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Core Micro-Instability Analysis of JET Hybrid and Baseline Discharges with Carbon Wall

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In recent years there has been an increasing worldwide effort in the development of the so-called hybrid or improved H-mode scenarios as a hybrid between an AT and a baseline plasma. In these scenarios, by optimising the current density profile, an enhanced normalised confinement can be achieved, as compared to the ITER baseline scenario, the ELMy H-mode. During the 2008-2009 experimental campaigns at the JET, a remarkable improvement in the normalised confinement was achieved in hybrid scenarios (H98(y,2)˜1.3-1.4) in both high (delta =0.4) and low (delta=0.2) triangularity plasmas [1]. However, the underlying physics basis for the observed increased normalized confinement remain somewhat unclear, making the hybrid plasmas an interesting choice for modelling and trying to explain the underlying mechanisms responsible for their deviation from the "known" H-mode confinement. Therefore, in this work we investigate the core micro-instability characteristics of hybrid and baseline plasmas in a selected set of JET plasmas with carbon wall through local linear and non-linear gyro-kinetic simulations with the GYRO code [2]. We find that a good core confinement due to strong stabilisation of the micro-turbulence driven transport can be expected in the hybrid plasmas due to the stabilising effect of the fast ion pressure that is more effective at the low magnetic shear of the hybrid discharges. While parallel velocity gradient destabilization is important for the inner core, at outer radii the hybrid plasmas may benefit from a strong quench of the turbulence transport by ExB rotation shear.

[1] M.N. A Beurskens et al, Nucl. Fusion, 53, 013001 (2013).
[2] J. Candy and E. Belli, General Atomics Report, GA-A26818 (2011).

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