Turbulence structures in Neoclassical Tearing Mode and Turbulence Driven Magnetic Island

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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. Recently, in [6], it has been shown that a TDMI can be amplified by the bootstrap current and as a consequence can be at the origin of a NTM. Moreover, in [7] a series of DIII-D high confinement mode discharges demonstrate that turbulence is affected by the presence of a NTM.

We address the question of the magnetic island's impact on the turbulent structures by means of 2D nonlinear Reduced MHD simulations. More precisely, we focus on a comparison between a NTM generated from a classical Tearing Mode and a NTM resulting from the TDMI amplification by the bootstrap current.

References:

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