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Generation of the collimated quasi-monochromatic beams of accelerated electrons in the interaction of an intense femtosecond laser pulse with an inhomogeneous plasma

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The formation of quasi monoenergetic beams of accelerated electrons by focusing femtosecond laser radiation with an intensity of 2×10^{17} W/cm² onto an edge of aluminium foil has been experimentally demonstrated. The maximum of electrons energy distributions lied in the range from 0.2 to 0.8 MeV with an energy spread less than 20 %. The acceleration mechanism related to the generation of a plasma wave as a result of self-modulation instability of the laser pulse in the dense plasma formed by the prepulse of the laser system (arriving 10 ns before the main pulse) is considered. PIC simulations of the laser-plasma interaction showed that effective excitation of a plasma wave as well as trapping and acceleration of an electron beam with an energy about 1 MeV may occur in the presence of sharp gradients in plasma density and in the temporal shape of the pulse.

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