Contribution ID: **288** Type: **Oral Presentation**

EX/7-1: The Dependence of H-mode Energy Confinement and Transport on Collisionality in NSTX

Thursday, 11 October 2012 16:40 (20 minutes)

Understanding the dependence of confinement on collisionality in tokamaks is important for the design of next-step devices, which will operate at collisionalities at least one order of magnitude lower than in present generation. A wide range of collisionality has been obtained in the National Spherical Torus Experiment (NSTX) by employing two different wall conditioning techniques one with boronization and between-shot helium glow discharge conditioning, and one using lithium evaporation. Discharges with lithium conditioning generally achieved lower collisionality. The data from experiments using these different techniques differed in terms of their confinement dependence on dimensional, engineering variables; data from unlithiated discharges had a strong, nearly linear dependence on BT, with a weaker dependence on Ip. The lithiated discharges, on the other hand, tended to follow the ITER98y2 scaling. These different sets of data, however, were unified by an underlying dependence on collisionality, exhibiting a strong increase of normalized confinement time with decreasing collisionality, holding other dimensionless variables as fixed as possible. This result is consistent with gyrokinetic calculations that show microtearing and Electron Temperature Gradient modes to be more stable at lower collisionality.

This work was supported by U.S. Dept. of Energy Contract Nos. DE-AC02-09CH11466 and DE-AC05-00OR22725.

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Session Classification: Transport and Turbulence

Track Classification: EXC - Magnetic Confinement Experiments: Confinement