OVERVIEW OF PHYSICS RESULTS FROM NSTX

[1]R. Raman for the NSTX Research Team
(email: raman@aa.washington.edu)

[1] University of Washington, Seattle, WA 98195

NSTX research in toroidal magnetic confinement at low aspect ratio has made extensive use this year of both lithium coatings for wall conditioning and external non-axisymmetric field correction to reliably produce high-performance discharges extending to 1.7s in duration. Toroidal beta above 25% has been sustained for up to 0.4s. The error-field correction coils have been used to trigger ELMs for controlled ELM pace-making with high reliability and have also contributed to an improved understanding of both neoclassical tearing mode and resistive wall mode physics. Recent research on the Resistive Wall Mode (RWM) has shown that kinetic effects are important for determining the plasma rotation required to stabilize the mode. Measurements of the toroidal rotation profile in neutral beam discharges heated by RF show a slowing down of the edge toroidal velocity and at the longest launched wavelengths to clamp. Recent results from a Fast Ion D-Alpha diagnostic show a depletion of the fast ion profile over a broad spatial region as a result of toroidicity-induced Alfvén eigenmodes (TAE) and energetic particle modes (EPM) bursts. In addition, it is observed that other modes (e.g. Global Alfvén eigenmodes) can trigger TAE and EPM bursts, suggesting redistribution of fast ions by high-frequency AEs. NSTX results also show the pinch velocity to decrease as the collisionality is reduced a result of particular importance to ITER as it will have limited external momentum input. In NSTX helium plasmas, it was found that P_{LH}/n_e is nearly identical to that in deuterium plasmas, which suggests that operation in helium may be the best approach to developing H-mode scenarios in the early non-nuclear phase of ITER operation. In support of tritium retention studies in ITER, the processes governing deuterium retention by graphite and lithium-coated graphite plasma facing components (PFCs) was investigated in NSTX. To reduce divertor heat flux, a novel divertor configuration, called the “snowflake” divertor was tested in NSTX and many beneficial aspects were found. A reduction in the required central solenoid flux has been realized in NSTX when discharges initiated by coaxial helicity injection were ramped in current using induction. Other experiments have been conducted to address research of high priority to the ITPA and ITER.

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