Reversed shear internal transport barriers in the National Spherical Torus Experiment

H.Y. Yuh,[1], S. M. Kaye,[2] F. M. Levinton,[1] E. Mazzucato,[2] D. R. Mikkelsen,[2] D. R. Smith,[3] R. E. Bell,[2] J. C. Hosea,[2] B. P. LeBlanc,[2] J. L. Peterson[2]

[1]Nova Photonics Inc., Princeton, New Jersey 08540, USA
[2]Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08543, USA
[3]Dept. of Eng. Physics, University of Wisconsin-Madison, Madison, Wisconsin 53706, USA

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. Sufficiently negative magnetic shear is found to be necessary to suppress electron turbulence and improve electron thermal transport sufficiently to transition out of a stiff T_e profile regime. While $E \times B$ shear appears to explain the ion ITB, the electron ITB is only observed with negative magnetic shear, with the locations of the ITBs correlating with the locations maximum $E \times B$ shear and minimum magnetic shear respectively. Fluctuation suppression and e-ITB formation in RF heated discharges with negligible $E \times B$ shear shows that negative magnetic shear alone is sufficient to suppress electron scale turbulence. Even with electron temperature gradient significantly exceeding ETG critical gradients from gyrokinetic calculations, continuous ETG mode activity is reduced to intermittent bursts, while electron thermal diffusivity improves below 0.1 electron gyro-Bohms.