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Theoretical Model of ITER High Resolution H-Alpha Spectroscopy for a Strong Divertor Stray Light and Validation against JET-ILW Experiments

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Theoretical model suggested for ITER H-alpha High-Resolution Spectroscopy (HRS) is validated against recent JET ITER-like wall (ILW) experiments. The model assumes reconstruction of neutral hydrogen isotopes density in the SOL, and evaluation of the recycling flux from the main chamber first wall, via solving a multi-parametric inverse problem with allowance for (i) strong divertor stray light (DSL) on the in-vessel lines-of-sight (LoS), (ii) substantial deviation of neutral atom velocity distribution function from a Maxwellian in the SOL, (iii) data for direct observation of divertor. The developed "synthetic" Balmer-alpha diagnostic is tested on the example of data from the SOLPS4.3 (B2-EIRENE) code predictive modeling of the flat-top of Q=10 inductive operation of ITER. The JET-ILW HRS data on resolving the power at deuterium spectral line D-alpha with direct observation of the divertor from the top and with observation of the inner wall along tangential and radial LoS from equatorial ports are analyzed. These data allow to evaluate the spectrum of the DSL and the signal-to-background ratio for D-alpha light emitted from the far SOL and divertor in JET ILW. The results support the expectation of a strong impact of the DSL upon the H-alpha (and Visible Light) Spectroscopy Diagnostic in ITER.

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