Evolution of energy losses and of microturbulence at modulated ECRH of L-2M stellarator plasmas

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After recent upgrade of the electron-cyclotron resonance heating (ECRH) system of the L-2M stellarator it is possible to study plasma dynamics at 100% modulated ECRH. Such modulation implies that heating goes in a form of a sequence of microwave pulses and between pulses high-temperature current-free plasma is confined without auxiliary heating. One of many interesting aspects to study in this operational regime is evolution of energy losses namely the steep increase of energy losses that happens shortly after (~ 1 ms) start of each heating pulse (Fig.1).

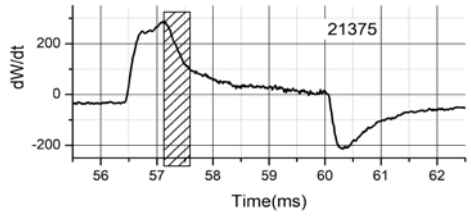

Fig.1. Diamagnetic signal – black solid line; shaded rectangle is the time interval with steep increase of energy losses.

Experiments reported here were carried out at average electron density $n_e = 2 \cdot 10^{19}$ m^{-3} and 400 kW of central X2 ECRH. Lengths of microwave pulses and time interval between pulses (quiet interval) were varied. Main focus of this report is an attempt to find relation between the steep increase of energy losses and evolution of microturbulence that was investigated using microwave scattering techniques at the L-2M. Four collective scattering diagnostics operate in the ECRH cross-section while Doppler reflectometry is installed in another cross-section. For density fluctuations in the local region near plasma axis it was found that intensity of density fluctuations $n_{\sim}^2$ is maximal in the time interval of the energy losses increase. Line averaged measurements of density fluctuations yielded same results. However, results of edge localized measurements of Doppler reflectometry demonstrate no change of fluctuations intensity. But change of Doppler reflectometry spectra is prominent: till the onset of the energy losses steep increase the peak near zero-frequency dominates in the spectrum and when the increase starts the spectrum becomes broader while the side peak arises near 750 kHz. The reported study was funded by RFBR project № 18-02-00621.