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Turbulence characteristics of the I-mode confinement regime in ASDEX Upgrade

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The I-mode is an improved confinement regime of tokamak plasmas operating in the unfavorable ion gradB-drift direction combining H-mode-like energy confinement with L-mode-like particle and impurity transport [1]. To qualify the I-mode as an operating scenario for ITER threshold and accessibility studies [2] also on a multi-machine basis [3] are needed. Even if the I-mode might not be considered as a promising scenario for ITER, studies of turbulence in I-mode may offer a better understanding of the physics of the interaction of energy and particle transport barriers in general. The mechanism which selectively reduces only one of the transport channels is not understood. In the present contribution the turbulence characteristics of I-mode plasmas in ASDEX Upgrade (AUG) have been studied in detail. In AUG the WCM appear at frequencies around 100 kHz with a width of a few 10 kHz[4]. The GAM advects the WCM and leads to the broadening through the Doppler effect [4]. In AUG magnetic fluctuations already present in L-mode close to the WCM frequency are
amplified during the I-mode. Using the measured background profiles the gyrokinetic eigenvalue solver LIGKA is used to determine the kinetic continuum branches of the GAM and the geodesic Alfénic mode (GAlf). The frequency of the magnetic fluctuations close to the WCM frequency coincides with the GAlf frequency[4]. Comparisons with the Mirnov coils show the characteristic toroidal and poloidal mode numbers of the GAlf of zero and one, respectively[4]. The origin of the WCM lies in the intermittent events, which exhibit a wavelet-like temporal structure where the characteristic frequency coincides with the centre-of-mass frequency of the WCM[5]. Possible generation scenarios for the bursts are discussed. The nonlinear interaction between GAM, WCM and the bursts will be discussed based on a detailed bispectral analysis of non-local interactions in frequency space of the experimental data. The importance of the solitary events for a selective density transport remains an open issue.

References

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