On possibility of turbulence wave number spectra reconstruction using radial correlation reflectometry in Tore Supra and FT-2 tokamaks

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Radial correlation reflectometry (RCR) [1] is a microwave scattering technique for measuring the properties of electron density fluctuations in tokamaks. The coherence decay of two scattering signals with growing difference of probing frequencies is studied by the diagnostic to determine the correlation length.

As it was shown already in 1D numerical computations performed in Born approximation [2] the scattering signal cross correlation function (CCF) decays spatially much more gradually than the turbulence CCF. This slow decay of RCR CCF was attributed to the contribution of small angle scattering off very long scale fluctuations. Later this observation was confirmed also in 2D analytical study [3] and in full-wave 1D numerical modeling [4] for small level of turbulent density fluctuations. Recently a new theoretical approach has been proposed [5] allowing to overcome this difficulty and to determine not only the turbulence correlation length but the spectrum as well. Namely, it was shown that in the case of linear density profile the radial wavenumber spectrum of the turbulence can be expressed in terms of the ordinary mode RCR CCF using the integral transformation.

In the present paper we perform the numerical modeling of the RCR experiments targeted to reconstruction of the turbulence spectrum in preparation at Tore Supra and FT-2 tokamaks. Calculations are carried out for a set of realistic density profiles and probing frequency ranges currently used on these very different machines. The feasibility of the theoretically proposed reconstruction procedure [5] is clearly demonstrated. We also discuss the limitations of the method, and possible application to ITER.

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