X-RAY SPECTROSCOPY VALIDATION OF IONIZATION POTENTIAL DEPRESSION MODELS IN DENSE PLASMA CREATED BY RELATIVISTIC LASER PULSES

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Recently, the IPD effect was experimentally studied using free-electron X-ray lasers radiation [1, 2] and high-power optical lasers [3, 4]. It turned out that in the first case, the observational results were consistent with the EK model [5] only, while in the second case - with SP model [6] only, and the difference between the obtained results was significant.

We studied the IPD effect of the Si XIII ions using an emission X-ray spectrum of silicon plasma generated by an optical laser pulse on Vulcan PW (CLF, UK) laser facility with a duration of 1.2 ps and an intensity of up to 4×10^{20} W/cm^2 irradiating the targets of various types. A comparison of the experimental spectra with the simulation results (provided by a PrismSPECT radiation-collision code) showed that the EK model greatly overestimates the IPD in comparison with the SP model. A set of emission spectra of silicon plasma corresponding to an ion density from 10^{21} cm^{-3} to 4×10^{22} cm^{-2} was studied in our present work. The spectral lines of He-like Si XIII ions, as well as corresponding upper states "disappear" one by one with an increase of the plasma density, up to the state with the principal quantum number of $n = 4$, inclusively.

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