HHFW Heating Efficiency on NSTX versus B_Φ and Antenna $k_{||}$* J. Hosea[1], R. Bell[1], S. Bernabei[1], L Delgado-Aparicio[2], B. LeBlanc[1], C. K. Phillips[1], P. Ryan[3], S. Sabbagh[4], K. Tritz[2], J. Wilgen[3], J. R. Wilson[1], H. Yuh[5] and the NSTX Team
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HHFW RF power delivered to the core plasma of NSTX is strongly reduced as the launched wavelength is increased – for B_Φ= 4.5kG, heating is ~ 1/2 as effective at - 7m^{-1} as at 14 m^{-1} and ~ 1/10 as effective at - 3m^{-1}. Measured edge ion heating, attributable to parametric decay (PDI), increases with wavelength as well but does not increase fast enough to account for the observed power loss. Surface fast waves (FW) may enhance both PDI and also losses in sheaths and structures around the machine – FW fields propagate closer to the wall with decreasing B_Φ and $k_{||}$ (onset $n_e \propto B_\Phi \times k_{||}^2$). A dramatic increase in core heating efficiency is observed at - 7m^{-1} when B_Φ is increased to 5.5 kG – central T_e near 4 keV at P_{RF} = 2 MW. Also, the PDI losses are a weak function of B_Φ and $k_{||}$, whereas the far-field RF poloidal magnetic field (at 5.5 kG) increases a factor of ~ 3 when $k_{||}$ is reduced from 14m^{-1} to - 3m^{-1}, suggesting a large increase in wall/sheath power loss. The greatly improved coupling conditions at B_Φ = 5.5 kG are now supporting HHFW current drive and plasma velocity studies with MSE and CHERS. The implications for the role of surface wave losses for HHFW and IC heating regimes will be discussed.
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