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INVESTIGATION OF RADIO FREQUENCY WAVES OF THE LOWER HYBRID RANGE IN THE FT-2 TOKAMAK CURRENT DRIVE REGIME BY PROBES *)

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The propagation of high frequency (HF) waves of the lower hybrid (LH) frequency range in a tokamak, used for non-inductive current generation, is a complex phenomenon, often accompanied by the development of nonlinear effects. In hydrogen discharge in the FT-2 tokamak with RF-waves injection on the frequency f_{RF} = 923 MHz at central density $1.5 \cdot 10^{19}$ m^{-3}, plasma current 23 kA and toroidal field 2 T, signals of two RF probes, located in two-waveguide RF grill antenna cross-section (P_1) and the cross-section, shifted by 90° in the toroidal direction (P_2), were studied. In addition to the intense line at the pump frequency f_{RF}, the probe spectra recorded a series (i = 1..5) of practically equidistant spectral HF satellites $f_{HF(i)}$ in the range of 740-880 MHz, as well as a wide noise spectra with a set of spectral lines $f_{LF(i)}$ in the low-frequency (LF) region of 40-180 MHz.

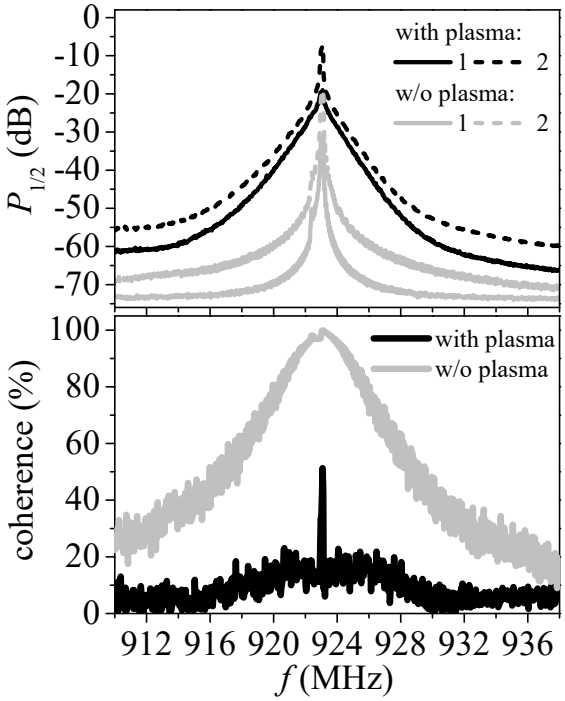

Fig. 1. *Spectra of probes and coherence between them*

A study of the correlation of signals of two probes revealed (figure 1) a drop in the coherence level from 50% to 16% at frequency offset 70 kHz from the f_{RF}. Without plasma, the coherence at the pump frequency reached 100% and at the frequency offset 1 MHz decreased by no more than 5%. The observed drop in the coherence near the pump frequency indicates that under the influence of the LF turbulence the spectrum of the LH wave changes as it propagates along the torus.

For the signal of each RF probe, the bicoherence spectra were studied, which revealed the presence of stable phase synchronism between individual HF and LF satellites and the line at the frequency f_{RF}. The processes in which the phase of the LF lines is formed as the difference between the phases of the HF pump and HF satellites turned out to be dominant, while the inverse processes, in which the phases of the LF and HF satellites are added, are weakly expressed. In particular, for the probe near the RF grill, the bicoherence level for the three-wave interaction of the $f_{RF} - f_{HF(i)} = f_{LF(i)}$ type reached 83%, for the inverse process $f_{RF} - f_{LF(i)} = f_{HF(i)}$ a slightly lower level of 59% was observed, and for the interaction of the $f_{HF(i)} + f_{LF(i)} = f_{RF}$ type an insignificant level of 12% was recorded. For the probe in another toroidal section, the corresponding bicoherence values were 36%, 27%, and 7%. Bicoherence analysis demonstrated that the wave corresponding to each satellite in the HF region interacts only with one wave in the LF region, as well as with the HF pumping wave itself. In other words, the bicoherence spectrum does not show any regions that would indicate interaction between neighboring satellites in the HF or LF regions, i.e., no energy transfer is observed between adjacent satellites.

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