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Extreme-ultra-violet emission of W ions with open 4f-shell

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The plasma divertor for the International Thermonuclear Experimental Reactor (ITER) will have target plates made out of tungsten (W) [1]. The inevitable W contamination will emit characteristic radiation that depends on the specific charge state balance, electron temperature and density conditions. Therefore, the respective emission spectra can be used as real-time diagnostics of the fusion reactor plasma physical conditions [1, 2]. Given the importance of the spectra of this elements, both its low and highly charged ions have already been extensively studied in the past in a wide range of the electromagnetic spectrum [2-5]. However, the emission of the open 4f-shell charges states, between 12+ and 28+, still remains largely understudied, has the emissions of this group of ions is usually observed mixed with each other. In our work, an Electron Beam Ion Trap (EBIT) was used to produce and individually observe the EUV spectrum (12 – 26 nm) of each of the charge states in the open 4f-shell complex. A slow electron beam energy scan between 300 and 1000 eV allowed us to observe the emissions for every individual charge state. The excellent resolution allows to retrieve each charge state contribution with the Non-Negative Matrix Factorization (NNMF) method. The decomposed data was matched with the respective theoretical wavelengths of the Unresolved Transition Arrays (UTA) calculated with Flexible Atomic Code (FAC) [6]. In this regime, we observed the O-O transitions derived from N-O collisional excitations. This data is of great importance, as it can be incorporated in diagnostic models relevant for fusion plasma monitoring.

References

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