

Time Delay Estimation based method for determining turbulent structure tilting

D. Guszejnov^{1,2}, A. Bencze¹, S. Zoletnik¹

¹ *MTA Wigner RCP, EURATOM Association, PO Box 49, H-1525 Budapest, Hungary*

² *Department of Nuclear Techniques, Budapest University of Technology and Economics, Association EURATOM, Műegyetem rkp. 9., H-1111 Budapest, Hungary*

Turbulence plays a key role in the transport of energy and particles in hot magnetized plasmas, but it is still not completely understood, despite intensive scientific investigation. Numerical simulations have shown that zonal flow shearing is a significant factor in controlling plasma turbulence. It is believed that the tilting of eddies could have a significant impact on the excitation of sheared flows [1]. This possibility makes necessary the development of new quantitative statistical methods for studying the tilting of turbulent structures using the diagnostic signals of the present turbulence measurements.

The method presented in this paper, is based on Time Delay Estimation (TDE), which is one of most commonly used techniques to study the propagation properties of turbulent structures in fusion plasmas. From the prospective of the comparison of theory and experiment it is important to estimate the statistical properties of the TDE based on solid mathematical groundings. We provide an analytic derivation of the variance of the TDE using a two-dimensional Gaussian model for coherent turbulent structures and also give an explicit method for determining the Bloch-angle (or ballooning angle) of structures. As a demonstration this method is applied to the results of a quasi-2D Beam Emission Spectroscopy (BES) measurement performed at the TEXTOR tokamak to determine turbulent structure parameters.

References

- [1] C. Hidalgo, Plasma Physics and Controlled Fusion, **53**, 074003, (2011)