

P1.1023 The impact of nonlinear scattering effects on Doppler reflectometry and radial correlation Doppler reflectometry

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See the full abstract here:

<http://ocs.ciemat.es/EPS2019ABS/pdf/P1.1023.pdf>

Turbulent transport plays a key role in plasma confinement, which makes understanding and control of plasma turbulence one of the major goals of fusion research. The tools for turbulence characterization include Doppler reflectometry (DR) and radial correlation Doppler reflectometry (RCDR) [1], latter of which utilizes simultaneous probing with two microwaves at different frequencies incident obliquely onto magnetic surface in the presence of the cutoff. By performing correlation analysis of reflected signals, the information about turbulence properties, such as radial correlation length can be extracted.

However, for both RCDR and conventional DR, analytical theory can only describe measured quantities and their relation to turbulence characteristics in the linear regime of scattering [2], corresponding to low turbulence amplitude. Some analytical results, such as the criteria for onset on nonlinearity [3] and transition to fully nonlinear regime [4] were obtained, but the main tools to analyze experimental data for nonlinear effects distorting the measurements at the moment are full-wave calculations.

In the present paper full-wave modeling with the use of IPF-FD3D code [5] is applied to the results of gyrokinetic modeling of FT-2 tokamak discharge to observe the effects of nonlinear scattering on the measurements of DR and RCDR. Scanning the amplitude of density fluctuations provided by ELMFIRE permits to identify nonlinear effects such as multiple scattering, strong phase modulation of the probing wave and nonlinear saturation of scattered signal power. Their impact on experimental data is also discussed.

[1] Schirmer J et al. 2007 Plasma Phys. Control. Fusion 49 1019.

[2] E Z Gusakov and A Yu Popov 2004 Plasma Phys. Control. Fusion 46 1393

[3] O.L. Krutkin et al 2019 Plasma Phys. Control. Fusion <https://doi.org/10.1088/1361-6587/ab0236>

[4] E.Z. Gusakov, A.Yu. Popov 2002 Plasma Phys. and Control. Fusion 44 2327

[5] Lechte et al. 2017 Plasma Phys. Control. Fusion 59, 07500

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