theoretical concepts on interrelation between fast transport transitions and plasma instabilities and their comparison with experiments at the L-2M stellarator

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According to orthodox interpretation (see, e.g., [1]) the decrease in the fluctuation level at the edge of the plasma column during the transition into the H-mode leads to improved plasma confinement and may result in an increase in the pressure gradient in this region, thereby causing the onset of magnetohydrodynamic (MHD) modes. However, the necessity to stabilize several modes does not forbid serving other instabilities as trigger for transition [2–4]. Current state of the theoretical considerations on interrelation between transport transitions and plasma instabilities is briefly outlined. We also outline briefly changes in general opinion on instability classification. In particular so called electrostatic modes are considered as particular case of more general class of electromagnetic instabilities.

In previous report breakdown by the 2nd electron cyclotron harmonic microwaves in a stellarator was re-examined theoretically [5]. Processes were investigated in [5] within the framework of asymptotic methods. Quite a simple analytical estimate for the breakdown delay time was suggested, which, nevertheless, seems to be in a good agreement with the experimental results from the L-2M stellarator.

Peculiarities of plasma transition to stationary state at fixed external heating power were investigated using L-2M stellarator. Strictly speaking, if transition to stationary state is fast then breakdown time is also fast as we have shown above. Generally speaking, transition to stationary state does not violate principles of classical thermodynamics. At given plasma density transition time decreases with heating power. At given heating power transition time increases with average density. Here, it is shown that the process of the transition to stationary state is governed by the properties of near-boundary plasma. We discuss the manner in which the near-boundary plasma influences the global confinement.

References

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