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Multi-MeV, stable electron bunch using supersonic air jet target

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Relativistic interaction of short-pulse, high intensity lasers with underdense plasmas results in acceleration of electrons in relativistic regime. These relativistic electron beams have the ability to serve as a source of spatially coherent collimated, point-like and femtosecond X-ray radiation. Generation of a quasi-monoenergetic bunch of electrons is important for generation of stable betatron radiation and X-ray pulses from inverse Compton scattering.
The purpose this work was to optimize conditions necessary for building this type of electron and X-ray source in a small laboratory equipped with a common femtosecond few-terawatt laser. Various gas jet targets, such as helium, a mixture of helium and argon, helium with an admixture of synthetic air, and dry air were tested for this purpose using different backing pressures and the obtained results are compared. Additionally, a razor blade was used to create steep density gradient of the neutral gas in order to achieve shock injection and thus to increase the number of trapped electrons. Simulations and experimental results are presented.

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