DPP14-2014-000477

Abstract for an Invited Paper
for the DPP14 Meeting of
the American Physical Society

The effects of impurities and core pressure on pedestal stability in JET and MAST[1]

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The H-mode pedestal plays an important role in determining global confinement in tokamaks. In high triangularity H-mode experiments in JET with the ITER-like wall (JET-ILW), plasma purity is improved, but both the pedestal temperature height and global confinement are degraded compared with JET plasmas with a carbon wall (JET-C). The JET-C performance can be partially recovered with nitrogen seeding. The stability calculations show that edge localised impurity concentration can increase the electron pressure pedestal at the point of marginal stability, mainly through ion dilution but also due to changes in the bootstrap current profile, whilst not degrading the total core pressure. The edge stability in low triangularity plasmas is improved less by the edge impurities due to a different shape of the stability boundary, consistent with a weak improvement in pedestal height with impurity seeding. Significantly better confinement and pedestal height has been observed in JET plasmas when the global pressure is increased. The enhanced pedestal height is linked to an improvement in edge stability arising from an increase in the Shafranov-shift. In MAST a 20% increase in the global β at the LH-transition led to a doubling of the electron pressure pedestal height just before the first ELM. The increase in global β results in an increase in the marginally stable pressure gradient. This increases the attainable pedestal height, but also results in increased edge impurity content due to a longer first ELM period, which enhances the electron pressure pedestal height by ion dilution. The JET and MAST experiments and modelling show the importance of impurities and core pressure in determining the pedestal height.

[1]Work supported by the RCUK Energy Programme and EUROfusion