Interesting Physics in "Boring Plasmas"

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Large-scale global organisation of turbulence has attracted persistent interest in fusion plasmas as a means to control transport and access improved confinement. Self-organised processes control zonal flow formation and saturation, front propagation -a natural tendency in heat flux-driven turbulence- and possibly turbulence spreading to quasi-linearly stable regions. This presentation is based on a careful confrontation between flux- and gradient-driven gyrokinetics using the GYSELA code and recent experimental data.

We present detailed experimental evidence of predicted ExB staircase [1,2] using state-of-the-art ultrafast sweeping reflectometry [3,4]. The ExB staircase reconciles seemingly antagonistic trends in turbulence self-organisation whilst spontaneously generating sets of weak transport barriers on global scales. Striking new features are also reported: (i) an enigmatic apparent disappearance of this structure at the LOC/SOC transition, associated with a change in the nature of turbulence (electron versus ion drift wave), as well as (ii) a possible route to gyro-Bohm breaking through modified staircase permeability at low ρ* and in the far-core, near-edge so-called No Man's Land region.

This led to elucidating aspects of the controversial "shortfall problem". A combination in GYSELA of flux drive and Scrape-Off-Layer-like boundary conditions now allow to address No Man's Land dynamics, as core turbulence spreads into the marginally stable edge. A careful comparison within the same numerical framework between flux- and gradient-driven gyrokinetic computations of the same L-mode plasmas leads to properly quantifying spreading and its impact on the turbulence fluctuation levels and heat transport in the far-core near-edge tokamak region. If time allows, isotope effects on transport and on flow generation may also be discussed.

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