Microtearing instabilities and electron transport in NSTX

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While ETG turbulence is a popular candidate for the explanation of anomalous electron transport in tokamaks, microtearing modes also may be particularly important in spherical tokamaks due to their low magnetic field. These modes can be the fastest growing modes at low $k_\theta \rho_s$ in NSTX[1] and MAST[2]. Microtearing modes have odd parity electrostatic eigenfunctions, are extended along field lines and they propagate in the electron diamagnetic drift direction. Such analysis was extended to NSTX data recently. Estimates of their effects on electron transport[3] based on existing nonlinear theory[4] are within the uncertainties of the transport analysis of our experimental data in a H-mode plasma with normal magnetic shear where the island overlap criterion is easily satisfied. The good agreement spans over the entire region where there is a steep electron temperature gradient which drives the microtearing instability; no adjustable parameter is needed. This should not be a surprise because the assumptions based on which the theory was formulated are true. Tearing modes with high mode numbers are found to be stable in a plasma with reversed magnetic shear. This can be a viable explanation for the substantially higher central electron temperature observed[5] in this reversed shear plasma.

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References

[1]M.H. Redi et al, Proc. 30th Conf. Control. Fusion Plasma Phys. Pp.494 (2003)
[2]D.J. Applegate et al., Phys. Plasmas **11**, 5085 (2004)
[3]A.B. Rechester and M.N. Rosenbluth, Phys. Rev. Lett. **40**, 38 (1978)
[4]J.F. Drake et al., Phys. Rev. Lett. **44**, 994(1980)
[5]F. Levinton et al., to be published in Phys. Plasmas