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Wakefield-acceleration of relativistic electrons with few-cycle laser pulses at kHz-repetition-rate[1] DIEGO GUENOT, DOMINYKAS GUSTAS, ALINE VERNIER, FREDERIK BOEHLE, BENOIT BEAUREPAIRE, RODRIGO LOPEZ-MARTENS, JEROME FAURE, laboratoire d'Optique Appliquee, APPLI TEAM — The generation of relativistic electron beams using laser wakefield acceleration has become a standard technique, providing low emittance electron bunches with femtosecond durations. However, this technique usually requires multi-ten-terawatt lasers and is thus limited to low repetition-rate (typically 10 Hz or less). We have recently demonstrated the generation of few MeV electrons using 2.5-mJ, 4-fs, 1-kHz repetition-rate laser pulses, focused to relativistic intensity onto a gas jet with electron density $\approx 10^{20}$ cm^{-3}. We have investigated the influence of the pulse duration, the gas density. We demonstrated that an electron beam with a charge in the range of 10-fC/shot, with a divergence of 20-mrad and a peaked spectrum with energies between 2 and 4 MeV can be generated at kHz repetition-rate. These results confirm the possibility of using few-cycle laser pulses with very low energy for exciting wakefields in the bubble regime and for trapping electrons, as predicted by PIC simulations. This kHz electron source is ideally suited for performing electron diffraction experiments with very high temporal resolution. Our results also open the way to other applications, such as the generation of a kHz ultrafast X-ray source.

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