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Generation and characterization of attosecond micro-bunched electron pulse trains via dielectric laser acceleration

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Dielectric laser acceleration is a versatile scheme to accelerate and control electrons with femtosecond laser pulses in nanophotonic structures. We show recent results of the generation of a train of electron pulses with individual pulse durations as short as 270 +/- 80 attoseconds. We achieve these attosecond micro-bunch trains based on two subsequent dielectric laser interaction regions connected by a free-space electron drift section, all on a single photonic chip. In the first interaction region (the modulator), an energy modulation is imprinted on the electron pulse. During free propagation, this energy modulation evolves into a charge density modulation, called ballistic bunching. The resulting density modulation is probed in the second interaction region (the analyzer). This work represents a crucial step for dielectric laser accelerators, namely to enable phase synchronous acceleration of a significant fraction of electrons injected into the device. In addition, ultrafast experiments with these attosecond electron pulse trains come to mind.

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