Spatial structure of density fluctuations and their correlations along magnetic field line on t-10 tokamak

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Main characteristics of density fluctuations are their spatial distributions, radial rotation profile and radial and poloidal correlational properties and also correlational properties along magnetic field lines. Experiments on measuring correlations of density fluctuations along magnetic field line were conducted on T-10 tokamak by means of correlation reflectometry [1, 2]. In this work experiments conducted with new antenna system are considered. This antenna system enabled to conduct measurements on 4 poloidal angles: 0°, 60°, 120°, 180°. Stable and low noise semiconductor generators were used in the new experiments and spectrometric systems for measuring frequencies were also used. Experiments on measuring radial correlations and correlations along magnetic field line were conducted. In new experiments measurements of correlations along magnetic field line were conducted for the first time with changing sign of toroidal magnetic field and current direction. 4 antennas were used in experiments at high field side (HFS) (2 antennas in cross-section D and 2 antennas in cross-section A). So it allowed to conduct measurements for 4 combinations of pairs of antennas. In the experiments, plasma was probed via reflectometry at two ends of the magnetic field line, and delay times of the two antenna signals were calculated. The delay times proved to be depending on field direction. It may indicate that there is a directed speed of spreading of fluctuations along the magnetic field lines that corresponds to spreading of fluctuations from low field side (LFS) to HFS. Corresponding velocities estimated from the delay times proved to be close to ion sound velocity at the given radius. Thus, density fluctuations generate at LFS and they spread to HFS with ion sound velocity. Those results are new and they have crucial value because they show that the turbulence observed by reflectometry is a drift-type turbulence, not magnetic turbulence. The results are also confirmed by dependences of turbulence amplitudes on poloidal angle. Turbulence amplitude has a maximum at LFS and it drops significantly at HFS. Radial correlational measurements were also conducted at poloidal angles 0°, 60°, 120°, 180°. They show that radial correlation lengths are minimal at HFS and maximal at LFS and it is in a good agreement with previously developed model [3].

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References

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