Edge-SOL stability: a two-layer approach

F. Wilczynski[1], D.W. Hughes[1], S. Van Loo[1], F. Millitelo[2], W. Arter[2]

[1] *University of Leeds, United Kingdom*

[2] *Culham Centre for Fusion Energy, Abingdon, United Kingdom*

In magnetic confinement devices, the boundary turbulence is characterised by intermittent ejection of coherent filamentary structures. These filaments transport plasma from the well-confined core region, through the Scrape-Off Layer (SOL), towards the material surfaces. This results in increased plasma-wall interaction, which has the potential to damage plasma-facing components and shorten the lifetime of the device. It is therefore essential to develop full understanding of the mechanisms behind the transport in the edge of the plasma.

Study of the formation and expulsion of filaments requires consideration of both the core and the SOL region. The two regions exhibit distinct dynamics parallel to the magnetic field. In the core, field lines are considered periodic in the parallel direction, while in the SOL the field lines end with a Debye sheath at a material surface. The presence of the sheath provides a sink for plasma particles and energy. Mathematically, this is represented by inclusion of parallel loss terms in the SOL region. The resulting sharp transition between the two regions imposes a number of continuity conditions that need to be satisfied at the separatrix.

In this contribution, we study the stability of the boundary plasma by considering a two dimensional interchange model that includes a simple description of open and closed field line regions based on the sheath dissipation closure. We calculate the linear stability threshold and characterise the onset of instability. Furthermore, we discuss how the stability threshold is affected subject to changes in our model, such as varying the separatrix location, or different choices of boundary conditions.