Edge turbulence effects on core radial k-spectrum extracted from reflectometry data.

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It is now clear that the plasma confinement time and MHD activities are coupled with the plasma turbulence, and a good understanding on these links is essential to control fusion plasmas. This is also a key issue for fusion reactor design. However to reach this goal, it is necessary to accurately interpret turbulence measurements. Ultra-Fast Swept Frequency Reflectometry (USFR) is one of them, being used to get turbulence properties such as radial k-number spectrum and amplitude of density perturbations with high spatial and temporal resolution. To extract this data from the O-mode reflectometry signals an analytical expression was obtained to solve the inverse problem, and for X-mode this can be resolved with the help of the close loop method \cite{1} with 1D solver. Instead of 1D solver direct problem can be solved using 2D full-wave codes \cite{2} or analytical methods in the case of low turbulence levels yielding to a linear diagnostic response \cite{3}. Assuming in application of the close loop that signal properties depend mostly on the turbulence in the vicinity of the cut-off region. Usually tokamak plasmas have strong perturbations in the edge region and more weaker ones in the core region. When the probing beam crosses the strongly turbulent edge region it suffers widening and losses of coherency. These effects are well described \cite{4} and used to investigate ECRH heating localisation and efficiency. However the effects of edge turbulence on the phase variations of USFR when the cut-off position is situated in the plasma core are not well known. The present study is devoted to the phase k-spectrum change induced by the edge turbulence level. During interpretation of real experimental reflectometer data, this change can be linked with the turbulence properties near the cut-off region. To find the signature of edge turbulence effects, together with the phase variation, reflectometer complex signal and signal amplitude were studied. Complex signal analysis can give more information about the spectrum nature as demonstrated in this work. Using this method it is then possible to separate primary scattering and secondary scattering have been occurring after cut-off reflection. One can extract more information using several antennas distributed along with poloidal direction. Such a diagnostic exists and have been used to measure plasma rotation and turbulence correlation time \cite{5}. Using these analysis methods it is possible to evaluate if edge turbulence effects core turbulence measurements.

\cite{1} T. Gerbaud et al. Rev. Sci. Instrum. 77 (2006) 10E928
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\cite{4} E.V. Sysoeva et al., Nuclear Fusion 55 (2015) 033016
\cite{5} D. Prisiazhniuk et al., IRW12 proceedings (2015) http://www.fz-juelich.de/conferences/IRW12/EN/Publications/_node