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Suppression of turbulent transport in NSTX internal transport barriers[1]

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Electron transport will be important for ITER where fusion alphas and high-energy beam ions will primarily heat electrons. In the NSTX, internal transport barriers (ITBs) are observed in reversed (negative) shear discharges where diffusivities for electron and ion thermal channels and momentum are reduced. While neutral beam heating can produce ITBs in both electron and ion channels, High Harmonic Fast Wave (HHFW) heating can produce electron thermal ITBs under reversed magnetic shear conditions without momentum input. Interestingly, the location of the electron ITB does not necessarily match that of the ion ITB: the electron ITB correlates well with the minimum in the magnetic shear determined by Motional Stark Effect (MSE) [1] constrained equilibria, whereas the ion ITB better correlates with the maximum E$\times$B shearing rate. Measured electron temperature gradients can exceed critical linear thresholds for ETG instability calculated by linear gyrokinetic codes in the ITB confinement region. The high-k microwave scattering diagnostic [2] shows reduced local density fluctuations at wavenumbers characteristic of electron turbulence for discharges with strongly negative magnetic shear versus weakly negative or positive magnetic shear. Fluctuation reductions are found to be spatially and temporally correlated with the local magnetic shear. These results are consistent with non-linear gyrokinetic simulations predictions showing the reduction of electron transport in negative magnetic shear conditions despite being linearly unstable [3]. Electron transport improvement via negative magnetic shear rather than E$\times$B shear highlights the importance of current profile control in ITER and future devices. [1] F.M. Levinton, H. Yuh et al., PoP **14**, 056119 [2] D.R. Smith, E. Mazzucato et al., RSI **75**, 3840 [3] Jenko, F. and Dorland, W., PRL **89** 225001

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