FLASH1 experimental hall 'Albert Einstein'

BL1	non-monochromatic FEL photons Kirkpatrick-Baez (KB) focusing optics, FEL focal spot of ≈ 7 µm × 8 µm (FWHM)
	split-and-delay unit for XUV pump – XUV probe experiments *TU Berlin* (mirrors for 13.57 nm, -30 ps to +650 ps delay)
	optical pump – probe laser not available before 2026
	permanent end station: multipurpose CAMP chamber with pnCCD detectors, electron and ion spectrometers and collinear incoupling optics for optical laser
BL3 (FL11)	**Currently rebuilt into FL11, future capabilities in 2026:** non-monochromatic FEL photons, wavelength range: 2–60 nm fundamental Kirkpatrick-Baez (KB) focusing optics with variable foci down to < 10 µm (FWHM)/unfocussed beam size ≈ 5–10 mm (FWHM, depending on wavelength)
	optional pump – probe experiments using the **new** FLASH1 optical laser system for BL1 and BL3 (future FL11)
	optional pump – probe experiments using THz radiation: Double pulse scheme with tunable undulator source and broadband dipole source synchronised to X-ray pulses, new parameters to be confirmed after shutdown
	about 3 × 4 m platform for user-provided end station
PG1	high resolution plane grating XUV monochromator (SX 700 type, < 10^{-4} bandwidth, carbon coated optics): - variable combination of photon flux and resolution (from high flux to high resolution) - controlled temporal-spectral properties at moderate resolution for pump – probe experiments - high photon flux with harmonic filtering Kirkpatrick-Baez (KB) refocusing optics, FEL focal spot down to 5 µm FWHM (vertically, monochromator exit slit size dependent)
	permanent end station: - XUV-Raman spectrometer TRIXS for high-resolution and time-resolved RIXS measurements on solid samples (20–400 K, resolving power ≈ 1700, time resolution 170–300 fs FWHM) - optional pump – probe experiments (RIXS; XAS and reflectivity with angular resolution) using the FLASH1 optical laser system for PG1 and PG2
PG2	uses the same monochromator as PG1 50 µm focus
	XUV beam splitter with variable time delay (±6 ps) for time resolved studies
	optional pump – probe experiments using FLASH1 optical laser system for PG1 and PG2
	about 3 × 4 m platform for user-provided end station

FLASH1 optical / NIR laser system for pump – probe experiments for beamlines **BL1** and **BL3 (future FL11)**

The FLASH1 pump probe laser for BL1 and BL3 has been decommissioned in 2024.
A new laser facility is in preparation, but will not be available in 2025.
The parameters of the laser serving BL1 and FL11 in the future will be similar to the laser provided for FL23.

FLASH1 optical / NIR laser system for pump – probe experiments for beamlines PG1 and PG2

central wavelength	1030 nm
spectral bandwidth	30 to 50 nm (pre-set for experiment)
intra-burst repetition rate	Up to 1 MHz
number of pulses per burst	1–800
pulse duration	60–100 fs FWHM
timing jitter to FEL	< 60 fs rms
pulse energy	0–30 µJ (at interaction point at 1030 nm)
polarisation	Linear (s or p)
peak intensity	> 10^{14} W/cm^2
time delay to FEL	-1.5 ns to +1.5 ns, larger delays optional
energy stability	< 10% pulse-to-pulse peak (3% rms)

Harmonic generation conversion to (SHG) 515 nm, (THG) 343 nm or (FHG) 257 nm central wavelength is available with conversion efficiencies of > 50% SHG, > 10% THG, > 6% FHG.

All FLASH beamlines provide online photon diagnostics for intensity, wavelength and beam position, fast shutter, aperture and filter sets.

FLASH2 experimental hall 'Kai Siegbahn'

FL21	diagnostics beamline – not available for user experiments	
FL23	pulse-length preserving double grating monochromator beamline wavelength range: 2–20 nm fundamental plus 3. harmonic High transmission option (single grating) & high temporal resolution option (double grating) (effective) pulse duration <50 fs FWHM Kirkpatrick-Baez (KB) focusing optics with variable foci down to < 10 µm (FWHM)/unfocussed beam size ≈ 5–10 mm (FWHM, depending on wavelength)	
	optional pump – probe experiments using FLASH2 optical laser system	
	grazing incidence split-and-delay unit with -5/+18 ps time delay	*Univ. Münster*
	about 3 × 4 m platform for user-provided end station	
FL24	non-monochromatic FEL photons wavelength range: 4–90 nm fundamental Kirkpatrick-Baez (KB) focusing optics with variable foci down to < 10 µm (FWHM)/unfocussed beam size ≈ 5–10 mm (FWHM, depending on wavelength)	
	optional pump – probe experiments using FLASH2 optical laser system	
	grazing incidence split-and-delay unit with -5/+18 ps time delay	*Univ. Münster*
	about 3 × 4 m platform for user-provided end station	
FL26	non-monochromatic FEL photons wavelength range: 6–90 nm fundamental	
	optional pump – probe experiments using FLASH2 optical laser system	
	Laser-based high harmonic generation VUV source for VUV-XUV pump-probe experiments with up to 50 eV VUV photon energy	*Univ. Hannover*
	permanent end station: - reaction microscope (REMI) for time-resolved AMO spectroscopy - grazing incidence split-and-delay unit and refocusing optics: FEL focal spot < 10 µm × 10 µm (FWHM, depending on wavelength) - ± 2.7 ps time delay range, 1 fs precision - grating spectrometer for online spectral distribution monitoring and for transient absorption spectroscopy	*MPI-K Heidelberg*

FLASH2 optical / NIR laser system for pump – probe experiments for beamline **FL23**

central wavelength	1030 nm
spectral bandwidth (@-10dB)	< 50 nm
intra-burst repetition rate	100 kHz
number of pulses per burst	80 (burst 800 µs flat)
pulse duration	> 70 fs (FWHM (compressed to 1.1 × bandwidth limit), >1000 fs FWHM (uncompressed)
timing jitter to FEL	t.b.d.
pulse energy	0–1.8 mJ (at interface with experimental chamber)
polarisation	Linear (s or p)
focus size ($1/e^2$ diameter)	> 50 µm ($1/e^2$)
peak intensity	> 10^{15} W/cm^2
time delay to FEL	-1.5 ns to +1.5 ns, larger delays optional
energy stability	< 10% pulse-to-pulse peak (3% rms)
Harmonic generation conversion to 515, 343 and 257 nm central wavelength is available	

FLASH2 optical / NIR laser system for pump – probe experiments for beamlines **FL24 and FL26**

central wavelength	700 to 900 nm (fast tuneable)
spectral bandwidth	30 to 140 nm (pre-set for experiment)
intra-burst repetition rate	100 kHz
number of pulses per burst	1–77
pulse duration	15–65 fs FWHM (compressed to 1.1 × bandwidth limit), ~1000 fs FWHM (uncompressed)
timing jitter to FEL	~ 30 fs rms (~ 15 fs rms with Laser Arrival Monitor [LAM])
pulse energy	0–120 µJ (at interaction region)
polarisation	Linear (s or p)
focus size ($1/e^2$ diameter)	> 50 µm ($1/e^2$)
peak intensity	10^{13} W/cm^2 (@50 µm)
time delay to FEL	-1.5 ns to +1.5 ns, larger delays optional
energy stability	< 10% pulse-to-pulse peak (3% rms)
Harmonic generation conversion to 400 nm (SHG) and 266 nm (THG) central wavelength is available with conversion efficiencies of > 10% SHG, > 3% THG, pulse durations are increasing.	