Improving a High-Power Laser Based Relativistic Electron Source: The Role of Laser Pulse Contrast and Gas Jet Density Profile

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A new relativistic electron source based on high power laser interaction with gas jet targets has been developed at the Institute of Plasma Physics & Lasers (IPPL) of the Hellenic Mediterranean University. Initial measurements were conducted using the “Zeus” high power laser pulses with peak intensities in the range of 10^{18}-10^{19} W/cm^2 interacting with a He pulsed gas jet having a 0.8 mm diameter nozzle. A dramatic improvement of the electron signal was measured after using an absorber to improve the laser pulse contrast from 10^{-7} to 10^{-9}. Thus, a high stability quasi-monoenergetic electron beam of about 50 MeV was achieved, using a home-made magnetic spectrometer equipped with a Lanex screen, for pulsed gas jet backing pressure of 12 bar. For comparison purposes, studies using a 3 mm diameter nozzle for backing pressures in the range of 35 to 40 bar showed electron beam production with energies spread in the range from 50 to 150 MeV. The pulsed jet density profile was determined using interferometric techniques while the interaction area was imaged using shadowgraphy. Particle in Cell simulations, at the above experimentally determined conditions, support our experimental findings [1]. Our relativistic electron beam source has been already applied in testing space electronic devices as well as irradiating polymeric gel dosimeters and biological samples. In addition, studies of this source including the simultaneous detection of the generated betatron-type x-ray radiation and the relativistic electrons has been recently reported [2,3].

References

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