Turbulence wave number spectra reconstruction from the radial correlation reflectometry data.

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Fluctuation reflectometry is widely used technique providing information on the tokamak plasma drift wave turbulence. Technical simplicity and operation at a single access to plasma are among its merits, which however cause interpretation problems related to localization of measurements and wave number resolution. In order to improve the fluctuation reflectometry wave number selectivity a more sophisticated radial correlation reflectometry (RCR), using simultaneously different frequencies for probing was proposed and developed at numerous magnetic fusion devices. The coherence decay of two scattering signals with growing difference of probing frequencies is studied in this diagnostic and interpreted in terms of the turbulence radial correlation length. However, as it was shown in [1-4] using different theoretical models, the small angle scattering along the probing trajectory reduces the diagnostic spatial resolution leading to a very slow decay of coherence in RCR, thus appealing for a more sophisticated RCR data interpretation. Recently [5] an analytical integral formula expressing the RCR cross-correlation function (CCF) in terms of turbulence radial wave number spectrum was derived and a procedure of its correct inversion for the spectrum determination from the CCF in the case of linear density profile was proposed.

In the present paper the feasibility of this spectrum reconstruction procedure is checked using 1D numerical modeling. The reflectometry signals are computed for sets of random density perturbations obeying a specified spectrum. As a result of ensemble averaging, the RCR cross correlation function is determined and the turbulence radial wave number spectrum is reconstructed and compared to the original one. The reconstruction procedure accuracy dependence on probing frequency range and resolution as well as on the noise level is investigated. The reconstruction procedure is generalized for the arbitrary profile and statistically inhomogeneous turbulence cases modeling transport barrier.

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[1] Hutchinson I 1992 Plasma Phys. Control. Fusion 34 1225
[2] Gusakov E Z and Popov A Yu 2002 Plasma Phys. Control. Fusion 44 2327
[3] Gusakov E Z and Yakovlev B O 2002 Plasma Phys. Control. Fusion 44 2525
[4] Gusakov E Z, et al. 34th EPS Conf. on Plasma Phys. Warsaw, 2 - 6 July 2007 ECA Vol.**31F**, P-5.100
[5] Gusakov E Z, et al. 35th EPS Conf. on Plasma Phys. Hersonissos, 9 - 13 June 2008 ECA Vol.**32**, P-1.082