CONDITIONs OF drift WAVE DECAY AND ESTIMATES OF plasma TURBULENT FLUCTUATIONS

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A mechanism of transition from ordered plasma wave (here is ITG drift wave) to turbulent structure is considered such as it is done for a fluid where is a transition from laminar flow to turbulent flow [1]. Such reason complements existing theories [2], in which a dynamic of unstable drift wave or a dynamic (a correlation) of turbulent eddies is studied separately.

Observed experimental result [3] is discussed in which a transition of two quasi harmonics (fixed frequencies in drift range) into noise spectrum is accomplished. This experiment is showed as a sequence of onset of quasi harmonics drift waves in turbulent noise, its rising due instability, its decay as a breakdown of oscillation signal, an existing of developed turbulence during a finite time as a turbulent noise, and an onset of new such cycle.

A condition of drift wave decay is introduced. It is a rising local plasma density and temperature change due instability which modifies an original conditions of ITG instability appearance. In [2] a limit of rising wave amplitude is related with limit energy quantity that plasma can inject in wave development. In [4] a limit is related with plasma density gradient at forming of wave surface. In [4] the density gradient is compared with original plasma density gradient at which an unstable wave is appeared. Despite differ assumptions in [2] and [4], estimates of boundary amplitude quantity give the same result. Differs in [2] and [4] are next. A reaching of the maximum value of wave amplitude and an existing in this position during an infinitive time are assumed in [2]. A transition into turbulent state is assumed in [4]. This assumption allows making estimates of average quantities of turbulent fluctuations.

Received from measurements by using BES technology [5] estimates of turbulent fluctuations are represented. Since the one possibility of further development is a wave decay after reaching the critical value of amplitude, most likely wave decay leads to a dividing of wave into separate elements which linear dimensions are about half of wave length. Then instead of drift wave with rising amplitude many elementary perturbations should appear. These perturbations preserve wave structure in the sense that they have to be located linear and they are perturbations with increased and decreased plasma densities in alternating order. Perturbations with increased and decreased plasma densities are compared with average unperturbed density quantities and they move along a direction of drift wave distribution with a velocity of drift wave.

References

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