Effect of the ionization potential depression on electron-impact ionization cross-sections in dense plasmas

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Collisional-radiative calculations can provide reliable emission and opacity spectra if the cross-sections of the various microscopic processes occurring in a dense plasma are accurate. In this work, we focus on electron impact ionization (EII). Since the EII cross-section depends strongly on the ionization energy and since the latter is very sensitive to the plasma environment ("density effects"), we need to take into account the ionization potential depression (IPD). The IPD can be calculated by using the Stewart-Pyatt [1] or Ecker-Kröll [2] formulas. A recent model, based on classical molecular dynamics [3], was developed at Aix-Marseille University. It simulates multi-component plasmas, and accounts for all the charge correlations, providing a distribution of ionization energies for each ion charge state. This distribution is a result of the fluctuations of the environment. In this work, we compare calculated IPDs to experimental results obtained at LCLS (Stanford) [4]. Following a recent work [5], we discuss the distribution of the ionization energy in an aluminum plasma, and propose an alternative formulation of the cross-section, suitable for the inclusion of the IPD.

References

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