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3-D effects on transport and plasma control in the TJ-II stellarator

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Recent improvements in diagnostics and operation have led to better understanding of 3-D effects on transport and plasma control in the TJ-II stellarator. Impurity transport: Direct measurements of electrostatic potential variations within the same magnetic flux surface in ECRH plasmas are presented. Calculations show that such asymmetries affect impurity accumulation. The asymmetry value and its observed dependency on the electric field are reproduced by neoclassical MC calculations. The dependence of the impurity confinement time on charge and mass has also been studied. Experiments have shown evidence of the influence of ECRH on turbulent mechanisms, increasing both the fluctuation level and the amplitude of Long-Range-Correlations as proxy of Zonal Flows (ZF), as well as affecting NC radial electric fields. Momentum transport and electromagnetic effects: Radial electric fields, ZF-like structures, time memory and radial correlations are modulated by low order rationals. It is shown that magnetic oscillations associated with rational surfaces play a key role in confinement transitions. Furthermore, evidence of the mutual interaction of NC and turbulent mechanisms in qualitative agreement with GK simulations is presented. Innovative power-exhaust scenarios using liquid metals: Novel solutions for plasma facing components based on liquid metals like Li and Sn/Li alloys have been developed. Biasing of Li limiters with respect to carbon ones has evidenced the role of the secondary electron emission of plasma exposed surfaces. Plasma stability studies: It has been shown that a reduction of magnetic well has a direct impact on fluctuations without reducing plasma confinement drastically, suggesting that Mercier stability calculations are missing some stabilization mechanisms. Plasma fuelling experiments and neutral dynamics: First core plasma fuelling experiments using a cryogenic pellet injector system are presented. The radial redistribution of particles can be understood qualitatively from NC predictions. First results on the impact of neutral fluctuations on the observed turbulent structures will be reported. Role of ECRH and iota profile on fast ion confinement: Results show that ECRH and iota-profile are potential tools for AE control. Coherent modes in NBI-heated plasmas are explained as global (GAE) and discrete shear-AEs induced by magnetic islands.

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