Influence of the peak density of near-critical gas targets on the spectrum features using ultra-high laser intensity through numerical modeling

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In the past two decades, laser-accelerated ion sources and their applications have been intensely researched due to the increased focus in developing potential laser plasma sources with applications in proton radiography [1], fast ignition [2], hadrontherapy [3], [4], radioisotope production [5] and laboratory astrophysics [6]. Recently, it has been shown through experiments that proton beams with characteristics comparable to those obtained with solid targets can be obtained from gaseous targets. By means of Particle-In-Cell simulations, this paper studies in detail the effects of a near-critical density gradient on ion and electron acceleration after the interaction with ultra high intensity lasers. We can observe the influence of the peak density of the gas jet on the accelerated particle spectrum features. We can observe that as the gas jet density increases, so does the peak energy of the central quasi-monoenergetic ion bunch due to the increase in laser absorption while at the same time having a broadening effect on the electron angular distribution. Furthermore, the gamma photon production is studied for all cases comprised in the study in order to ascertain the feasibility of such targets as secondary sources.

References:

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