Optimization of a synchrotron radiation source in the relativistic self-trapping regime

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Synchrotron radiation sources generated through the interaction of short laser pulses with low-density plasma exhibit unique features, including compact size ($\sim$ μm), narrow directivity ($\sim$10 mrad), ultra-short radiation duration ($\sim$10 fs), and high brightness. These sources are suitable not only for diagnostics and control in laser-plasma experiments, but also hold practical potential in fields such as security, medicine, microelectronics, and the study of ultrafast physical processes. We examine laser pulses with an energy of 1 J and different durations from 40 fs to 6 fs. Such pulse modifications can be experimentally implemented using the CafCA (TFC) system. Previously we demonstrated that shortening the pulse duration increases the conversion efficiency of laser energy into the total energy of fast electrons by up to 50%. Consequently, an improvement in the characteristics of the synchrotron radiation can be expected.