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Measuring of ultra-short electron bunch durations from LWFA by using of a broadband, single-shot spectrometer for Coherent Transition Radiation

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Laser-wakefield accelerators (LWFA) feature electron bunch durations about a few fs. Precise knowledge of the longitudinal profile of such ultra-short electron bunches is essential for the design of future table-top X-ray light-sources and remains a big challenge due to the resolution limit of existing diagnostic techniques and also limited reproducibility of electron bunches.

Measurement of broadband transition radiation produced when LWFA electron bunches pass a metal foil is a promising way to analyze longitudinal characteristics of these bunches.

Our ultra-broadband, single-shot spectrometer combines the TR spectrum in UV/VIS (200-1000nm), NIR (0.9-1.7 μ m) and mid-IR (1.6-12 μ m). A complete characterization and calibration of the spectrometer has been done with regard to wavelengths, relative spectral sensitivities and absolute photometric sensitivity.

Our spectrometer is able to characterize electron bunches with charges as low as 1 pC and resolve time-scales from 0.7 to 40 fs.

We present results from our recent measurement campaign by analyzing transition radiation spectra produced by nC class LWFA electron bunches from ionization-injection regime as well as study of transvers bunch profile by simultaneous imaging of the CTR at far- and near-field.

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