Effects of Applied Non-axisymmetric Fields on ELMs and Plasma Rotation Using New Midplane Coil Configurations in NSTX

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ELM control and plasma rotation alteration were recently examined in NSTX using new variations of applied field spectra compared to past work using a dominantly n = 3 field. In the present work, both DC and AC fields were used with dominant toroidal mode numbers, n=2, n=3, and n=2+3. ELM suppression using these fields has not yet been observed, however, significant modifications of ELM and H-mode characteristics have been observed. In Type-I ELMy H-mode plasmas, increases in ELM period and size have been observed for a range of q_{95} and applied field amplitude. ELM destabilization (excitation of Type I ELMs in a previously ELM-free discharge) has been observed for a range of plasma boundary shapes (to be discussed in detail in a companion talk by J. Canik). Significant n = 2 fields applied prior to the time of the nominal H-mode transition during the plasma current ramp were observed to delay the transition until after I_p flat-top. Non-resonant magnetic braking of the plasma rotation by neoclassical toroidal viscosity (NTV) using an n = 2 field configuration was observed. As with n = 3 braking, now used in NSTX for years to control plasma rotation, the braking profile is radially extended and non-resonant. This contrasts with localized resonant braking in which momentum transfer across key rational surfaces and a local flattening of rotation at the rational surface is observed. This field configuration has strong n = 2 and 4 components, but essentially no n = 1 component, providing further support that the effect is not dominated by the resonant n = 1 field. These results suggest that off-midplane coils may be required in next-step devices such as ITER to minimize rotation damping while also providing ergodizing fields in the pedestal. Thus far, the non-axisymmetric fields have not decreased the pedestal density in NSTX. This could be due to lack of divertor pumping and/or rotational shielding of the fields resulting in incomplete ergodization of the pedestal region.