserting a collisional loss in the SOL of AORSA to represent a damping process indicates an effective collisional term of $\nu/\omega \sim [0.05 - 0.1]$ which is considerably larger than the $\nu/\omega \sim 0.005$ obtained with Spitzer resistivity, suggesting the damping scale of the loss mechanism. The magnitude of the edge collisional losses are being used to evaluate possible potential damping mechanisms in the SOL. Initial numerical analyses show that the presence of the SOL has a significant impact on the launched antenna spectrum. The upgrade of NSTX, NSTX-U, will operate with toroidal magnetic fields (B_{T}) up to 1 T, nearly twice the values used on NSTX. The doubling of B_{T} while retaining the 30 MHz RF frequency moves the heating regime for NSTX-U to the mid harmonic fast wave (MHFW) regime [3], which will be analyzed and contrasted with the HHFW regime on NSTX. These studies indicate that direct ion damping might be more significant in NSTX-U under TRANSP predicted full performance conditions. Modifications of fast ion distributions due to the interaction of fast waves with NBI will be presented in both MHFW and HHFW regimes.

[1] R. J. Perkins et al, Phys. Rev. Lett. 109, 045001 (2012).
[2] D. L. Green et al, Phys. Rev. Lett. 107, 145001 (2011).
[3] N. Bertelli et al, 20th Topical Conf. on RF Power in Plasma (2013), to be published in AIP Conference Proceedings.

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