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Application of Monte-Carlo methods for photon transport in divertors

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15 years ago the EIRENE Monte-Carlo code was developed to solve the radiation transport equation by acknowledging an analogy to the kinetic Boltzmann equation. At that time the relevance of photonic reabsorption of strong (Lyman) lines in divertors was proven, leading into a revision of the SOLPS4.3 model used for the ITER divertor design to include Lyman line opacity effects. Although the accessible operational window of the ITER divertor was not strongly affected (e.g. in terms of target heat-flux as a function of divertor neutral pressure) a change in the ionisation-recombination balance was predicted with an impact on the eroding particle fluxes. Recently, Lyman-line opacity in divertors has gained a larger attention due to its significant impact on the interpretation of visible/VUV spectra for the purpose of edge code validation.

A review on the numerical treatment of photon transport in fusion plasma using the EIRENE Monte-Carlo methods is given. The required ingredients of divers broadening mechanisms are summarised, including effects that will become more important in high-density DT fusion experiments in a metallic environment (JET-DT, ITER or DEMO), i.e. isotope effects and Zeeman splitting. A large uncertainty exists in the description of surface reflections on (deposited) metal surfaces (W or Be). The relevance of revised collisional radiative models with Lyman opacity including various line broadening mechanisms is discussed with supporting examples. The status of a continued development of the radiation transport EIRENE module is summarised.

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