Interpretation of opacity measurements in the JET ITER-like wall divertor using a particle balance approach

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Recent improvements in spectroscopic measurements of the JET ITER-like wall divertor plasma temperature and density have facilitated estimates of the outer target volumetric ion source and sink rates using ADAS [1] inverse photon efficiency coefficients. In high-recycling outer divertor conditions a factor of three shortfall was found in the ionization rate obtained from Ly_α intensity profiles compared to the reference D_α estimates. Additionally, radial profiles of the $(Ly_\beta/D_\alpha)(A_{D\alpha}/A_{Ly\beta})$ ratio suggest strong opacity of the Ly series lines at the outer target. To reconcile the Ly_α ionization rate discrepancy, a detailed interpretation of opacity corrections using the population escape factor approach [2] is presented. To aid in the measurement interpretation and assessment of the impact of spectroscopy line-integration effects, an *ad hoc* opacity model is employed using the EDGE2D-EIRENE [3] fluid-neutral code package. Post-processing of the simulations with synthetic spectroscopy shows good correspondence to experiment which reinforces the estimated Ly_β and Ly_α escape factor values at the outer target of less than 0.5 and 0.1, respectively, (i.e., more than 50% Ly_β and 90% Ly_α photon reabsorption along the vertical line-of-sight). These findings suggest a renewed effort should be undertaken in the assessment of the opacity impact on both diagnostic interpretation and divertor plasma dynamics using the more sophisticated EIRENE photon transport model [4] in the context of metal wall tokamaks.

References

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