Modelling NTM evolution and its effect on transport in TCV

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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].

The TCV tokamak is equipped with a very flexible ECRH/ECCD system [2], and is therefore very suited for the analysis of the birth, growth and suppression of NTMs. In December 2015 a series of dedicated experiments was performed in TCV to study NTM evolution and suppression. In these experiments 2 gyrotrons were used with time varying power deposition locations, delivering heating and current drive.

The main aim of the present work is to model the evolution of the NTMs in TCV, and compare it with experimental results. For this purpose the Rapid Plasma Transport simulatOR (RAPTOR) is used [3, 4]. It has a module that solves the NTM evolution based on the MRE. RAPTOR self-consistently calculates the simultaneous evolution of electron temperature ($T_e$) 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. This increase is assessed by using, in stead of a calculated NTM width, a prescribed NTM width, taken from experiment; an increase by a factor of $\approx 2$ gives a good reproduction of the observed confinement degradation.

The present work concentrates on the $n/m = 2/1$ NTM, being the most detrimental mode. It is shown that the triggering and suppression of the $n/m = 2/1$ NTM in TCV by varying the ECCD deposition, can be described well by the MRE.

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