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Monochromatic shadowgraphy and mid-infrared probing of LWFA

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Ultrafast shadowgraphy with transverse few-cycle probe pulses has enabled the observation of details of the laser-plasma interactions with unprecedented temporal (fs) and spatial (μm) resolution. However, in previous studies, probe pulses spanning a broad frequency spectrum have been commonly used to achieve an acceptable signal-to-noise ratio because of the limit of probe pulse energy. Recently, ultrafast monochromatic shadowgraphic images of laser-generated wakefields became feasible due to an increased probe pulse energy. Narrow-band shadowgraphic images are shown in this poster, which were taken with 10 nm (FWHM) bandpass filters at different center wavelengths. Nevertheless, in previous pump-probe studies, the probe pulses were split off from the main pulses, which means that the probe spectrum is closely related to the pump spectrum, particularly its central wavelength. This sets a low-density limit ($< 5\times10^{18}$ cm^{-3}) for the investigation of LWFAs. In the future, a separate 1 kHz Ti: sapphire laser will be synchronized to the pump laser to generate the probe pulses, with a relative timing jitter of $<$ 20 fs (RMS). With the help of nonlinear optics processes, the central wavelength of the probe pulses can be tuned into the mid-infrared regime, which will allow the direct observation of LWFAs in the low-density regime.

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