The relation of the plasma fluctuations in l-2m stellarator with gradient drift instabilities

G.M. Batanov, V.D. Borzosekov, I.Yu. Vafin, A.A. Letunov, D.V. Malakhov, A.I. Mesheryakov, K.A. Sarksyan, N.N. Skvortsova, N.K. Kharchev, V.I. Khvesyuk\*, A.Yu. Chirkov*\**

A.M. Prokhorov General Physics Institute RAS, [batanov@fpl.gpi.ru](mailto:batanov@fpl.gpi.ru)  
\*Bauman Moscow State Technical University, Russia

In investigations of microturbulence in high temperature plasmas, it is an issue to identify the instability mode which is responsible for saturation of the drift short wavelength instability (e.g. review [1]). Also there is an objective to define a relation between fluctuations parameters (spectra and energy) and scale lengths of the gradients (temperature and density). An effect of the gradients variation on fluctuations energy and spectra was shown in tokamak experiments (e.g. [2-4]). For high temperature plasmas of the L-2M stellarator the spectra of density fluctuations (transversal wave number *k*⊥ ≈ 30 cm-1) and their change with electron cyclotron heating (ECH) power were previously studied [5] using heating gyrotron radiation scattering techniques. In this work, we analyze to what extent the experimental fluctuations spectra widths correspond to the region of the unstable gradient drift modes.

Linear gradient drift instabilities were studied under the conditions of mentioned experiments. The analysis was based on the model [6, 7] involving both ion and electron modes (ITG, ETG) taking into account instabilities induced by trapped particles. For the measurements, *k*⊥ρ*Ti* ≈ 2–3, where *k*⊥ is transversal (to the magnetic field lines) wave number, ρ*Ti* is ion thermal dyroradius. Regimes with hollow density are the essential features or the stellarator from the point of view of gradient drift instabilities. In this case, gradients of density and temperature are directed contrary. the instability type is determined by the following features of the calculated modes. ii) For the modes with *k*⊥ρ*Ti* ≈ 2–3, the sign of the real frequency corresponds to electron diamagnetic drift frequency. ii) Calculations have shown relatively broad *k*||-spectrum at fixed *k*⊥ and relatively low longitudinal inhomogeneity of the magnetic field. These facts relate calculated modes to ETG-instability. Frequency width of the spectra at fixed *k*⊥ is about 50 kHz, with is consistent with the results of the measurements taking into account Doppler shift.

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