P06

Lyman line opacities in tokamak divertor plasmas under high-recycling and detached conditions

R. Chandra[1], **D. Reiter**[2], **N. Horsten**[3], **M. Groth**[1]

[1]*Aalto University, Department of Applied Physics, Espoo, Finland*
[2]*Institut for Laser and Plasmaphysics, Heinrich-Heine-Universität, Düsseldorf, Germany*
[3]*KU Leuven, Department of Mechanical Engineering, Leuven, Belgium*

The radiation transport modelling of deuterium Lyman series using EIRENE predicts a 20% enhancement of ionization in the JET-ILW low-confinement (L-mode) divertor plasma under high-recycling and detached conditions. Opacity of the hydrogen Lyman line radiation directly affects the population of electronically excited states and thereby affects the effective ionization rates and the spectroscopic interpretation of local plasma parameters [1, 2, 3]. Proper treatment of opacity requires a coupled solution between the collisional equilibrium of the involved species and radiation transport, both of which depends on the information of plasma temperature and density at all points in space. The opacity is calculated using an inline collisional-radiative model (CRM) [4] of the kinetic Monte Carlo model EIRENE [5, 6] from particle and photon trajectories. The CRM-EIRENE model is applied to plasma solutions provided by EDGE2D[7] and B2.5 (in SOLPS-ITER[8, 9]) fluid solvers for JET-ILW low confinement plasma with different separatrix densities representing low-recycling, high-recycling and detached conditions. In both boundary plasma code solutions, the model suggests high opacity of the Lyman-α and Lyman-β lines in the JET divertor volume under high-recycling and detached plasma conditions.

This work has been carried out within the framework of the EUROfusion Consortium, funded by the European Union via the Euratom Research and Training Programme (GrantAgreement No 101052200 — EUROfusion). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the European Commission can be held responsible for them. This work has been supported by the Academy of Finland under grant no. 1330050. The results are obtained with the help of the EIRENE package (see www.eirene.de) including the related code, data and tools.

[1] J. L. Terry et al., Physics of Plasmas **5** 1759–66 (1998)
[2] S. Lisgo et al., Journal of Nuclear Materials **337–339** 139–45 (2005)
[3] B Lomanowski et al., Plasma Physics and Controlled Fusion **62** 6:065006 (2020)
[4] K. Sawada et al., Journal of Applied Physics **73** 8122 (1993)
[5] D. Reiter et al., Plasma Physics and Controlled Fusion **44** 8:1723–37 (2002)
[6] V. Kotov et al., Contribution to Plasma Physics **46** 635 – 642 (2006)
[7] R. Simonini et al., Contribution to Plasma Physics **34** 368-373 (1994)
[8] S. Wiesen et al., Journal of Nuclear Materials **463** 480–84 (2015)
[9] X. Bonnin et al., Plasma and Fusion Research **11** 1403102–1403102 (2016)
[10] N. Horsten et al., Nuclear Materials and Energy **33** 101247 (2022)