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OV/5-1: Dynamics of Flows and Confinement in the TJ-II Stellarator

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Operation with Li coated wall is the basis for a significant improvement in the performance of TJ-II, and lies behind the findings in this overview, related to the role of flows in confinement improvement. Specific progress has been performed in the use of Li as alternative to solid plasma facing materials for future fusion devices. Recently a liquid lithium limiter (LLL) based on the Capillary Porous System (CPS) has been installed in TJ-II and first results will be reported.
Although TJ-II presents a strong damping, the simulations predict that the presence of an ambipolar radial electric field as well as turbulence driven flows provide driving mechanisms for mean and fluctuating flows that will cause long range toroidal correlation whose typical frequencies are in agreement with the experiment. The transitions to improved confinement are accompanied by an amplification of long-range correlation in the plasma potential, which is a footprint of zonal flows. The amplitude of these structures have been seen to modulate the particle transport into the SOL for the first time. We also investigate the relation between the zonal flows and the turbulent flux of particles and momentum via the Reynolds and Maxwell stresses as well as suprathermal particles. Suprathermal ion can contribute with significant energy content, with poloidal rotation up to 2–5 higher than the thermal component even the ECRH regime.
Taking advantage of the flexibility of TJ-II, low order rationals are introduced in the plasma, which helps to transit from L to H mode. The influence of the so developed MHD modes on transport is investigated showing a bursty behaviour and evidence of radially propagating events. During L-H transitions, an oscillating low frequency non-damped sheared flow appears in the edge prior to the change to H mode, which presents a predator-pray relation with the turbulence. The spatial evolution of this turbulence-flow shows both radial outward and inward propagations. These results show the need to study L-H transition within a 1-D spatio-temporal framework.
The dynamical coupling between density gradients and particle transport has been investigated and compared in the plasma boundary of different tokamaks (JET, ISTTOK) and stellarator (TJ-II), showing that the size of turbulent events is minimum in the proximity of the most probable density gradient.

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