

5 years of experience with the THz streaking beamline FL21 at FLASH

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The intense ultra-short XUV pulses of the free-electron laser FLASH@DESY fluctuate from pulse to pulse due to the underlying SASE-FEL operating principle and thus demand single-shot diagnostics. To cope with this, a beamline (FL21) for temporal diagnostics was designed, built and put into operation at FLASH2 in 2019.

The beamline has been equipped with a permanently installed terahertz field-driven streaking setup that enables the determination of single shot pulse duration and arrival time.

In numerous beamtimes we had the chance to collect a large number of THz streaking measurements. Here we present some lessons learned and the variety of different options offered by the streaking setup. Looking at gain curve measurements, two-color FEL operation, harmonic content of the FEL radiation, frequency chirp of the XUV pulse as well as on correlations between the pulse duration and other parameters like pulse energy or spectral distribution, we can learn more about the performance of FLASH. Having all the experimental data at hand, we also used it to compare to different theoretical models and to find/verify scaling laws.

Finally, an outlook will be given on the plans for pulse duration measurements at FLASH2 in the next years.

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