Theoretical study of emission cascade in W^{25+} ion

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Ions in electron beam ion traps (EBIT) move in cycloidal orbits spending part of their time outside electron beam [1]. Process of cascade emission has to start when interaction of ion with electrons from beam ends. Time fraction the ions spend inside and outside the electron beam depends on many parameters: ion temperature, electron beam energy, electron beam current, electric and magnetic fields. On the other hand, the range of ion radius r_i ratio against the geometric electron radius r_e can be expressed through the effective charge Z_{eff} of ion: $1/\left(Z_{eff}/Z\right)^{\alpha}$ with $1 < \alpha \leq 2$ [2]. We have $r_i/r_e \approx 3^{\alpha}$ for W^{25+}, i. e. ions mainly dwell outside the electron beam.

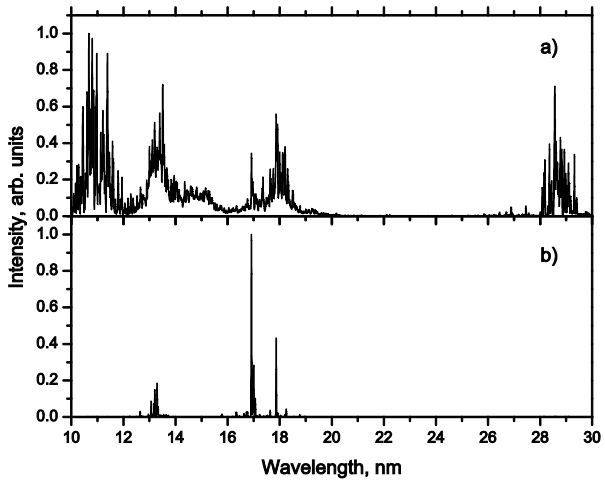

Figure 1. Theoretical spectra of W^{25+} ion obtained a) from CRM and b) with emission cascade.

The main aim of the current work is to analyse influence of emission cascade to the formation of W^{25+} spectra in EBIT plasma performing large scale calculations. Flexible Atomic Code [3] was employed to obtain energy levels and radiative transition probabilities in W^{25+} using configuration interaction (CI) method. CI basis consists of 13952 levels which originate from 22 configurations. Electron impact excitation rates are calculated within distorted wave approximation for electron beam energy of 728 eV. Gaussian distribution function with a full width at a half-maximum of 30 eV used for electron energy.

Figure 1 demonstrates that cascade emission boosts intensities only for a few lines in the spectrum. Those lines correspond to $4f^2 5d \rightarrow 4f^2 5p$ transitions in W^{25+} among the levels with large J values. Because the number of such levels is significantly smaller, and due to selection rules for radiative dipole transitions, cascade emission leads to the concentration of intensity. Intensity of other transitions is spread over a wide range in the spectrum of cascade emission. Cascade emission boosts lines corresponding to the radiative dipole transitions among the lowest configurations of the ion.

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