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Analysis of W soft x-ray spectra gathered through the PHA system on the W7-X stellarator

Soft X-ray Pulse Height Analysis (PHA) system [1,2] is routinely used in various fusion devices, including tokamaks and stellarators such as Wendelstein 7-X, during the experiments [3-6]. The PHA system serves the vital function of providing information regarding the impurity content and core electron temperature (T_e) within the plasma environment. Additionally, it enables the estimation of the average effective charge (Z_{eff}) by comparing experimental spectra with theoretical ones [4,5]. However, the interpretation of experimental X-ray spectra in terms of plasma parameters of interest necessitates prior identification and consideration of all relevant factors affecting the spectrum within theoretical radiation models. Therefore, for this purpose, two theoretical models have been applied. RayX code [7], which allows performance simulations for different plasma scenarios characterized by varying the temperature and density profiles as well as the electron cyclotron resonance heating power over a wide range, and Flexible Atomic Code [8], which allows to calculate various atomic properties such as energy levels, cross sections for excitation and ionization by electron impact, transition probabilities for radiative transitions and autoionization, and any others as needed in the Collisional-Radiative approximation. The spectra recorded during experimental sessions OP1.2b and OP2.1 have been analyzed, striving to achieve agreement between the registered and simulated spectra. This comparison enabled us to ascertain both the effective charge (Z_{eff}) and the level of impurities present in the plasma.

References

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