Progress towards stable Steady State Operation on NSTX

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Modifications to the NSTX poloidal field coils have led to a significant enhancement in shaping capability and has led to has lead to the achievement of a record shape factor ($S= q_{95}(I_p/aB_t)$) of ~37 [MA/mTesla]. Achieving high shape factor is an important result for future ST burning plasma experiments as exemplified by studies for future ST reactor concepts, such as ARIES-ST [1], as well as neutron producing devices such as the Component Test Facility (CTF) [2], which rely on achieving even higher shape factors in order to achieve steady-state operation while maintaining MHD stability. Plasmas with high shape factor have been sustained for pulse lengths which correspond to $\tau_{pulse} = 1.6s \sim 50\tau_E \sim 5\tau_{CR}$, where τ_{CR} is the current relaxation time and τ_E is the energy confinement time. The non-inductive current fraction in the longest pulse discharges has reached ~65%, with ~55% pressure driven current and ~10% neutral beam driven current. An interesting feature of these discharges is the observation that the central value of the safety factor $q(0)$ remains elevated for several current diffusion times, an indication of the “hybrid mode”. Use of the “early H-mode” scenario has been further optimized during the 2005, exhibiting a substantial reduction in the frequency and size of ELMs. The reduction in ELM magnitude and frequency has improved energy confinement time. NSTX operates with peak divertor heat fluxes which are in the same range as those expected for the ITER device, i.e. with $P_{heat\_max} \sim 10MW/m^2$. High triangularity, high elongation plasmas on NSTX have been demonstrated to have reduced peak heat flux to the divertor plates to <3 MW/m^2.

[1] S. Jardin, et al., J. Comput. Phys. **66** 481 (1986)
[2] F. Najmabadi, et al., Fusion Engineering and Design **65** 143 (2003)

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