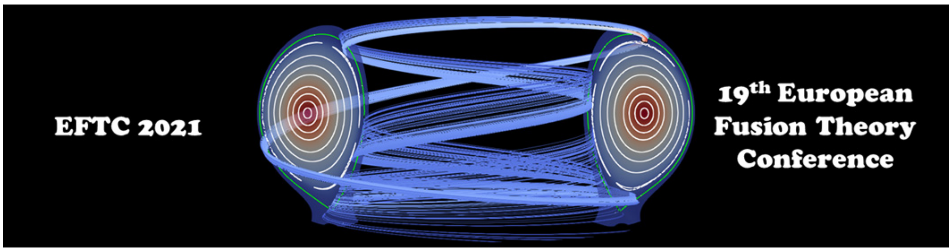

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First global simulations of plasma turbulence in a stellarator with an island divertor

Thursday 14 October 2021 14:30 (20 minutes)

We present the results of 3D, flux-driven, global, two-fluid electrostatic turbulence simulations in a 5-field period stellarator with an island divertor. The numerical simulations are carried out with the GBS code, which solves the two-fluid drift-reduced Braginskii equations and has been extended recently to simulate plasma turbulence in non-axisymmetric magnetic equilibria. The vacuum magnetic field used in the simulations is carefully constructed using Dommaschk potentials in order to describe a configuration with a central region of nested flux surfaces, surrounded by a chain of magnetic islands. In a similar way to the diverted configurations of W7-AS and W7-X, particles and heat, transported radially outwards from the core region, reach the island region, which effectively acts as a scrape-off-layer with the open field lines striking the walls at specific toroidal locations of the device wall. We find that the radial particle and heat transport is mainly driven by a field-aligned mode with low poloidal wavenumber, whose origin is investigated theoretically. The equilibrium radial electric field in the core is found to be in the ion-root regime, Er<0. Transport is observed to be larger on the high-field-side of the device, where the amplitude of fluctuations is larger, despite the cross-phase between density and potential being smaller. A very good agreement is obtained when comparing the radial ExB flux of the simulation with the one predicted theoretically due to a single (dominant) coherent mode. In contrast to tokamak simulations and experiments, we do not observe radial propagation of coherent filamentary structures (blobs) that usually contribute to intermittent transport events in axisymmetric configurations, thus shedding light on the surprising differences between transport mechanisms in stellarator and tokamak configurations.

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