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Electron-bunch manipulation at 400GHz for compression, de-chirping, acceleration and synchronisation of femtosecond bunches.

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Laser-generated terahertz frequency pulses have been used to manipulate the phase-space of electron beams at the CLARA test facility.
Acceleration gradients of 20 MeV.m^{-1} were achieved in dielectric lined waveguides with narrow-band 400 GHz sources with MW peak powers, and with bunch charge from 2pC to 100pC.
The high-frequency of the acceleration field provided an extremely fast temporal variation of the acceleration gradient, up to 50 MeV.m^{-1}.ps^{-1}.
With this temporal gradient we have demonstrated the de-chirping of near-compressed 100fs duration electron bunches, obtaining a seven-fold reduction in energy spread. Similarly, we can impose chirp for THz-driven compression. Staged interactions with independent timing (phase) control of two THz pulses interacting with an single electron beam has been undertaken.
THz phase scans and projected energy spread measurement has provided an energy-time phase-space diagnostic for the electron bunch, while examination of the energy gain as a function of phase and interaction location (timing) within the sub-mm waveguide acts as a diagnostic of the acceleration structure.

Progress towards application of these THz acceleration concepts for THz-driven compression and active synchronisation of higher-energy electron beams, for hybrid THz- and laser-plasma acceleration experiments will be discussed.

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Footnotes

I have read and accept the Privacy Policy Statement

Yes

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