Simulation of K-shell emission spectra of Mg in the interaction of XFEL

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The investigation of x-ray–matter interaction with x-ray free electron laser (XFEL) has attracted considerable attention in the past decade [1], which produces ultrafast ultra-intense x-ray pulses. Research on XFEL-matter interaction is significant for fundamental investigations and applications. In this work, we simulated the emission spectra of Mg in the interaction of XFEL with the photon energy of 1540 eV, duration of 100 fs and peak intensity of ~10^{17} W/cm^2[2]. A time-dependent rate equation is utilized to calculate the temporal evolution of the fine-structure level populations[3-4]. The emission spectra are compared with the experiment and reasonable good agreement is found. The delocalization of high orbtials of highly charged Mg ions in hot dense plasma environment are investigated using an a.b. init. method, in which the plasma screening effects on atomic wavefunctions are considered by introducing an effective screening potential into Hamiltonian. Compared with the commonly used analytic models, better agreement in the K-shell emission spectra of Li-like and He-like Mg are obtained.

References

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