Reconstruction of 2D Dα emission profile in the SOL and divertor IN ITER using the ray transfer matrix approach in synthetic diagnostic [[1]](#footnote-1)\*)

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Within the framework of synthetic diagnostics [1], a tomographic problem is solved for reconstructing the two-dimensional (axially symmetric) Dα emission profile in the scrape-off layer (SOL) and divertor in ITER from Dα intensity measurements in the fields of view of “Divertor Impurity Monitor” and “H-alpha (and Visible) Spectroscopy” diagnostics. The stray light produced by reflections from the metal wall of the vacuum chamber is taken into account. To solve the problem, we use the approach of ray transfer matrices [2]. These matrices provide the transformation of the signal from each individual unit light source to each pixel of the receiver, using the ray-tracing simulation, and act as Green’s functions in similar problems [3]. The calculations were performed by the ray-tracing method using the Raysect (www.raysect.org) and Cherab (https://github.com/cherab) numerical codes [4] improved by a fast algorithm for calculating ray transfer matrices, which is hundreds of times faster than the method used in [2]. The simulations results [5], obtained with the SOLPS4.3 code [6] (which is based on B2-EIRENE code [7, 8]) on the numerical mesh extended with OSM code [9], were used as synthetic experimental data for the Dα emission in the SOL and divertor in ITER.

It is shown that it is possible to filter out the reflected light observed in the main chamber and to reconstruct the 2D Dα profile in the limited area of the SOL in scenarios with a high plasma density in the far-SOL when the stray light from divertor (background signal) does not exceeds the direct light from the SOL (useful signal) no more than 10 times. The key factors affecting the quality of the result are the accuracy of the model for reflectivity (value of reflection coefficient and distribution between specular and diffusive reflection) of the first wall, and the presence of fields of view in the tokamak main chamber, where the same area of the SOL is observed at different angles.

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