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Ionization and K-shell Spectral Signatures in Dense Plasmas with non-Maxwellian Electron Distributions.

IGOR GOLOVKIN, Prism Computational Sciences

Radiation-based diagnostics – including imaging, spectroscopy, and absolute flux measurements – are widely used to determine key features of high energy density laboratory plasmas (HEDLP). In short-pulse laser experiments, energetic particles can also be generated by intense laser fields. Spectroscopic analysis based on Kα/Kβ satellite line emission can provide important information regarding characteristics of both the target plasma and the energetic electrons. The electrons travel through the dense plasma and produce Kα and Kβ emission by collisionally ionizing and exciting K-shell electrons of target ions. The subsequent refilling of the K shell by 2p$\rightarrow$1s and 3p$\rightarrow$1s transitions results in the emission of Kα and Kβ line radiation, respectively. We will present detailed analysis of time-dependent atomic kinetics in plasmas with non-Maxwellian electrons and discuss processes involved in formation of Kα/Kβ composite spectral features. In particular, we will show how dense plasma effects influence plasma ionization and line shifts in experiments on Omega EP laser facility. We will also demonstrate, based on the analysis of experiments at the Zebra pulsed-power facility, that strong external magnetic fields can have a significant impact on spectroscopic observables.