Suppression of ELMs by Resonant Magnetic Perturbations in DIII-D with the ITER Similar Shape and Parameters*

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Resonant magnetic perturbation (RMP) edge localized mode (ELM) suppression has been achieved in DIII-D at the ITER value of I/aB [1] in the ITER-design cross section scaled down by 3.7. The conditions are at the ITER baseline scenario relevant values of $\beta_N = 1.7$, $H_{98} = 1.1$, I/aB = 1.39 and $\nu^*_{e\_ped} = 0.05$, the latter — being the electron collisionality at the top of the H-mode pedestal. This was achieved using only one of the two toroidal rows of RMP I-coils in DIII-D [2] applying $n = 3$, with n the toroidal mode number. The single row has thus far proven to be more effective in this range of I/aB, presumably due to details of the applied RMP spectra. Stability analysis with the ELITE code [3] shows that the RMP relaxes the pedestal conditions to being below the instability boundary, as has been found with standard double row I-coil suppression [3]. One focus of RMP ELM suppression is understanding how the perturbation limits the pedestal energy to bring about stability. Equilibrium reconstruction that recognizes the pedestal bootstrap current shows that an $m/3$ resonant magnetic surface exists at the top, and bottom, of the electron pressure pedestal profile under ELM suppressed conditions, where m is the poloidal mode number. The measured electron pressure profile versus the radial coordinate $m = 3q$ is shown in Fig. 1, where the black curve is during ELMing conditions and and the red with ELMs suppressed. The 8/3 resonant surface near the top of the pedestal with RMP is consistent with the hypothesis that the pedestal limitation that results in stability is caused by a “wall" near the top of the pressure pedestal [3], which could be provided by a magnetic island that has opened on a rational surface where the electron perpendicular drift flow is small enough to limit plasma screening of the magnetic perturbation.

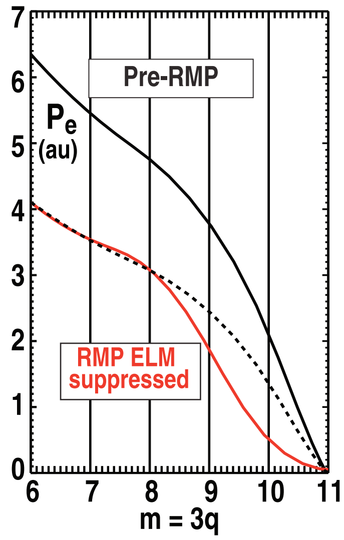

Figure 1: Pedestal electron pressure, P_e, vs m. The dashed line is the pre-RMP profile scaled to match the RMP profile at $m = 6$.

References

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*This work was supported by the US Department of Energy under DE-FC02-04ER54698, DE-FG02-05ER54809, DE-AC52-07NA27344, and DE-C02-09CH11466.