

Peeling mode relaxation ELM model

C G Gimblett, R J Hastie and P Helander

Euratom/UKAEA Fusion Association, Culham Science Centre, Abingdon,
Oxon OX14 3DB, UK

Edge Localized Modes (ELMs) are cyclic disturbances in the outer region of tokamak plasmas that are influential in determining present and future tokamak performance. The transient power deposition that is associated with ELMs poses a threat to plasma facing components of the main vacuum chamber wall and divertor.

The ideal magnetohydrodynamic ‘peeling’ and ‘ballooning’ instabilities, driven by edge current density and pressure gradient, have long been thought to play a role in the generation of ELM fluctuations. Here we outline an approach to modelling ELMs in which toroidal peeling modes⁽¹⁾ are envisaged to initiate a constrained relaxation⁽²⁾ of the tokamak outer region plasma. Relaxation produces both a flattened edge current profile (which tends to further destabilise a peeling mode), and a plasma-vacuum *negative current sheet* which has a counteracting stabilising influence; the balance that is struck between these two effects determines the radial extent (d_E) of the ELM relaxed region. The model is sensitive to the precise position of the mode rational surfaces with respect to the plasma surface, and hence there is a ‘deterministic scatter’ in the results which accords with experimental data. Trends with the edge safety factor and collisionality are also in agreement with experiment. The toroidal peeling stability criterion involves the edge pressure, and using this in conjunction with predictions of d_E allows us to evaluate the ELM energy losses.

(1) J.W. Connor *et al.*, Phys. Plasmas **5**, 2687 (1998).

(2) J.B. Taylor, Phys. Rev. Lett. **33**, 1139 (1974).

Acknowledgment. This work was funded jointly by the United Kingdom Engineering and Physical Sciences Research Council and by the European Communities under the contract of Association between EURATOM and UKAEA. The views and opinions expressed herein do not necessarily reflect those of the European Commission.