Drift-wave instabilities in Wendelstein 7-X plasmas

J.A. Alcusón[1] and the Wendelstein 7-X team[1]

1. Max-Planck-Institut für Plamaphysik, Greifswald, Germany

Contrary to tokamaks, the radial transport in stellarators is governed mostly by neoclassical (NC) processes. Nevertheless, the magnetic field of the Wendelstein 7-X stellarator (W7-X), operating in Greifswald, Germany, has been optimized in order to reduce the NC contributions down to tokamak levels [1]. Indeed, in several discharges, specially at the outer region of the plasma ($r_{eff} > 0.6$), NC calculations alone are not sufficient to interpret the total radial losses measured, and turbulent transport is considered the main candidate to explain these discrepancies.

The present work aims to serve as a guide for future studies connecting experimental and numerical estimations of turbulence in W7-X. Based on gyrokinetic simulations performed with the GENE code [2, 3] under W7-X experimental conditions, we will characterize the turbulent transport in different configurations and scenarios by identifying the dominant micro-instability (ITG, TEM, ETG) in each situation.

In a stellarator configuration, drift-wave instabilities can be also influenced by features of the geometry, apart from plasma conditions. Three different configurations (low-mirror, standard and high mirror) together with their variation along the radial direction will be used to analyze the impact of the geometry on the instabilities [4, 5] (specially the intrinsic quasi-isodinamicity of W7-X through its relation with the quasi-poloidal symmetry). The influence of the kinetic profiles will be investigated by means of a stability diagram as shown in Fig. 1 for both, core and edge plasmas. Finally, a comparison of the fluctuations level between non-linear simulations and experimental measurement (PCI, reflectometers, etc) will be provided to illustrate some of the conclusions.

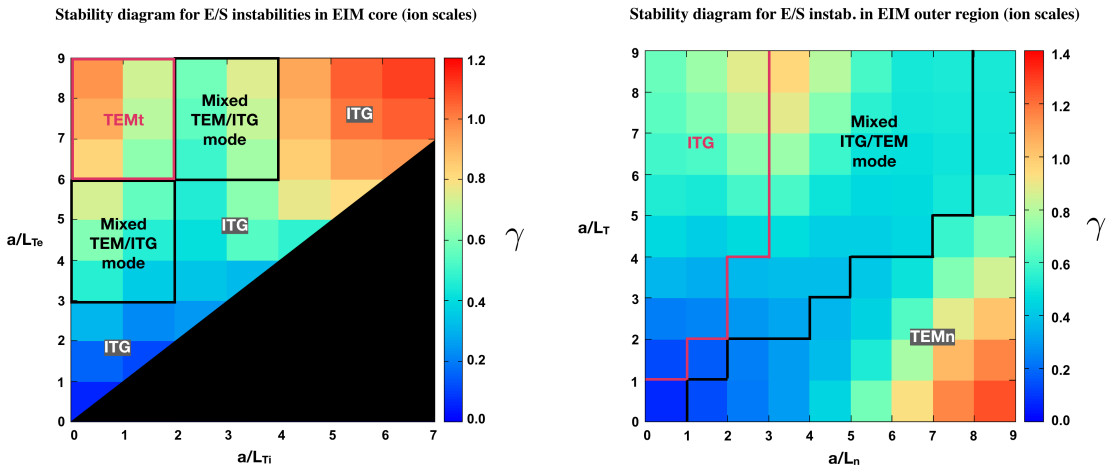

Figure 1: *Stability diagrams: linear growth rates γ of the dominant instabilities in a) core scenario and b) outer region scenario of the W7-X standard configuration.*

References

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