Algorithm to separate direct and stray light in the H-α spectra in all-metal wall tokamaks

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The algorithm used in [1] to separate the divertor stray light (DSL) (i.e. reflected from the vacuum chamber walls) in the D-α light collected by the high resolution spectrometer (HRS) targeted at the scrape-off layer (SOL) plasma in the recent ITER-like wall (ILW) experiments in JET tokamak is described. The algorithm uses the D-α HRS data from direct observations of divertor and is based on the formulation and solving the multi-variable non-linear optimization problems.

On the first step, we determine the effective neutral atom temperatures in divertor as well as statistical weight of each group of atoms with respective temperatures, by fitting the direct divertor spectra. On the second step, we construct the DSL spectrum using the modification of the model [2] and the recovered data on the neutral atoms in divertor. This spectrum contains only one free parameter, namely, the fraction of the π-component in the Zeeman triplet. On the third step, we reconstruct the SOL plasma parameters the same way we did it on the first step, using the spectrum at the ohmic phase of the discharge (when the plasma in divertor does not emit). Here we can separate the contributions to the spectral intensity from the inner and outer SOL light (SOLL). The model we use here takes into account the spectral asymmetry relative to the line center due to non-Maxwellian neutral atoms [3,4]. On the fourth step, we solve the same problem at the divertor phase of the discharge using previously constructed DSL spectrum. Here we obtain the DSL/SOLL (background/signal) ratio.

The algorithm is tested on the data for the JET pulses with the moderate (pulse No. 83624) and high (pulse No. 835551) power NBI, and for the ohmic pulse No. 82626 [1]. It is shown that one has to use the data from other diagnostics to increase the accuracy of the results and to mitigate the difficulty of separating the DSL and the outer wall SOLL.

The results support the expectation of a strong impact of the DSL upon the measurements of neutral atom density with the H-alpha (and Visible Light) Spectroscopy Diagnostic in ITER, and the necessity of the bifurcated-LOS measurements (targeting at an optical dump and very closely to it on the standard surface of the vacuum chamber first wall).

References

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