Detection of Turbulent Driven Magnetic Islands in Tokamaks : Towards Neural Network ?

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Magnetic reconnection is a physical process involving conductive plasma flows and leading to a topology modification of the magnetic filed. It can be a major obstacle to the good realization of fusion experiments. In particular, large magnetic islands (with a size of the order of centimeter) can lead to the destruction of the plasma confinement. This phenomenon, known as Neoclassical Tearing Mode (NTM) [1], requires a seed island, which will be nonlinearly amplified by the so-called bootstrap current. The origin of such seed island and NTM triggering mechanisms are still fully open questions.

In fusion experiments, large magnetic islands coexist with micro turbulence and a lot of numerical studies are devoted to their multi-scale interactions [2, 3, 4, 5, 6]. In [2, 3, 4, 5], it has been underlined that a Turbulence Driven Magnetic Island (TDMI) can be generated thanks to a nonlinear beating of small-scale interchange modes.

In [7], neural network has been used to evaluate the relevant parameters required to predict the NTM growth using various JET discharges data. However, in this study, turbulence in plasma is not supposed to be important.
Thus, our goal is to use a set of nonlinear simulation of NTM including turbulence to train a neural network and focus on the impact on the turbulence level on the NTM size.

References :

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