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Average Current Enhancement of Laser-Plasma Accelerators

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Since they have been proposed, laser-plasma accelerators have interested the scientific community for their ability to generate electric fields exceeding the ones of Linacs and RF cavities. Several efforts have been made in order to produce monochromatic electron beams and to increase their maximum energy, often at the expense of the charge. However, some applications like femtosecond chemistry, radio-biology and industrial radiography do not need monochromatic beams, but rather highly charged
ones (i.e., > 1 nC). For some of these applications it is also necessary to reduce the amount of high energy electrons (i.e., > 10 MeV), in order to avoid the activation of materials. Such beams can be produced using high Z gases like Nitrogen and Argon, exploiting the ionization injection of several plasma period. Here we numerically and experimentally investigate this little-known regime, employing different laser energies, f-numbers and plasma densities. This allowed us to find the conditions to produce electron beams with charges up to tens of nC and exceeding 100 mrad in divergence. We will also show and explain the dependencies of these beams (e.g., their charges and energy spectra) as functions of the aforementioned laser and plasma parameters.

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