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Coherent nanophotonic electron accelerator

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The acceleration of electrons with the help of laser light inside a photonic nanostructure represents a microscopic alternative to microwave-driven accelerators. The main advantage is that the much higher driving facilitates damage thresholds of dielectric materials reaching 10 GV/m. This means that acceleration gradients far in excess of 1 GeV/m should be attainable. Furthermore, the structure size of the optical accelerators lies in the nanometer range, meaning that nanofabrication methods can be employed to build the accelerator structures. In pursuit of these goals, we demonstrated a scalable nanophotonic linear electron accelerator that coherently combines particle acceleration and transverse beam confinement utilizing an alternating phase focusing (APF) scheme. It accelerates and guides electrons over a considerable distance of 500 μm in a channel just 225 nm wide. The highest energy gain observed was 43%, from 28.4 keV to 40.7 keV. We expect this work to pave the way for nanophotonic accelerators. These on-chip particle accelerators might enable transformative applications in medicine, industry, materials research and science. In this talk, we will give a status update of nanophotonics accelerators.

Footnotes

Chlouba, T., Shiloh, R., Kraus, S. et al. Coherent nanophotonic electron accelerator. Nature 622, 476–480 (2023). https://doi.org/10.1038/s41586-023-06602-7

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