2nd Asia-Pacific Conference on Plasma Physics, 12-17,11.2018, Kanazawa, Japan

Electron temperature gradient driven instabilities in helical reversed field pinch plasmas

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Helical states have, in general, beneficial consequences on the reversed field pinch plasma performance. Good confinement properties are achieved due to an overall reduction of magnetic chaos. On the other hand, this physical condition favors the onset of radially localized electrostatic/electromagnetic turbulence due to the simultaneous formation of large pressure gradients in the region surrounding the helical core.

In a previous work, ion-temperature-gradient (ITG) turbulence has been investigated with a realistic geometric description of the 3D configuration*. The core displacement turns out to have an unfavorable effect in terms of ITG turbulent transport: in the region of higher magnetic surface proximity, the local temperature gradients become larger with consequent growing instabilities, weaker zonal flows, and, in general, larger ion heat fluxes.

Since the transport barriers are usually observed in the electron heat channel, in this contribution we mainly focus on the occurrence of instabilities driven by the electron temperature gradient. Due to the importance of electromagnetic effects in the reversed field pinch, we include finite β and collisionality, using realistic geometry and plasma profiles. The occurrence of low wavenumber microtearing modes (MTMs) and high wavenumber electron-temperature-gradient (ETG) modes is discussed, with their possible role in the determination of the electron heat conductivity. The role of the geometric coefficients is also explicitly analyzed, making a comparison with the corresponding axisymmetric configurations.

* I. Predebon and P. Xanthopoulos, Phys. Plasmas **22**, 052308 (2015).