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Modelling of ion extraction from a pulsed photo-plasma in presence of ion-atom collisions

Efficient extraction of ions from a pulsed photo-plasma has been a major area of research in the field of laser isotope separation. The dynamics of the process becomes far more complex when the ion-atom collisional effects due to the background atomic beam become significant. In this paper, a Monte-Carlo-based PIC (Particle-In-Cell) model has been presented that incorporates collisions of the plasma ions with the atoms of the background atomic beam to simulate the dynamics of plasma ion extraction. The transient characteristics of the plasma evolution have been simulated for a typical range of experimentally-realized parameters of the plasma and the atomic beam. It is found that the charge-exchange collision becomes dominant as the density of the atomic beam increases, resulting in the increase of the non-selectively ionized isotopes. This adversely affects the desired isotope's enrichment level in the collected product. In this paper, these ion-atom collisional aspects have been explored and their influence on the ion extraction dynamics has been presented.

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