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Ionization Potential Depression and dense plasma collisional properties.

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The radiative properties of an atom or an ion surrounded by a plasma, are modified through various mechanisms. Depending on plasma conditions the electrons supposedly occupying the upper quantum levels of radiators no longer exist as they belong to the plasma free electron population. All the charges present in the radiator environment, electrons and ions, contribute to the lowering of the energy required to free an electron in the fundamental state. This mechanism is known as ionization potential depression (IPD). The knowledge of IPD is fundamental as it affects both the radiative properties of the various ionic states and their populations. Its evaluation deals with highly complex n-body coupled systems, involving particles with different dynamics and attractive ion-electron forces. Two distinct models, namely the Stewart–Pyatt (SP) [1] and Ecker–Kröll (EK) [2] models, are widely used to estimate the IPD.

More recently, an approach based on classical molecular dynamics simulation has been developed providing an alternative way to calculate the IPD [3]. Ions and electrons are treated as classical particles and a minimum of quantum properties are taken into account through a regularized potential allowing to model collisional ionization and recombination processes. The related numerical code, BinGo-TCP, has been designed to describe neutral mixtures composed of ions of the same atom with different charge states, and electrons. Within the limits of classical mechanics, all charge-charge interactions are accounted for in the particle motion.

In this work, after a brief reminder of the modeling basis, the importance of the choice of the IPD modelling will be emphasized through a study of the influence of the IPD on the magnitude of the cross-section of ionization by free-electron impacts in the high-density domain [4]. Additionally, we will discuss the ionization energy distributions obtained with BinGo-TCP due to the fluctuating environment of the ions.

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