Effect of resistivity on the MHD pedestal stability in JET

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The pedestal in type I ELMy plasmas is commonly accepted to be limited by ideal peeling-ballooning modes. However, recent JET results obtained in type I ELMy H-modes have shown that the ELM can be triggered also before the ideal peeling-ballooning boundary [1, 2, 3]. In terms of engineering parameters, this typically occurs at high power and high gas rate [2] or, in terms of physics parameters, at high relative shift between the density and temperature pedestals [4]. More recently, the disagreement between experimental results and ideal MHD predictions has been correlated with the resistivity in the middle-bottom of the pedestal [5]. This correlation indicates that resistive MHD might be required to describe the pedestal in plasmas with high relative shift.

In this work, we present the initial results of including resistivity on the MHD stability analysis of an extended JET dataset. In the stability analysis the CASTOR [6] code has been used. The CASTOR code is a linear MHD eigenvalue solver that includes resistivity but does not include diamagnetic effects. The effect of the diamagnetic stabilization is therefore implemented as a critical limit in the growth rate, taken as $\gamma = 0.25\omega^*_{max}$ where ω^*_{max} is the maximum diamagnetic frequency in the pedestal.

The work is focused on two parts. Firstly, the detailed analysis of four different shots with differing gas and power, to understand the effect resistivity has on the peeling-ballooning stability. Secondly, a larger dataset is considered to see if the results obtained in the detailed analysis generalizes to other shots.

The stability boundary in j-α space for JET shot 87342 can be seen in figure 1 where the inclusion of resistivity shifts the stability boundary to within the uncertainty of the experimental point. When a larger dataset is considered, the results of this work indicate that resistivity can significantly improve the model predictions and remove the correlation between relative shift and disagreement between model and experiment. Additionally the shots that are ideally peeling-ballooning limited are only weakly affected by including resistivity. This work therefore suggests that including resistivity is an important first step in reconciling model and experiment in devices with large relative shift where the pedestal does not appear to be ideally peeling-ballooning limited.

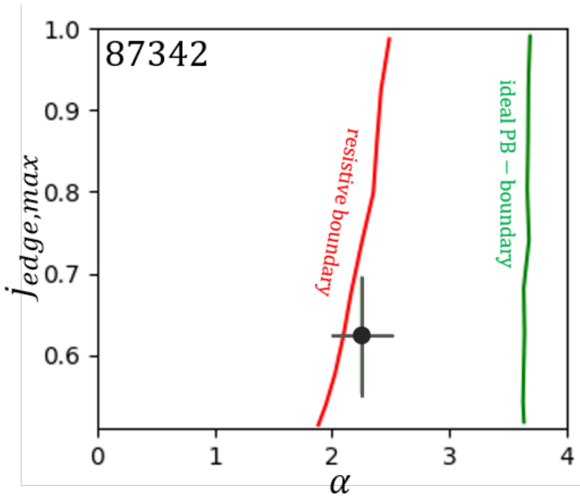

Figure 1. Stability boundary for JET shot 87342 in j-α space including (red) and excluding resistivity (green). Experimental point is shown with error bars.

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