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Effects of Microtearing Modes on the Evolution of Electron Temperature Profiles in High Collisionality NSTX discharges

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A goal of this research project is to describe the evolution of the electron temperature profiles in high collisionality NSTX H-mode discharges. In these discharges the ion thermal transport is generally near neoclassical levels. However, it is found that the electron thermal transport is anomalous and can limit the overall global energy confinement scaling. Gyrokinetic simulations indicate that microtearing modes (MTMs) are a source of significant electron thermal transport in these discharges. In order to understand the effect MTMs have on transport and, consequently, on the evolution of electron temperature in NSTX discharges, a reduced transport model for MTMs has been developed. The dependence of the MTM real frequency and growth rate on plasma parameters, appropriate for high collisionality NSTX discharges, is obtained employing the new MTM transport model. The dependencies on plasma parameters are compared and found to be consistent with MTM results previously obtained using the gyrokinetic GYRO code. The MTM real frequency, growth rate, magnetic fluctuations and resulting electron thermal transport are examined for high collisionality NSTX discharges in systematic scans over plasma parameters. The electron temperature gradient along with the collision frequency and plasma beta are found to be sufficient for the microtearing modes to become unstable. In earlier studies it was found that the version of the Multi-Mode (MM) transport model, that did not include the effect of MTMs, provided a suitable description of the electron temperature profiles in high collisionality standard tokamak discharges. That version of the MM model included contributions to electron thermal transport from the ion temperature gradient, trapped electrons, kinetic ballooning, peeling ballooning, collisionless and collision dominated MHD modes, and electron temperature gradient modes. When the MM model, that includes transport associated with MTMs, is installed in the TRANSP code and is utilized in studying electron thermal transport in high collisionality NSTX discharges, it is found that agreement with the experimental electron temperature profile is significantly improved. Future research will involve improving the electron thermal transport model for low collisionality NSTX discharges. *Supported by the U.S. DoE, DE-SC0013977, DE-FG02-92ER54141, and DE-AC02-09CH11466.

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