EFTC 2017

17th European Fusion Theory Conference

9 - 12 October 2017, Athens - Greece

Separating the effects of heating and current drive on NTM evolution in TCV

G. M. D. Hogeweij[1], F. Felici[2], M. Kong[3], O. Sauter[3], and the TCV team

[1]*DIFFER - Dutch Institute for Fundamental Energy Research, De Zaale 20, 5612 AJ Eindhoven, the Netherlands, www.differ.nl*
[2]*Eindhoven University of Technology, Eindhoven, The Netherlands*
[3]*École Fédérale Polytechnique de Lausanne (EPFL), Swiss Plasma Center (SPC), CH-1015 Lausanne, Switzerland*

Neoclassical Tearing Modes (NTMs) are widely observed in tokamak plasmas. They have a detrimental effect on plasma confinement and may even lead to disruptions. Therefore it is important to understand the evolution of NTMs, which is influenced by several effects. These effects are summarized in the modified Rutherford Equation (MRE), see e.g. [1,2].

The birth of NTMs can be prevented, and existing NTMs can be stabilized by localized heating (H) and current drive (CD) near the location of the NTM. An important question is the relative importance of the H and CD terms in the evolution of the NTM.

The TCV tokamak is equipped with a very flexible ECRH/ECCD system [3], and is therefore very suited to address this question. In a series of dedicated experiments the m/n = 2/1 NTM was triggered by central co-ECCD using 2 gyrotrons, and then it was tried to stabilize this NTM with a third gyrotron whose deposition location was swept from the centre towards the q = 2 surface. In otherwise similar discharges, this third gyrotron was delivering either co- or counter-ECCD, or pure ECRH. In the experiment a clear difference in NTM stabilization was observed between these discharges.

The main aim of the present work is to model the evolution of the NTMs, and reproduce these different time evolutions. For this purpose the Rapid Plasma Transport simulator (RAPTOR) is used [4,5]. It has a module that solves the NTM evolution based on the MRE. RAPTOR self-consistently calculates the simultaneous evolution of electron temperature (Te) profile, q profile and NTM width. The effect of an NTM on plasma confinement is modelled by assuming an increase of the thermal diffusion coefficient over the width of the NTM; an increase by a factor of $\simeq$ 2 gives a good reproduction of the observed confinement degradation.

It is shown that the triggering and suppression of the m/n = 2/1 NTM in TCV by varying the ECCD deposition and by varying the sign of the CD, can be described well by the MRE. Moreover, it is shown that the H term in the MRE is essential to fully capture the observed dynamics.

References

[1] O. Sauter et al, Details on the expressions used in the various terms of the modified Rutherford equation (MRE) (2015), included in the RAPTOR documentation, https://crppsvn.epfl.ch/wsvn/RAPTOR/tags/release-1.3/
[2] D. De Lazzari et al 2009 Nucl. Fusion 49 075002
[3] T. P. Goodman et al 2008 Nucl. Fusion 48 054011
[4] F. Felici et al 2012 Plasma Phys. Contr. Fusion 54 025002
[5] P. Geelen et al 2015 Plasma Phys. Contr. Fusion 57 125008