Influence of an n=1 perturbation field on type-I edge localized modes in H-mode plasmas on JET

H. R. Koslowski and JET-EFDA contributors*

Forschungszentrum Jülich GmbH, Institut für Plasmaphysik, Association EURATOM-FZ Jülich, Trilateral Euregio Cluster, D-52425 Jülich, Germany

Recent experiments on JET have shown that type-I edge localized modes (ELMs) can be mitigated by applying a static $n = 1$ perturbation field produced by four external error fields correction coils (EFCC) mounted far away from the plasma between the transformer limbs [1].

When an $n = 1$ perturbation field with an amplitude of a few Gauss at the plasma boundary ($\rho > 0.95$) is applied during the stationary phase of a type-I ELMy H-mode plasma, the ELM frequency rises by a factor of 4 up to ~120 Hz and the amplitude of the D_α bursts measured at the divertor plates drops by a factor of ~10. Magnetic pick-up coils show a corresponding decrease of the amplitude in the ELM bursts. The periodic change in the edge temperature at the pedestal top is reduced from 500 – 700 eV down to 100-200 eV. When the EFCC current was slowly ramped-up a drop in the edge density (pump out effect) occurred. The central ion and electron temperatures were found to increase by about 15%. The energy loss per ELM decreases down to $\Delta W/W \leq$ 1%.

Changing the orientation of the perturbation field shows that the pump-out effect and the ELM mitigation does not depend on the phase of the $n = 1$ external field. However, taking into account the action of the position and boundary control feedback system, an optimum direction for the perturbation field was determined. In the optimal case the temperature of the outer limiter dropped during the EFCC phase, while the temperature of the outer divertor plate increased.

Transport analyses has shown no degradation of energy confinement during the ELM mitigation phase when optimum EFCC currents and phasing were chosen. The Chirikov parameter calculated for these discharge parameters approaches 1 at $r/a > 0.95$ [2].

Benign ELMs were created for a wide range of plasma currents $3.0 < q_{95} < 4.8$, for EFCC currents well below the locked mode excitation threshold. These results demonstrate that active ELM control by externally applied fields is a viable and attractive method for ITER.

[1] Y. Liang et al., to be submitted to PRL
[2] E. Nardon, private communication

---

* See the Appendix of M. L. Watkins et al., Fusion Energy 2006 (Proc. 21st Int. Conf. Chengdu, 2006) IAEA, 2006