Self-consistent interaction between MHD island and turbulence

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Magnetic reconnection can be problematic for tokamak plasmas: tearing modes (neoclassical or otherwise) grow slowly expelling energetic particles from the plasma core and possibly lead to disruption phenomena that can terminate the discharge and cause damage to the plasma facing components. However, the neoclassical tearing modes (NTMs) are not associated to a linear instability (the so-called Δ' parameter is negative) and require pre-existing seed islands to grow [1]. In experiments, precursors as sawtooth oscillations, fishbones instabilities or edge localized modes could appear before a NTM. These precursors are supposed to trigger the requested seed island. However, sometimes, a NTM can grow without any noticeable MHD event [2]. Thus, the question of the origin of the seed magnetic island is still an open question for fusion reactor. Moreover, in tokamaks, macro-scale MHD instabilities (magnetic islands) coexist with micro-scale turbulent fluctuations and zonal flows [3], and some recent works have shown the microturbulence impact on the island dynamics [4, 5]. In [4], 2D nonlinear simulations show that the nonlinear beating of the fastest growing small-scale interchange modes on a given rational surface drives a magnetic island located on the same surface. Here, we show that such turbulent driven seed island can be amplified by the current bootstrap leading to a self-consistent generation of a NTM. Moreover, such turbulence driven NTM presents a significant signature : the pressure flattening inside the island is partial, *i.e.* the pressure gradient inside the island is finite and constant in space and in time.

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