1E30

Simulations and Stability Analysis of ELMs in JET Discharges

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Abstract

The JETTO predictive integrated modeling code and the MISKHA MHD stability code are used to investigate the edge instabilities in JET tokamak plasmas. For a JET power scan, it is concluded that the crash of the edge localized modes (ELMs) can be triggered either by pressure-driven (ballooning) modes or by current-driven (peeling) modes. The availability of both modes is required for the simulation and experimental stored energy to agree. If the criterion for triggering ELMs is satisfied, transport in the pedestal region is increased significantly in the simulation. ELM durations and frequencies obtained in the simulation are compared with experimental values. It appears that in simulations where ELMs are triggered by the peeling mode instability, the duration of the ELM is longer than that found experimentally. The simulated duration of the ELM is not decreased by increasing transport in the ELM region since this alone does not result in a rapid redistribution of edge plasma current. For the high power discharge, it is found that the first few ELM crashes after the transition from L-mode to H-mode and a short ELM-free period are usually triggered by ballooning modes, while subsequent ELM crashes are usually triggered by peeling modes. The JETTO simulations provide edge equilibrium information, such as pressure gradient and plasma geometry, which are then used as input for the MISKA code. This code yields an s-α diagram which provides information regarding the stability of the edge plasma. It is found that the discharges in the power scan considered have access to second stability and that the pressure gradient is limited either by the finite *n* ballooning modes or by the peeling mode.