method of evaluating the accuracy of non-maxwellian plasma thomson diagnostics in tokamak-reactors

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The Thomson Scattering (TS) diagnostics of a high electron temperature *T*e in the core plasma in tokamak reactors (ITER and DEMO) has to operate in a limited spectral range of a strongly broadened TS spectrum and allow for possible deviation of electron velocity distribution function (eVDF) from a Maxwellian under condition of a strong auxiliary heating. The analysis [1] of opportunities to enhance the accuracy of the core plasma TS diagnostics suggested (a) the use of several probing wavelengths to increase the number of signals from various spectral channels and (b) the interpretation of TS data in the case of a non-Maxwellian eVDF in thermal and weakly/moderate superthermal energy range, with account of data for higher energy range from other diagnostics (e.g., from diagnostics suggested in [2]).

Here we present a method which is elaborated for evaluating the accuracy of the TS diagnostics of a non-Maxwellian electron plasma in tokamak-reactors. The method is based on the correct error assessment to determine main parameters of the eVDF from the TS spectrum measurements with allowance for all possible sources of error. The method is applied to a preliminary analysis of the advantages of the formerly suggested use of various wavelengths of the probing laser radiation in the Thomson diagnostics of Maxwellian and non-Maxwellian plasmas by solving an inverse problem for error estimation, including the possibility to recover electron temperature *T*e of the main thermal (i.e. Maxwellian) component up to 40 keV from visible and infrared light spectral range ~400-1000 nm and (ii) moderate anisotropy of the eVDF in electron pitch angles in the thermal and weakly/moderate superthermal energy range. A particular example of the ITER core plasma TS system design is considered, and a comparative analysis of conservative and advanced approaches of *T*e measurements is given. The results obtained confirm the relevance of the diversification of the probing laser radiation wavelength and show the necessity of a detailed analysis of the TS diagnostics accuracy in tokamak-reactors.

References

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