application of HETERODYNE CORRELATION REFLECTOMETRY at the t-11 M TOKAMAK. first results

1,3Vershkov V.A., 2,3Petrov A.A., 2,3Petrov V.G., 1,3Shelukhin D.A.

1NRC "Kurchatov Institute", Moscow, Russia, [v.vershkov@fc.iterru.ru](mailto:v.vershkov@fc.iterru.ru)  
2Troitsk Institute for Innovation and Fusion Research, Troitsk, Moscow, Russia,  
 [vpetrov@triniti.ru](mailto:vpetrov@triniti.ru)  
3Fusion Centre, Moscow, Russia, [d.shelukhi@fc.iterru.ru](mailto:d.shelukhi@fc.iterru.ru)

Currently, correlation reflectometry [1] is a widespread method of measuring the behavior of plasma density fluctuations on a number of large devices: JET, Tore Supra, JT-60, T-10, etc.

On the T-10 tokamak, turbulence was measured at 60° in the poloidal direction from the low field side (LFS) equator. The data obtained on T-10 are well described by the expression δn/n = δn/n = 0.2⋅qa⋅r/Ln, where r and Ln are the small radius and the characteristic length of the density decay, respectively. Considering the increase in the level of integral turbulence on LFS by 1.28 times, this expression for the low magnetic field side (LFS) can be written as δn/n = 0.256⋅qa⋅r/Ln [2]. In order to extrapolate the turbulence parameters on the ITER, it is important to conduct experiments on tokamaks with different a, R, using the same technique. Such experiments were carried out on the tokamak T-11 M (R = 70 cm, a = 18...19 cm, B = 1 T, Ip = 70 kA), the heterodyne correlation reflectometer used was similar to the one applied on the tokamak T-10 previously.

The scheme of the experiments conducted on the tokamak T-11M is described, a block diagram of a two-channel heterodyne correlation reflectometer of Ka range (26.5-40.0 GHz, ncr = 0.084…0.198⋅1020 m–3), constructed using tunable solid-state oscillators (VCO – voltage-controlled oscillators) and efficient frequency multipliers. Phase measurements were carried out at an intermediate frequency of 20 MHz using a quadrature I/Q demodulator. Program for data elaboration used was identical to the one used on T-10, also.

The plasma was probed on an ordinary wave from a low magnetic field side. The antenna system of tokamak T-11M reflectometry, specially designed for this purpose, consisting of three horn antennas spaced in the poloidal direction, was used.

The data obtained on radial dependence of density fluctuations on T-11 M tokamak helped to clarify the T-10 scaling, introducing a dependence on the major radius R. Comparison of the radial dependence of turbulence δn/n, previously obtained experimentally for the Tore Supra tokamak in [3], with the modified T-10 scaling was carried out. There is a good enough correspondence, especially in the region r/a < 0.5, while for r/a > 0.5 the measured level of fluctuations was lower than predicted by the modified T-10 scaling.

References

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