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Broadband (UV - mid-IR) spectrometer for single-shot femtosecond electron bunch measurement

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Laser-wakefield accelerators (LWFA) feature electron bunch durations ranging from several fs to tens of fs. Precise knowledge of the longitudinal profile of such fs electron bunches is essential for the design of future table-top Xray sources and remains a big challenge due to the resolution limit of existing diagnostic techniques.

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

Because of the limited reproducibility due to the nonlinear nature of the electron source this characterization requires single-shot capability.

Our 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 high spectral sensitivity, dynamic bandwidth and spectral resolution are realized by three optimized dispersion and detection systems to a single-shot spectrometer.

A complete calibration of the spectrometer has been done with regard to wavelengths, relative spectral sensitivities and absolute photometric sensitivity, also taking into account for the light polarization.

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.

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