Developing and Testing the EPED Pedestal Model*

P.B. Snyder[1] M.N.A. Beurskens,[2], R.J. Groebner[1], J.W. Hughes[3], T.H. Osborne[1], J.R. Walk[3], and H.R. Wilson[5]

[1]*General Atomics, PO Box 85608, San Diego, California 92186-5608, USA*
[2]*EFDA JET, Culham Science Centre, Abingdon, Oxfordshire, OX14 3DB, UK*
[3]*Massachusetts Institute for Technology, Cambridge, Massachusetts 02139, USA*
[4]*Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, Tennessee 37831, USA*
[5]*Department of Physics, University of York, Heslington, York Y010 5DD, UK*

The pressure at the top of the edge transport barrier (or "pedestal height") strongly impacts global confinement and fusion performance, while large edge localized modes (ELMs) can significantly limit component lifetimes. The EPED model [1, 2] predicts the H-mode pedestal height and width based upon two fundamental and calculable constraints: 1) onset of non-local peeling-ballooning (P-B) modes at low to intermediate mode number, 2) onset of nearly local kinetic ballooning modes (KBM) at high mode number. The model calculates both constraints directly with no fit parameters, using ELITE to calculate the P-B constraint, and a "BCP" technique to calculate the KBM constraint [1]. EPED has been successfully compared to observed pedestal height for 259 cases on 5 tokamaks, finding agreement within $\sim$20% [1, 2, 3, 4, 5]. As part of a 2011 US milestone, the EPED model was extensively tested in a set of dedicated experiments on Alcator C-Mod and DIII-D, in which the magnetic field, current, density and shape were varied, yielding pedestal pressures varying more than an order of magnitude, and pedestal widths which varied more than a factor of 3. On DIII-D, a new higher resolution Thomson system allowed very high accuracy measurements of both height and width. In these tests, very good agreement with the model was found in both pedestal height and width, with $\sim$20% or better accuracy of the model, and very strong correlation ($r > 0.8$) between predictions and observations. In addition, EPED has been successfully compared to QH mode discharges, and used to develop a working model for suppression of ELMs by resonant magnetic perturbations (RMP). Predictions for ITER in a variety of regimes will also be discussed.

References

[1] P.B. Snyder *et al.*, Nucl. Fusion **51**, 103016 (2011).

[2] P.B. Snyder *et al.*, Phys. Plasmas **16**, 056118 (2009); Nucl. Fusion **49**, 085035 (2009).

[3] R.J. Groebner *et al.*, Nucl. Fusion **50**, 064002 (2010); Nucl. Fusion **49**, 085037 (2009).

[4] M. Beurskens *et al.*, Phys. Plasmas **18**, 056120 (2011); M. Beurskens *et al.*, H-mode Workshop (2011).

[5] J.R. Walk *et al.*, "Characterization of the pedestal in Alcator C-Mod ELMing H-modes and comparison to the EPED Model," submitted to Nucl. Fusion (2011).

*This work was supported by the US Department of Energy under DE-FG02-95ER54309, DE-FC02-04ER54698, and DE-AC05-00OR22725.