DPP10-2010-001172

Abstract for an Invited Paper
for the DPP10 Meeting of
the American Physical Society

Turbulence and transport reduction with innovative plasma shapes in TCV – correlation ECE measurement and gyrokinetic simulations[1]

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Due to turbulence, core energy transport in tokamaks generally exceeds collisional transport by at least an order of magnitude. It is therefore crucial to understand the instabilities driving the turbulent state and to find ways to control them. Shaping the plasma is one of these fundamental tools. In low collisionality plasmas, such as in a reactor, changing triangularity from positive (delta=+0.4) to negative triangularity (delta=-0.4) is shown on TCV to reduce the energy transport by a factor two. This opens the possibility of having H-mode-like confinement time within an L-mode edge, or reduced ELMs. An optimum triangularity can be sought between steep edge barriers (delta>0), plagued by large ELMs, and improved core confinement (delta<0). Recent correlation ECE measurements show that the reduction of transport at negative delta is reflected in a reduction by a factor of two of both the amplitude of temperature fluctuations in the broadband frequency range 30-150 kHz, and the fluctuation correlation length, measured at mid-radius. In addition, the fluctuations amplitude is reduced with increasing collisionality, consistent with a reduction of the Trapped Electron Modes (TEM) drive. The effect of negative triangularity on turbulence and transport is compared to gyrokinetic code results: First, global linear simulations predict shorter radial TEM wavelength, consistent with the shorter radial turbulence correlation length observed. Second, at least close to the strongly shaped plasma boundary, local nonlinear simulations predict lower TEM induced transport with decreased triangularity. Calculations are now being extended to global nonlinear simulations.

[1]In collaboration with the TCV team and CRPP theory group. This work was supported in part by the Swiss National Science Foundation.