Accounting for the effect of a finite lifetime of fluctuations on measuring the rotation velocity of perturbations in a tokamak plasma [[1]](#footnote-1)\*)

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Measurement of the rotation velocity of small-scale plasma fluctuations is one of the important issues in plasma physics. Studies in thermonuclear facilities have shown a significant role of plasma rotation in the formation of an external transport barrier (H-modes), however, a number of issues in the physics of the formation of a barrier need further study. Correlation reflectometry is one of the diagnostics that allow one to measure the poloidal velocity of fluctuations in most of the plasma column.

In the traditional approach, the measurement of the rotation velocity of fluctuations using reflectometry is based on the measurement of the time delay during the propagation of the plasma perturbation and the distance between the measurement regions. This approach is based on the Taylor hypothesis of frozen flows [1]. However, it has been shown that measurements of the rotation rate made with a reflectometer often do not agree with the diamagnetic plasma rotation rate obtained using other diagnostics [2]. Such a discrepancy may arise due to the finite lifetime of perturbations. An alternative method for estimating the propagation velocity of perturbations (the so-called elliptic approximation method) is based on the evolution of the space-time cross-correlation function; it was first used to measure the velocity on the W-7X stellarator [3]

On the basis of [4], an empirical model of a turbulent plasma with characteristic turbulence parameters measured on the T-10 tokamak was constructed, a Langmuir probe signal was simulated, and a full-wave simulation of the propagation of a reflectometer probing signal for this model was carried out. Comparison of the traditional Taylor and elliptic methods for the obtained data showed that the elliptical approximation approach gives the best agreement with the model velocity values.

The developed technique was applied to process the measurement data of the turbulence rotation velocity at the periphery of the plasma column (r/a ~ 0.95 – 1.1) in the T-10 tokamak. The obtained data showed that the elliptical approach gives a significant correction to the rotation speed measured with Langmuir probes. The report also presents comparison data of velocity measurements using correlation reflectometry within the traditional and elliptical approaches.

References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Mu/ru/CU-Vladimirov.docx) [↑](#footnote-ref-1)